# BUILDING RESILIENCE

CIB W89 International Conference on Building Education and Research, in conjunction with CIB W113, CIB TG53, CIB TG63, CIB TG67, CIB TG68, and CIB TG69

# Book of Executive Summaries

*Edited by*

Dr Richard Haigh & Professor Dilanthi Amaratunga

School of the Built Environment
The University of Salford
UK
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Dr Richard Haigh and Professor Dilanthi Amaratunga (*edited by)*
BUILDING RESILIENCE
CIB W89 International Conference on Building Education and Research
Book of Executive Summaries

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# Preface

This book contains the executive summaries of keynotes and papers submitted to, peer reviewed and accepted for the CIB International Conference on Building Education and Research (BEAR 2008), held from 11th – 15th February 2008 at Heritance Kandalama, Sri Lanka. The contributions reflect the call for papers of the following CIB Working Commissions and Task Groups:

CIB W89 (Building Education and Research)

CIB W113 (Law and Dispute Resolution)

CIB TG53 (Postgraduate Research Training in Building and Construction)

CIB TG63 (Disasters and the Built Environment)

CIB TG67 (Statutory Adjudication in Construction)

CIB TG68 (Construction Mediation)

CIB TG69 (Green Buildings and the Law)

BEAR 2008 was a collaboration by a number of CIB commissions: CIB W89, W113, TG53, TG63, TG67, TG68 and TG69, CIB International Student Chapters, and EURASIA, a three year EU Asia-Link programme funded project that aims to improve capacity in training, teaching and research activities associated with the creation and long-term management of public and commercial facilities and infrastructure in selected Higher Educational Institutes in Asia and Europe. All EURASIA partners - University of Moratuwa and University of Ruhuna in Sri Lanka, Tallinn University of Technology in Estonia, and Vilnius Gediminas Technical University in Lithuania – were able to join the University of Salford for this event.

In line with the Asia Link EURASIA concept, a major theme for the 2008 BEAR Conference was to promote built environment related education and research towards a more expansive view of the life cycle of infrastructure projects, one that extends beyond the traditional cycle of feasibility analysis, planning, design, construction, operation, maintenance and divestiture. This revised life cycle should encompass the building and construction professional's ability to anticipate and respond to unexpected events that damage or destroy an infrastructure project – from earthquakes and climate change to terrorist attacks – and reflect construction's ongoing responsibility toward an infrastructure's users. The role of building and construction industry professionals and local communities in developing resilience to these types of disasters can be viewed as two separate yet interrelated aspects: To create a built environment that is not vulnerable to a disaster or disruptive challenge. This relates to the resilience of the physical state of infrastructure, buildings and cities as well as developing policies, legal and regulatory controls, and practices that govern the building industry to build safe structures. Essentially this means building cities or infrastructure that will not be affected by a disaster, and to develop organisational structures, capacities through education and training, and construction systems, that can react in the event a disruptive challenge does occur. This means responding to the immediate after effects of a disaster to restore operational conditions of infrastructure or the built environment as quickly as possible. This means also to aid in the speedy recovery of the region through sustainable reconstruction, post-disaster building or other related projects.

It is evident that the CIB network of experts and member organisations active in the research community, in industry and in education, has a wide range of expertise to offer in addressing disaster related challenges. The BEAR Conference was an intriguing opportunity to bring together the interests and expertise of these wide-ranging Working Commissions and Task Groups to discuss and attempt to address the complex and global problems associated with anticipating and responding to unexpected events that damage or destroy an infrastructure project. The Conference provided an ideal backdrop for CIB members to identify challenges and opportunities, develop synergy, and collaborate on future work. It is hoped that a series of cross-commission and task group initiatives and workings may ensue.

The conference was held in Sri Lanka, an island situated in the Indian Ocean, at the base of the Indian Sub-Continent. It is a multi-ethnic, multi-religious country with a diverse and rich culture. Sri Lanka was severely affected by the tsunami on 26 December 2004, which killed some 40,000 people and displaced 400 – 500 thousand people along two thirds of the north-east, south and south-west coastline. Half the fishing fleet was destroyed, and a quarter of hotels in the affected areas sustained serious damage. It is our hope that Sri Lanka will benefit greatly from the research and activities of W89 and commissions and task groups, and that the country provided an appropriate backdrop for tackling challenging questions on built environment education and research.

The Conference provided a forum for researchers worldwide to debate and exchange ideas and experiences on a broad range of issues related to built and human environment research. All of the papers were selected on the basis of strict review by the Scientific Committee members to ensure a good quality standard. The conference had a broad scope and covered wide ranging topics which were organised around the following themes:

Capacity Building
Construction Management
Cost Planning and Control
Curriculum Development
Design
Developing the Law Curriculum in Built Environment Education
Disaster Mitigation
Education
E-learning
Environmental Management
Facilities Management
Information and Communication Technology
International and Comparative Law in the Built Environment
Legal Scholarship and Research within the Built Environment Discipline
Post-Disaster Reconstruction
Post-Disaster Relief
Procurement
Skill Development
Sustainability

The conference program and the structure of this book all reflect these themes. The papers on this book were developed by authors in the typical extended abstract form which includes background issues, literature reviews, problem-solving processes, decisions and conclusions. All executive summaries appearing on the book were reviewed in their entirety, prior to publication, by the International Scientific Committee comprising independent, qualified experts. Editors would like to extend their sincere gratitude to all the authors of the published contributions for their excellent work and participants at BEAR 2008. Full papers can be found in the CD-ROM produced separately.

There were five keynote addresses from leading academics: Professor Peter Barrett, President of the CIB; Professor Malik Ranasinghe, Vice Chancellor, The University of Moratuwa, Sri Lanka; Professor John Ratcliffe, Director of the Faculty of the Built Environment, Dublin Institute of Technology, The Republic of Ireland; Condrad De Tissera UN HABITAT Programme Manager for Sri Lanka, United Nations Human Settlements Programme Colombo, Sri Lanka; and, Associate Professor Vasantha Abeysekera, Programme Leader Construction Management Programmes, AUT University, Auckland, New Zealand. These keynote addresses provide a global perspective and vision for built environment research, as the, “development of research and other skills” has permeated the whole higher education sector.

*Editors*
Dr Richard Haigh
Professor Dilanthi Amaratunga

February 2008

# About the Editors

*Dr Richard Haigh* is a lecturer at the School of the Built Environment, University of Salford, UK and an active researcher in disaster management with a particular interest in capacity building and corporate social responsibility. Richard is also the Programme Director for a new Disaster Mitigation and Reconstruction Masters programme that the School is launching in autumn 2008, and joint-coordinator of CIB Task Group 63: Disasters and the Built Environment, a network of 58 Higher Education Institutes across 27 countries. Richard is joint principal investigator of EURASIA, an EU Asia-Link funded network project that aims to enhance the capacity of the partner institutions for training, teaching and research activities required for the creation and long-term management of public and commercial facilities and infrastructure.

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*Professor Dilanthi Amaratunga* holds a chair at the School of the Built Environment at the University of Salford, UK. She is an active researcher in the field of capability and capacity building in the built environment, with a particular interest in disaster management. She has nearly 200 published papers, and has successfully managed several research projects. She is the Coordinator of CIB TG53, which aims to improve the availability of skilled researchers in building education and research through the development of researchers' capacity to produce, transfer and utilise knowledge. Her other research interests are: gender, disasters and construction; research informed teaching.

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# Conference Organisers

The Conference was organised by:

School of the Built Environment, University of Salford, UK
CIB, International Council for Research and Innovation in Building and Construction

## Local Organisers and Hosts

Department of Building Economics, University of Moratuwa, Sri Lanka

Department of Civil and Environmental Engineering, University of Ruhuna, Sri Lanka

## In association with

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Department of Construction Economics and Property Management, Vilnius Gediminas Technical University, Lithuania

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EURASIA European and Asian Infrastructure Advantage, and the EU's Asia Link Programme
CEBE Centre for Education in the Built Environment, UK
CIOB Chartered Institute of Building
Lanka Bell, Sri Lanka
Emerald Property Journals, UK
Taylor and Francis Publishing, UK

# Endorsements

AIQS Australian Institute of Quantity Surveyors
CEBE Centre for Education in the Built Environment
HFH Habitat for Humanity
ICTAD Institute of Construction Training and Development, Sri Lanka
IESL Institution of Engineers, Sri Lanka
ISR Institute of Sustainable Resources
Ministry of Education, Sri Lanka
RICS Royal Institution of Charted Surveyors
SLIA Sri Lanka Institute of Architects
Sri Lanka Convention Bureau
Sri Lanka Institute of Quantity Surveyors
UGC University Grants Commission, Sri Lanka
World Bank

# EURASIA (European and Asian Infrastructure Advantage)

The 2008 Building Education and Research Conference was held in association with EURASIA (European and Asian Infrastructure Advantage).

The EURASIA project is an International research collaboration between Asia and Europe. The partnership includes: University of Salford, UK; University of Moratuwa, Sri Lanka; University of Ruhuna, Sri Lanka; Tallinn University of Technology, Estonia; and, Vilnius Gediminas Technical University, Lithuania.

There is growing recognition of a need to enhance the capacities of Higher Education Institutions (HEIs) worldwide to cater for the challenges facing the world today. In particular, the increasing numbers of disasters that impact communities across the world make it an imperative that knowledge on facilities and infrastructure management is developed to meet the demands of disaster mitigation and reconstruction challenges. In response, the EURASIA project aims to improve capacity in training, teaching and research activities associated with the creation and long-term management of public and commercial facilities and infrastructure in selected HEIs in Asia and Europe. In response, the programme specifically aims to enhance the capacity of the partner institutions for training, teaching and research activities required for the creation and long term management of public and commercial facilities and infrastructure. In doing so, the project will support the ongoing recovery programmes set up in Sri Lanka following the Indian Ocean Tsunami of December 2004. Overall, the Tsunami affected 2/3rds of the coastline of Sri Lanka. It resulted in the destruction of more than 100,000 houses and the discontinuance of several livelihoods such as fishing, farming, tourism and handicrafts-related activities. The post-Tsunami rehabilitation operation has been affected due to unprepared local government institutions with poor response capacities to address the needs of such a magnitude. This is mainly because, before the Tsunami, Sri Lanka was known to be a safe haven where outrages of nature scarcely occurred except for occasional floods and landslides during the rainy seasons. Thus, by enhancing the capacities of partner institutions, specifically in Sri Lanka, it is anticipated that Sri Lanka will be able to take up the challenge of post tsunami recovery more strongly and successfully. The major activities of this research programme include:

Development of a professionally accredited postgraduate curriculum on the creation and long term management of public and commercial facilities and elements of infrastructure, to be used in all the partner institutions

A split-site PhD programme for nominated staff of Sri Lankan partner Universities to enhance their capacity for teaching and research in the field of Disaster management

A major International Conference in Sri Lanka with a theme of creation and long-term management of public and commercial facilities and infrastructure

Developing and improving the professional and research skills of partner Institutions' staff and postgraduate students

Improving and consolidating academic networks through systematic exchanges so as to establish a sustainable link between EU and Sri Lankan partner Universities

Disseminating knowledge and interpreting information through joint publications, lectures, seminars and conferences

EURASIA is funded through the EU's Asia Link Programme, dedicated to fostering regional and multilateral networking between Higher Education institutions in the EU and Asia. As part of the project, a Virtual Environment for Built Environment Researchers (VEBER) has been set up which provides a broad range of functionality that will facilitate research activities among the partner institutions. The Salford team, in collaboration with its Sri Lankan partners, is now working towards setting up a web portal to share information on the post-tsunami response, with specific reference to case material in Sri Lanka. This work will be linked with other disaster management initiatives

undertaken by the Salford team, such as activities associated with the recently established CIB Task Group 63: Disaster Management and the Built Environment.

Further information on EURASIA can be obtained from: www.eurasia.buhu.salford.ac.uk.

## The Asia-Link Programme

The Asia-Link Programme was launched at the beginning of 2002 as an initiative by the European Union (EU) to foster regional and multilateral networking between higher education institutions in European Union Member States and South Asia, Southeast Asia and China. This five-year programme, which has a total budget of £40 million, aims to provide support to European and Asian higher education institutions in the areas of human resource development, curriculum development and institutional and systems development

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Our thanks go to the International Scientific Committee members who made extensive efforts in reviewing papers to tight time scales in ensuring the high quality of the conference. We also thank the key note speakers who delivered excellent speeches stimulating invaluable discussions and debate around the conference theme.

We have received exceptional help and support from a number of people, organisations and bodies in the work for this conference. We would particularly like to acknowledge the support of Professor Mel Lees, Head of School of the Built Environment, University of Salford, for all the support extended to us leading up the conference.

The 2008 Building Education and Research Conference is being held in association with EURASIA (European and Asian Infrastructure Advantage). EURASIA is an international research collaboration between Asia and Europe. The University of Salford in United Kingdom leads this project while the University of Moratuwa and University of Ruhuna, Sri Lanka play major roles as our partners from Asia. The rest of the European partners are the Tallinn University of Technology in Estonia and the Vilnius Gediminas Technical University in Lithuania. Accordingly, we acknowledge the support of the EU's Asia Link Programme, dedicated to fostering regional and multilateral networking between Higher Education institutions in the EU and Asia in providing us the seed funding in commencing conference activities, and also all our EURASIA partners for taking a keen interest in the conference.

Organisations that have provided sponsorships are especially thanked. The costs involved with a conference of this scale are significant and it would not have been possible to organise this conference without assistance. We particularly thank the Centre for Education in the Built Environment, the Chartered Institute of Building, Lanka Bell, Emerald Property Journals and Taylor and Francis Publishing.

We are also thankful to all of our colleagues on the organising committee, including Professor Chitra Weddikkara, Dr Rameezdeen and Suranga Jayasena for being the main point of contacts in Sri Lanka and Suranga for arranging the CIB student chapter competitions and sessions. Additionally, Kanchana Perera and Nayanthara de Silva have been indispensable in handling local registrations and local publicity in Sri Lanka.

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managed the complex accommodation arrangements for delegates, transfer hotels, all internal transport, printing assignments, and coordination of our suppliers in Sri Lanka.

Editors
Dr Richard Haigh
Professor Dilanthi Amaratunga

February 2008

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# SECTION I

## KEYNOTE ADDRESSES

# Complexity, Connections and Consciousness

Professor Peter Barrett
CIB President & Pro-Vice-Chancellor Research, University of Salford

*Professor Barrett is Pro-Vice Chancellor for Research and Graduate Studies at the University of Salford where he is also a long-time member and ex-director of Salford's 6* (top) rated Research Institute for the Built and Human Environment. He is also Chairman of SCRI, a £5M programme of research funded by the UK research council. He has been active in the CIB for many years, including as coordinator of W65 (organisation and management of construction). More recently he was Chair of the CIB Programme Committee and has now been elected President of the CIB for 2007 - 2010. Peter has led numerous construction management research projects over the last 15 years and has published over one hundred and sixty single volume reports and refereed papers. After becoming the first Chartered Building Surveyor to gain a PhD, Peter established the postgraduate programme of research at Salford which now supports around 160 research students. He is currently championing the CIB's proactive theme of Revaluing Construction, an important element of which is the "Awareness of the Systemic Contribution" of the built environment.*

This presentation will seek to link thematically the areas of disaster management (DM), education in the built environment and the activities and aspirations of the CIB.

In recent years DM has rightly come into focus for many construction researchers. It has, however, become apparent that, although the disaster itself is the most evident aspect that demands attention, it is important not to overlook the periods before and after the disaster. It is in these times that there is the opportunity to mitigate or at least prepare before a disaster and afterwards there is the long haul back to a new normality. Both of these periods deserve attention and broaden considerably the scope of DM research.

Implicit in this view is the need to educate people so that there is the technical and organisational capacity to respond. This involves being able to:

- analyse potentially hazardous situations
- engineer technical solutions
- organise the delivery of these solutions
- handle the associated social and economic issues
- sustain the effort through very different phases, that will last several years

The scope of the last two of this list in particular highlight the complexity of the skills required. Technical issues must be addressed in fractured social contexts, which are both shifting through radically different phases, once the initial basic demands have been met. So the education of construction professionals must fit these people to be able to deal with this complexity, both individually and collectively. Interestingly, the characteristics evident for DM are quite generally needed amongst construction professionals. The need to deal coherently with complexity links to the necessity of making connections, both in terms of connecting specialists in multi-disciplinary working and strongly connecting the processes into and out of the construction phase.

These dimensions of connection lead to consideration of the mind-set those involved have towards the scope of the issues involved. Everyone involved needs to have strong specialist knowledge and skills to contribute, but they equally need a broad consciousness of the purposes of construction as a contributor to and part of society more generally. This is most easily evident around understanding and responding to the role of clients and users of buildings and built infrastructure, but extends to wider social, environmental and economic issues. This has challenging implications for the education of built environment professionals.

The CIB brings together over 2000 experts in 60 countries and has for over 50 years covered a wide range of hard, technical and soft, social topics, through around 50 working groups. Central to the CIB is an acceptance of the complexity of construction related issues and to work to address this by making connections between relevant experts. Over recent years there has been a deepening understanding that this connectivity has to run powerfully through the whole life cycle of a building / facility strongly addressing the contribution made to clients, users and society. This trend involves a shift in consciousness that sees construction as a key means to creating value, but not an end in itself. Thus, the four CIB priority themes that cross-cut the work of the working groups, address both the demand side, with emphases on sustainable development and clients' needs, and the supply side, with pushes in the areas of "revaluing" the capacity of construction industries and achieving integrated design solutions at the project level.

And of course, the CIB also has working groups specialising in education and disaster management!

# Stakeholder Consultation in the Decision Making for Development Projects using Educated Trade-offs

Professor Malik Ranasinghe
Vice Chancellor, University of Moratuwa, Sri Lanka

*Professor Ranasinghe is the Vice Chancellor and a Professor in Civil Engineering at the University of Moratuwa (UoM). He is the immediate past Dean, Faculty of Engineering and a former Chairman, Centre of Excellence in Project Management at UoM. Prof. Ranasinghe is a Professional and Chartered Engineer, a Fellow of the Institution of Engineers, Sri Lanka and the National Academy of Science, Sri Lanka. He is also a Director on the Board of Directors of The Colombo Stock Exchange, Sri Lanka. In March 2000, Prof. Ranasinghe was appointed as the Head of the Department of Civil Engineering at the UoM, where he lead and managed the largest academic Department with over 40 senior academic staff. As a result of his unobtrusive leadership as Head of the Department of Civil Engineering, the Faculty of Engineering elected him unanimously to be their Dean in March 2001. The Faculty of Engineering at UoM is the largest Engineering Faculty in Sri Lanka with over 3500 undergraduate and postgraduate students. Prof. Ranasinghe's vision as the Vice Chancellor is to produce world class graduates at the UoM, in an environment that provides a rewarding experience for its students and staff.*

The recovery from the Tsunami that struck Sri Lanka in 2004 was hampered by a decision taken by the Government of Sri Lanka (GOSL) not to permit reconstruction of any building 100 meters from the coastline, even if the property right was privately owned and the reconstruction/rehabilitation was carried out without any support from the GOSL. This decision taken without any consultation with those who were affected, the stakeholders severely delayed the recovery from the devastating Tsunami.

When resources are scares, stakeholders' judgments on trade-offs between different resource uses tend to be emotional than rational. As such, stakeholders need to be well informed on all aspects of conflicting issues, to make rational decisions on trade-offs between limited natural resources. A five-step framework to formulate 'educated trade-offs' is proposed which can be used as a tool for effective stakeholder consultation in the decision making of development projects.

The term 'educated trade-off" means that stakeholders are able to engage in technically, economically and environmentally (including socially) informed (educated) decision-making between the critical resource uses (trade-offs) in development projects. The conflicting uses/issues of the development project are identified through the consultation of key stakeholders. The critical bounds of the technical requirements of the conflicting resource uses/issues identified (for example the minimum required volume when the use is by extraction of water from a river or the maximum volume not to exceed the assimilative capacity of the river or river valley for other issues related to a river) are first estimated. The economic value and the environmental value of the respective critical bound of the technical requirements are then estimated. Combining the economic and the environmental value of critical bounds, "educated trade-offs" for stakeholder consultations are established.

This paper focuses on the application of the developed framework to the conflicting issues related to clay mining in Sri Lanka for manufacture of bricks and roof tiles.

# 21st Century Hazards and the Built Environment: How Futures Thinking and the Foresight Principle Can Prepare Us

Professor John Ratcliffe
Director of the Faculty of the Built Environment, Dublin Institute of Technology, The Republic of Ireland

*John Ratcliffe is a chartered planning and development surveyor with almost forty years experience as a consultant and academic in the fields of urban planning and real estate development. Currently he is Director and Dean of the Faculty of the Built Environment at the Dublin Institute of Technology, which is the largest university level institution in the Republic of Ireland, and Founder and Chairman of The Futures Academy there. He is also an Honorary Visiting Professor at the University of Salford and the University of Lincoln as well as an Associate of the futures consultancy Outsights in the UK. Over the past decade he has acquired a particular expertise in the futures field, with special reference to the sustainable development of city regions. A special interest of Professor Ratcliffe at the moment is the nature and development of responsible business practice.*

There is the challenge to the professions of the built environment to create a mindset and a skillset within its ranks that promotes a greater awareness of risk and an improved facility in hazard appraisal and disaster management. The aims of the paper are fivefold: To explain why 21st Century hazards are different; To explore the global hazards we face; To examine the attributes of global challenges; To evaluate the nature of 'foresight' and the potential role of 'futures techniques' in preparing for hazard appraisal and risk management; To espouse a futures-oriented mindset among built environment researchers, educators an practitioners in facing and addressing the natural, man-made and environmental hazards that lie ahead. The overriding rationale being that: "No problem can be solved from the same level of consciousness that created it. We must learn to see the world anew" [Albert Einstein].

# International Community Perspectives in Disaster Mitigation in Developing Countries

Condrad De Tissera
UN HABITAT Programme Manager for Sri Lanka, United Nations Human Settlements Programme Colombo, Sri Lanka

*UN–HABITAT has a long history of cooperation in Sri Lanka and has pioneered innovative approaches in community rebuilding of housing and basic urban services and infrastructure delivery. As the UNHABITAT Programme Manager, Conrad Dr Tissera currently leads several post tsunami rebuilding community infrastructure & shelter projects, enabling the target communities to rebuild essential physical facilities, including shelter, so that they can restart functioning as normal communities, helping to create wage employment from the investment of the rebuilding process as a way of contributing to the recovery of the local economy and rebuilding self-confidence and restoring human dignity. Condrad has over 40 years of construction industry experience and has been the Director General of the Institute of Construction Training and Development of Sri Lanka and Secretary of the Ministry of Housing and Construction during his long standing career. In his role as a visiting lecturer, he has also shared his practical experience with university graduates whenever he has had the opportunity.*

# Building Theory for the Built Environment: The Case of Monetary Retentions

Associate Professor Vasantha Abeysekera
Programme Leader, Construction Management Programmes, AUT University, Auckland, New Zealand

*Dr Vasantha Abeysekera is a Sri Lankan New Zealander. He is the Associate Professor of Construction Management at AUT University in Auckland in New Zealand and heads the construction management programmes. He graduated with a first class in civil engineer from the University of Moratuwa and obtained his master's and doctorate in construction management from the Loughborough University, UK. He maintains professional memberships with engineering and quantity surveying associations in addition to various other professional bodies. In a career spanning over 25 years, with almost half in industry and the rest in academia, Dr Abeysekera has been involved in diverse roles in Asia, Africa and Oceania, He currently focusses on teaching and research with RD&D interests in, security of payment and contract retentions, health and safety, and time management.*

This study explores the notions of *theory as science*, and *practice as science*, in the pursuit of theory for the built environment. Whilst endorsing these notions, practice is differentiated with *scientific practice* suggesting that latter is part of theory, and that theory should be seen as science. The need for building theory for professional disciplines such as construction management is urged by reflecting on the engineering profession pointing out that practice without theory is akin to *action without thinking* or the practice of a quack-doctor.

The meaning of *theory* and *scientific practice* is explained in preference to definitions, portraying *theory* as *knowing* but of a particular kind of knowing, which is different to other ways of knowing such as authority, intuition, and experience, whereby logic (reason) is applied to questions. Theory is explained as *justified beliefs* as well. There is also a need to develop a structure with an accompanying narrative on *stories* about phenomena in the built environment in a way that it condenses knowledge, and informs practice.

Theory consists of answers to four elements, namely, 'what, how, why and so-what' with *what* identifying the phenomena, the *how* providing explanation (and prediction) and the *why* providing understanding. Other elements to include are responses to *when, where, who,* which are considered to be the limiting parameters (i.e. the context). Criteria for judging the value of theory are also given including a brief description of methodologies for building theory. By reflecting on the profession of engineering, it is proposed that theory for the built environment should consist of theory in the different professional disciplines (which often overlap) in an interactive and integrated manner.

With this synthesis of theory and practice, an 'unusual' phenomenon that has spanned well over a century is investigated with the intention of building theory. This phenomenon is the practice of holding a portion of the moneys due to a service provider from each and every payment until the project is fully completed. It is a practice which was originally enforced through legislation (in New Zealand), later abolished, and then re-enforced through contract.

Having explored different methodologies for building theory, metaphors was found to be a convenient and a powerful approach for building theory particularly for channelling knowledge, give it structure, and develop narrative, in a way that it condensed knowledge and facilitated practice. Accordingly, five theories were presented under *Images of Retentions* – an unfolding story about the practice of retention. These theories were named as *Cash-Cow*, *Steroid*, *Beast*, *Stress*, and as *Chaos*. They were seen as providing a deeper understanding of the reasons for this phenomenon along with new insights on retentions.

These theories are accounts of *justified beliefs*; they describe, explain, and predict what might happen if certain courses of actions are taken, particularly in a New Zealand context. These must be criticised and modified, and refined as necessary in the pursuit of deeper understanding: this is the nature of theory; theory is neither complete nor perfect.

Individually, these 'theories' tell us a one-sided story by highlighting certain interpretations and forcing others to the background. This needs to be understood but importantly the theories needs to be viewed together as a collection rather than in isolation, understanding the opposing and complementary points of view, along with their interactions.

The theory (and theories) presented herein on retentions are not exhaustive. There are still a number of issues pertaining to retentions that need to be understood. However, it is believed that these theories should provide a good foundation for further deliberation and research. In this regard, the use of metaphor as a methodology cannot be underestimated; it is an interesting, valuable, and an exciting approach for building theory as evidenced through this study.

This is only a beginning of a *story on retentions*; there is much to be understood about this *'unwanted essential'*!

# SECTION II

## COST PLANNING AND CONTROL

# Security of Payment and Payment Bonds: A New Zealand Perspective

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*Security of payment legislation does not provide protection to the contracting community when the principal or the funding institution goes into liquidation. Losses arising out of such failures are a major concern. A seemingly simple solution to such payment risks is to consider the use of 'payment bonds' similar to that used in the USA. This, however, is found to be of less value for the two types of losses this study is concerned with, namely, the loss of interim payments, and retention monies. To find a better solution, the nature of these risks is examined which reveals that risks associated with interim payments and retentions are significantly different. Thus, the provision of two different types of bonds, i.e. 'principal bonds' and 'retentions bonds' (as prescribed in NZ standard form contracts), appears to be a more sensible approach. However, these too are of little value as they are rarely used with industry resorting to various ad-hoc arrangements to cope with these risks. Given the power of cash-retentions and the many benefits that it offers to main contractors when combined with the 'retention-differentiation' strategy, it is unlikely that retentions will be abolished in New Zealand. Given this background, industry can lobby the government for a solution (i.e. for a statutory bonding mechanism through the Construction Contracts Act 2002 or otherwise) if the benefits outweigh costs, and also lobby the consulting and project management community for a solution through contract documents. In the alternative, industry could self-regulate through a central retention fund (by channelling all retentions to a central repository) which would no doubt provide security for retention monies and also for interim payments (by the issue of suitable bonds or otherwise); such an approach has the potential to usher a new era for the construction industry through a construction bank that better understands the commercial realities of construction. Further investigation is necessary before a sustainable solution can be found for a major national problem.*

**Keywords:** guarantee, payment bond, retentions, security of payment

## 1. Introduction

Security of payment is a major concern of contractors, subcontractors, and suppliers alike in an industry that is widely perceived to be risky and well known for its high rate of bankruptcy. In a breakthrough piece of legislation, contractors (including subcontractors) and some suppliers can now seek the protection of an Act of Parliament known as the Construction Contracts Act 2002. The main intention of the Act is to facilitate progress payments and to set in place a mechanism by which related disputes could be resolved speedily. Whilst such legislation exists in number of countries, they seem to fall short in providing protection to contractors, subcontractors and suppliers when the 'principal' or the 'funding institution' ceases to exist.

As far back as 1892, New Zealand had legislation to protect contractors, subcontractors and workmen for payments due to them. The provision of security for contractual debt was such that the Act provided a right of payment to any contractor, subcontractor, supplier of materials, or workman by way of security given over money (called a charge) or security given over the owner's interest in land or chattels (called a 'lien'). The Act required a percentage of the value of the work (i.e. 25% of the money payable) be retained by the payer (the owner, employer, or builder) for a specified period of time, out of the monies that would otherwise be payable for the work, so providing a fund against which the charge could operate. This Act was abolished in 1987 by which time the retention percentage had declined creating a retention regime with a sliding scale. With high levels of outsourcing, this regime is considered to be particularly beneficial to main contractors when utilised with the 'retention differentiation' strategy exposing subcontractors to a higher level or risk if the main contractor became bankrupt. Not only would they loose retention moneys but also interim payments. Likewise, main contractors would also be exposed to a similar type of risk, if the principal or the funding institution goes into liquidation.

## 2. The Problem and Solutions

Such payment risks are mainly of two types, firstly, those due to payment delays, and secondly, those due to 'payment losses' when the principal or the funding institution goes bankrupt. This study focuses on the latter type of risk, as it has no protection under the CCA when compared with the former. The seemingly simple US solution of using payment-bonds is first examined. Whilst such a bond is useful and provides new insights, this study finds that the nature and its scope are limited as it is for the protection of first-tier subcontractors and suppliers as required by law. In comparison, the NZ options of principal bonds and retention bonds appear to be more appropriate and are thus examined further by examining the nature of the risk connected with interim and retention payments.

## 3. Nature of Payment Risk

Many factors impact on these risks viz. types of principals, sectors in which contractors operate, project characteristics, type of work undertaken, the nature of building trades, the type of subcontract (labour-only or with materials), the time lag between payments, and retention regimes. Further examination reveals that the risks involved with interim payments and retention payments are significantly different suggesting that the type of payment bond used in the US is of little value as noted before

with principal bonds and retentions bonds being a better approach to pursue. However, investigations reveal that these are rarely used suggesting the need to understand why and also to investigate other approaches.

## 4. Risk Management Strategies

In the absence of any formal procedures, many adopt ad-hoc practices to cope with such risks from receiving payment in advance (before work/supply is completed), undertaking work only to the extent of funds made available, negotiating favourable retention regimes through price discounts, using retention bonds, and so on.

There are other options too: trust accounts for retentions, performance bonds in lieu of retentions, and combined performance and retention bonds, and letters of credit. Interestingly, yet another option is to channel all retention moneys to a central repository – an approach which is considered to be a 'new, and perhaps radical' approach. There is of course an extreme option, i.e. abolishing retentions altogether – an option which is unlikely to be accepted by the contracting community (in NZ) which perceives retentions as being a fair practice (subcontractors included) but more so by main contractors given the power of the 'retention differentiation' strategy. This suggests that there is a need to understand the costs and benefits of using retentions in order to make a decision on whether or not to use (a) a payment bond which provides protection for both interim and retention payments (b) whether two different types of bonds, one for interim payments and the other for retention payments should be used, and (c) a strategy for implementing such bonds (as for instance, through an act of parliament or though contract provisions).

## 5. Conclusions

Security of payment is a fundamental premise for creating a sustainable business environment. The CCA is a major piece of legislation in that direction but fails short when it comes to meeting this important premise. Over the last decade, a number of well known construction companies have gone bankrupt raising the need for an effective strategy for managing this risk, the risk of losing interim payments and also retention payments.

The nature of the interim payment and the retention payment risk is significantly different. As such, a single bond does not seem to be a viable option. The practice adopted in NZS 3910 is to create two types of bonds, one for interim payments and the other for retention payments; the former to be given by the principal and the latter by the contractor. The former deals with both the interim payment and retention payment risks and is therefore comprehensive. The need for such bonds and costs of such bonds would no doubt depend on the nature of the risk. Given that it is difficult to imagine principals voluntarily agreeing to such bonds, one option would be for the government to intervene through legislation. This would not be a reality unless there is a strong case for it. On the other hand, if industry prefers a hands-off approach, it could create a climate for such bonds through enforceable contractual provisions (or otherwise) particularly if benefits outweigh costs. Additionally, industry could self-regulate itself by channelling all retention moneys to a central repository which would certainly provide security for retentions, and also for interim payments through a cost-effective arrangement whilst providing various other services to construction contractors; in essence, such an arrangement would act as a (private) bank exclusively for the use and benefit of the construction industry. The government could also be part of such a mechanism. Given that commercial banks have consistently failed to understand construction, this is an interesting option to be evaluated; indeed, a radical approach to moneys 'otherwise dissipated and diluted to such an extent that they are of little use to a nation'.

# Estimation of contractor's project overhead rate as research on building cost

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*Empirical modesl of project overhead rate have been developed from historical data in the present study. The nature and significance of the contractor's project overhead are first explored, along with factors that have an influence on the overhead rate. The bid data for 173 building projects collected from a large construction firm in Taiwan is analyzed. The data is divided into two parts for model development and model testing according to order of time. Then, two methods of estimation are compared in their modeling and prediction errors: the cluster center method of categorizing projects into 24 groups and the multiple regression method using four variables, i.e. size, duration, type of work, and location. Either method can achieve an average error of about 3% of direct cost. The model may coexist with the itemized estimation method as a checking mechanism. Implications and recommendations for future research are also discussed.*

**Keywords:** cost estimation, project overhead, empirical model, statistics

## 1. Introduction

The contractor's project overhead costs are the on-site related costs for production support in undertaking a project. Unlike direct costs, they are not directly connected with the performance of any particular element of a project, but are required for running the project as a whole. Since the project overhead costs often constitute a greater part of the contract price than the markup for the contractor's home-office overhead and profit, project overhead estimation deserves no less attention than markup determination. Traditionally, to obtain a reasonably accurate estimate of the contractor's project overhead costs, the formal practice is to establish line items and calculate how much is needed for each item, based on a plan that meets project conditions and requirements. However, precise definition of project overhead charges is time consuming and may not guarantee the correctness of the results. Hence, often the ratio of project overhead to direct cost (referred to as "project overhead rate") is calculated and compared with those for past similar projects as a check on abnormality. On the other hand, the alternative method of applying an experience-based rate to cover the contractor's project overhead costs still is used widely, which is however prone to inaccuracy. To remedy subjectivity and to improve accuracy, this paper presents a research on developing more reliable models founded on historical data, which can be used for estimating or checking for coming projects. Establishing the relationships between project attributes and project overhead rate, two empirical methods, i.e. cluster center and linear regression, are compared about their performance in modeling and prediction, based on a contractor's past bid data according to some error measures.

## 2. Related researches

A previous research found that there is a lack of consistency among firms concerning categorization of costs as direct costs and indirect costs. However, the inconsistency of different firms does not affect the models in the present study, since they are oriented towards one firm, as long as it has its own way of categorization and categorizes costs consistently for different projects. Other researches relating to markup determination are also reviewed.

## 3. Factors influencing overhead

First, common to all construction projects, many overhead costs exhibit economies of scale, e.g. the larger the work, the lower the manpower required for supervision per unit of work due to a more efficient deployment, and so the project size as represented by total direct cost could be a factor. Next, the charges for several items of overhead costs such as office rents and utility fees are mostly in proportion to the time that a project lasts, and hence project duration is likely another factor. The main type of work of a project, i.e. road, building, etc, influences the number of specialty trades involved, the proportion of labor cost, and the character of the site, concentrated or spreading, and thus has an effect on supervision, coordination, and transportation requirements, which impact on the overhead rate. Similarly, the project location, urban or rural, influences setting-up and maintenance costs of offices, shops, and quarters. In particular, the country in which a project is located is an important factor as the contractor's operation is subject to customs, practices, and laws applicable. Other relevant project attributes include scope of contract, proportion of subcontracted work, and the quality level required of a project.

## 4. Description of data

The estimate summaries of 200 projects comprising bids submitted between March 2000 and March 2006 were collected from a large general contractor in Taiwan. For each project, the data shows project name, owner, project address, bid date, project duration, and a summary of various categories of direct costs, project overhead costs, and markups. Some problems in the data were found upon close examination and 27 projects were discarded, resulting in a usable collection of 173 projects. Numbered from 1 to 173 in chronological order, the sample projects range between 60 millions and 30 billions NT$ in bid amount and between 3 months and 106 months in duration. The following are classified in this study as project overhead costs: salaries for administration and supervision, office and shops, utilities and services, insurance/bonds, transport, safety, surveys/tests, environmental protection, and public relation. The obtained project overhead rates range between 0.0171 and 0.2912, with a

mean of 0.0793 and a standard deviation of 0.0428. Four factors were used as inputs in modeling: direct cost, duration, classification of work, and classification of location. Correlations among the quantifiable factors and project overhead rate were examined. The weak correlation of overhead rate with direct cost may be explained by the lessening of effects of economies of scale by large projects' more demanding quality and other factors at the same time. A classification scheme is required for the two categorical attributes. With respect to type of work, a project is classified according to limited project description available into one of eight groups. With respect to location, a project is placed into one of three classifications based on its address in Taiwan.

## 5. Description of models

Direct cost, duration, and project overhead rate are suitably represented by their measurements. For representing type of work and location, both decimal and binary ways are used. With decimal representation each input is assigned the group number for a project where the groups are ranked in order of increasing mean project overhead rate, meaning that an increase in the value of each input variable corresponds to an increase in the overhead rate. With binary representation a series of 0/1 variables are used for each input: seven for work type and two for location, bringing the total number of input variables to 11. The readied data is arranged into two sets for developing and testing models: 152 cases from 03/2000 to 03/2005 and 21 cases from 03/2005 to 03/2006. Data for the first five years are used as a large base of estimates from which a model is developed. Data for the last year is used as future cases for testing a developed model's prediction performance in estimating. The above arrangement agrees with the fact that a contractor makes estimates for coming projects based on experiences from prior projects, which grow with time. Three error measures are used to evaluate modeling and prediction performance: root of mean squared error (RMSE), mean absolute error (MAE), and mean absolute percent error (MAPE). RMSE is a consistent and convenient performance indicator for the present single output problem and is used as the main evaluator to measure model accuracy in monitoring performance and comparing different models, while MAE and MAPE are used as secondary measures. Two methods, cluster center and regression, were used to model overhead rates for a comparison. Using the cluster center method, the projects are classified by combinations of work type and location into clusters, with the maximum number of clusters at 8x3=24. The mean overhead rates for each cluster are calculated as the modeled rates. Using the regression method, two multiple regression equations involving all four inputs were built: one with the decimal representation and a total of four independent variables and the other with the binary representation and a total of 11 independent variables. The built equations are then used to produce overhead rates for cases within the modeling set as modeled rates and those for cases within the testing set as predicted rates. For each model above, the RMSE, MAE, and MAPE of modeling representing closeness of fit and those of prediction representing test accuracy are calculated.

## 6. Discussion and conclusions

Compared with the large standard deviation (0.0428) of overhead rates, all of the three models represent a significant improvement as a result of explaining factors being introduced. Overall, the cluster center method outperforms the regression method and the regression model with binary representation outperforms the regression model with decimal representation. Considering the level of noise in the data, the best result of about 3 percent error of direct cost achieved by either the cluster center method or the regression method with binary representation is considered acceptable. The fact that the cluster center method using only two factors achieves comparable or better performance requires further consideration. Heuristics from this study suggest that suitable factor selection and data representation are required for producing better results. Continual model updates with the buildup of estimates would be helpful. It is suggested that future researches collect actual costs for model development. Level of required project quality and type of contract can be considered for inclusion. The use of a nonlinear model such as artificial neural networks is called for in attempts to improve modeling and prediction performance.

# Risk allocation of road projects in Sri Lanka

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*Correct risk allocation in construction contracts has risen in prominence, because risk identification and risk allocation are influential factors in risk handling decisions. To handle them properly, it is necessary to identify the risks and allocate them correctly. This can only be achieved if all parties do comprehend their risk responsibilities, risk event conditions and risk management capabilities. This paper reports on a study carried out using multiple case studies, to identify various risks inherent in Sri Lankan road projects and the allocation of them between contractual parties. The study revealed that road projects are dealing with many risk sources, and parties not allocated with some risks through contract clauses also happen to bear consequences of those risks, urging all contractual parties to have a thorough understanding on such risk events.*

**Keywords:** Risk identification, Risk allocation, Road projects, Contractual parties.

## 1. Background

Risk and uncertainty are inherent in all construction work and as it has been stressed by Flanagan and Norman [1], 'the construction industry is subject to more risk and uncertainty than many other industries'. Bufaied (cited in [2]) has described the risk in relation to construction as, 'a variable in the process of a construction project whose variation results in uncertainty as to the final cost, duration and quality of the project'.

The Road Development Authority of Sri Lanka has planned for the future development of the national highway network [3]. However, road projects are exposed to the uncertain environment because of such factors as, presence of various interest groups, resource availability, climatic environment, economic and political environment and statutory regulations. The aim of this research study is to assist the Sri Lankan road contractors and employers to identify the risk sources inherent in road projects and understand their risk responsibilities. Against this background, the objectives of the study are to identify risk sources associated with Sri Lankan road projects, and the proper allocation of those risk sources among the contractual parties.

### 1.1 Methodology

The research was conducted by means of the case study approach and two foreign funded road projects that had significantly been completed were deployed. Multiple sources of evidence comprising semi-structured interviews, documents and archival records have been used for the data collection.

## 2. Risk identification, classification and allocation

According to Flanagan and Norman [1], a risk management framework would consist of risk: identification, classification, analysis, attitude and response. Therefore, risk identification and classification becomes important in minimising the probability and consequences of adverse events. It is also said that a bad definition of a risk will breed further ones. Identification is influenced by the risk perception of the risk management team. Classifying risks is by identifying the consequence, type and impact of risk. According to Bunni [4], when a risk has been identified, assessed and analysed, it must be allocated to various parties in order to keep them under contro and prevent the occurrence of harmful consequences. Careful analysis for a contract strategy also leads to the selection of the right allocation of responsibilities according to Thompson and Perry [5].

## 3. Results and findings

### 3.1 Risk identification

The study began with 26 risk sources and it was established that 23 risk sources were pertinent to the two cases. Those identified risk sources were classified under the following four types of risk sources, derived by Wiguna and Scott [6].

- **Technical and contractual risks**

(1) Insufficiency of the Preliminaries Bill, (2) Changes imposed by the Engineer, (3) Defective design, (4) Late handing over of the site, (5) Tentative drawings, (6) Scope change.

- **Economic, financial and political risks**

(1) Delayed payments, (2) Dependence on foreign funds, (3) Regulations and difficulty in obtaining permits, (4) Inflation, (5) Legislative changes

- **Managerial risks**

(1) Contractor competence, (2) Dealing with utility agencies, (3) Defective construction work, (4) Improper estimation, (5) Late approvals, (6) Low labour and equipment productivity, (7) Neighbourhood relationships, (8) Procurement of resources, (9) Public security and safety

- **External and site condition risks**

(1) Acts of God, (2) Adverse weather conditions, (3) Unforeseen site ground conditions

### 3.2 Risk allocation

The administration of construction risks was first analysed using the "FIDIC Conditions of Contract for Works of Civil Engineering Construction, Fourth Edition, 1987" which was used in both cases. The actual risk allocation was also then analysed according to the views of respondents. With regard to risks pertaining to Acts of God, defective design, late approvals, late handing over of the site, public security and safety, scope change, tentative drawings and unforeseen site ground conditions; they had impacts on parties other than the party to whom the risk had been allocated by the contract. As an individual party, the consultant was required to carry the risk of defective design, public security and safety, tentative drawings, and unforeseen site ground conditions - together with the employer and the contractor. The risks of delayed payments, dependence on foreign funds, and legislative changes had been borne by the employer himself. However, the risks of contractor competence, defective construction work, insufficient estimation, insufficiency of the preliminaries bill, low labour and equipment productivity, and procurement of resources were borne by the contractor. Risk sharing proved to be more effective with regard to dealing with utility agencies, neighbourhood relationships, regulations and difficulty in obtaining permits. Those risks, including other risks of adverse weather conditions, changes imposed by the engineer, and inflation were shared by the employer and the contractor.

## 4. Conclusion

The observance of real cases revealed the nature of the environment within which the construction works were operated and being exposed to many risks throughout their entire construction process. The risks of defective construction works, insufficiency of the preliminaries bill, low labour and equipment productivity, project programme and contractor competence were not particularly significant. Risk of Acts of God was location specific while the risk of dependence on foreign funds was project specific. Risks of defective design, late approvals, late handing over of the site, tentative drawings, and unforeseen site ground conditions had thwarted the contractor in many occasions. Conversely neighbourhood relationships, and public security and safety required careful attention. Inflation and scope changes had contributed the most to time and cost overruns. The contractual parties both required a continuous learning approach. Past projects and past events are real scenarios to gain a good experience in liaison with this and early identification of a risk source was felt to be essential in its proper allocation. Contractors need to have a clear understanding of risks they are allocated with by employers. Though some risks had been specifically allocated to a party through contract clauses, it could be realized that, the party who was assigned with those risks was not carrying the consequences of these alone, but with other parties who also happened to bear the consequences arisen because of those risks. The consultant also carried certain risks depending on his role in the contract. The study helps the contractual parties to identify and classify risk sources and also to improve their understanding of proper allocation of those risk sources.

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# Practical Standard Methods of Measurement Cost Estimating in the design stage

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*This research aims to study the utilization goal and the current utilization status of the standard methods of measurement of some countries, and to propose new directions for the domestic standard methods of measurement. Not only are the standard methods of measurement utilized in the detailed design stage, but a method of interconnecting the information to be utilized in the initial design stage is also required.*

**Keywords:** SMM (Standard Methods of Measurement), Cost Estimating, Design Stage

## 1. Background and Goal

This Study propose the cost model through it is compared and analyzed with the standard methods of measurement(SMM) of developed countries and that can reflect the construction cost factors based on quantities unit by design stage. This cost model is to support decision-making by the owner and the architecture considering cost and design simultaneously.

This study examined the methods of utilization of standard methods of cost measurement and calculation by stage based on related literature and standard methods of cost measurement in other developed countries.
(1) Study of the Cost Calculation Method by Design Stage

(2) Study of the Current Status of Advanced Foreign Countries' Standard Methods of Measurement

(3) Analysis of the Cost Estimating Utilization Model in the Planning Stage with the Standard Methods of Measurement in the Construction Documents Stage.

## 2. Cost Estimating Method by Design Stage

### 2.1 Planning Stage

There are three types of conceptual estimation methods in the planning and schematic design stages. The first method is the ROM (rough –order –of magnitude) method, or the calculation method by pyeong or ㎡. This calculation method estimates the construction cost based on the total gross area. The second method is the assemblies cost estimation method, which estimates the cost based on the database of the costs of the individual components of a building such as the base, roof, upper structure, lower structure, exterior wall, interior wall, interior, machine and electricity, etc. The third method is the calculation method by cost index..

### 2.2 Design Development Stage

Some parts of design or engineering construction are generally yet determined. Cost estimation is possible only when the design has been complete. Therefore it is used with conceptual estimation, when the design is incomplete or has yet been completed. And in complete designs, detailed cost estimation is performed through the market price or labor cost calculation method, take off quantities. Both methods are practically performed in a mixed manner in each type of design stage.

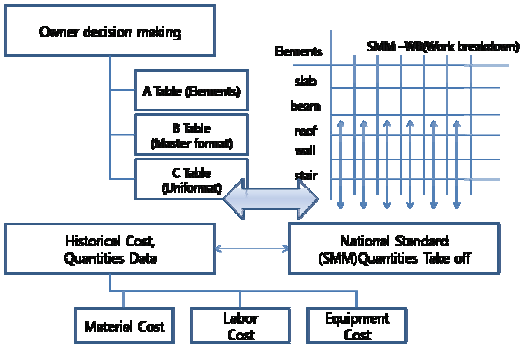
### 2.3 Construction Documents Stage

Detailed cost estimation is performed when the design specifications have been completed. The estimator performing quantities take off all types of construction materials used in the. In the USA, both types of calculation standards are used. The types are more widely known as Uniformat(GSA) and Masterformat(CSI) in Korea. The selection of the format depends on the personal preference or the strategy of the detailed estimation.

## 3. Current Status of the SMM in Developed Countries

In the case of Australia, it has about 10 years of history in SMM, and it went through four times the revision process. In the case of the UK, three main concepts on SMM were introduced in the 1970s, and a calculation concept related to the calculation method, time and quantities was proposed. In the case of the UK, where the level of utilization of SMM is high, it aimed to enhance the utilization level with respect to the integrated information concept of the project.

*Figure 1: The concept of cost estimating by connected SMM in design stage*




### 3.2 The Prototype of Cost Estimating by Utilized the SMM

The details of estimation, it is necessary to operate the Masterformat in the construction documents stage. The Uniformat is able to utilization of the standard methods of measurement in the planning design and design development stages. The figure 1 is concept of utilization SMM for cost estimating which is connecting in the construction documents stage and the initial design stage through with the quantities take off (figure 1.) It is connecting labor cost and equipment cost with the Quantities Take Off the works in each design stages.

| Unit/Works (Quantities) | Board Form (3th) |
|---|---|
| Substructure | 21,058 |
| Superstructure | 3,473 |
| Total | 24,747 |
| Total compound cost | 524,672,600 |

*Table 1. Sample historical cost and quantities date – Connected Materformat and Unit format*

| 010103 reinforced concrete | | | | | |
|---|---|---|---|---|---|
| | unit | Qu. | material | Labor | sum |
| Circle form | M2 | 1716 | 14,757,600 | 62,805,600 | 77,563,200 |
| Board form | M2 | 24747 | 96,443,100 | 425,338,800 | 521,781,900 |
| Uro-form | M2 | 34237 | 85,592,500 | 523,826,100 | 609,418,600 |

*Table 2. Sample cost on market and quantities take off data – Masterformat*

## 4. Conclusion

The Uniformat is a SMM that can be used as a semi-detailed cost estimation method by forecasted the quantities take off in the initial design stage. It is to used subject to building components of the base, superstructure, substructure, the exterior walls and finishing, etc. Effective cost estimating methods such as Uniformat SMM haven't practically been established yet. To enhance the accuracy of cost estimating in the planning design and the development design stage, the quantities measurement methods of transforming from the Masterformat to the Unitformat should first be performed. This study aims to encourage future studies on a method of connecting the Masterformat and the Unitformat through case studies with the historical data

## 5. Acknowledgments

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# Project Factors Influencing the Accuracy of Early Stage Estimates

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*Early stage cost estimate need to be accurate so that cost certainty from the early stages of project development is assured. This study explores 7 project factors driving the variance between conceptual cost estimates and tender estimates. It also investigates the views of quantity surveyors regarding 12 methods that could be used for improving the accuracy of these estimates. Finding from postal questionnaire survey of quantity surveyors in Australia showed that early stage estimating is an important service offered by quantity surveyors however, there is dissatisfaction with the current level of early stage estimate accuracy in Australia Construction Industry. Accuracy may vary according to project complexities, project location, and project procurement method. Thus project with different procurement method, varying complexities and in different location may require different estimating approach and process. Estimates could be improved by ensuring sufficient information is available at the time of estimating, increasing cost planning and control during the design phase and 'checking all assumptions with clients and consultants during the estimating period.*

**Keywords:** Estimating, Conceptual cost, Tender sum, Quantity Surveyors, Australia,

## 1. Background

Early stage estimate is one of the most important pieces of information for decision making at the conceptual stage of project [1]. The estimate provides initial information that are used to (a) decide on the financial feasibility of the project (b) evaluate alternatives to the project [2] ; and when the project proceeds, the estimate will (a)serve as a tool for budgetary control and (b) serve as a management tool [3]. If the estimates are inaccurate, they lose their effectiveness as tool for these outlined purposes. Estimating error at early stage could lead to misguided business decisions being made, which could also have long term consequences relating to project and performance of investors. In construction, when a project is finished, the quantity surveyor is often left with three figures namely the initial (conceptual) cost estimate, the tender estimate and the final completion cost. These three figures are often different, raising the question of estimate accuracy. This aim of this research is to explore project characteristics influencing the variances between the conceptual cost estimate and the tender estimate and in that regard investigate the most effective ways of improving the accuracy of early stage estimates. This study is important because the knowledge gained could help quantity surveyors and estimators so that they are aware of which project areas may need special attention and what practices would be most effective in improving the accuracy of their estimates.

## 2. Theoretical Framework

Serpell defines conceptual (early stage) estimating as "the forecasting of project costs that is performed before any significant amount of information is available from detailed design and with still incomplete work scope definition" [1]. Gunner and Skitmore summarised the factors relating to accuracy, bias and consistency identified in previous studies [4]. These were building function, type of contract, conditions of contract, contract sum, price intensity, contract period, number of bidders, good/bad years, procurement basis, sector, number of priced items, number of drawings and price forecast. Ling and Boo investigated the causes and suggest 13 measures to improve estimate accuracy [5]. Ensuring proper design documentation and information management was found to be the most popular measure to improving estimate accuracy, followed by checking all assumptions during the estimating process and thirdly, providing a realistic timeframe in which to undertake the estimate.

## 3. Research Method

A questionnaire survey was administered on 102 quantity surveying firms around Australia. Forty-one responded. Also, the accuracy of early stage estimate for 56 completed projects in Melbourne was estimated. Relative Importance Indices were also computed to determine the rank of 7 potential project factors that could contribute to bias and inconsistencies in early stage estimate. The relative effectiveness of 12 potential methods that could be used to improve the accuracy of the estimates was also determined. Agreement among quantity surveyors regarding the methods was tested using Fleiss' kappa statistics.

## 4. Results

More than 50% of the projects brought to 71% of respondents by clients included some form of early stage estimate. For 68% of respondents, between 10% and 40% of the total workload of their company is on early stage estimating. Early stage estimating was either an important or very important facet of the service offered by the quantity surveyors. Ninety-eight percent of the respondents believed that accuracy of early stage estimates is either important or very important for overall project success. Respondent considered a variance of ±10% between estimate and tender sum as acceptable. Sixty-three percent are dissatisfied with the current levels of early stage estimate accuracy within the industry. On a sample of 56 projects, it was

found that the early stage estimates are generally biased and are overestimated by 4.29%. The way the project is procured, followed by its location and size would contribute most to overall bias and inconsistency experienced in early stage estimates. Among 12 methods evaluated, ensuring sufficient information is available at the time of estimating, increasing cost planning and control during the design phase and checking all assumptions with clients and consultants during the estimating period are the three most effective methods of improving the accuracy of early stage estimates. However, all the12 methods evaluated are effective for improving estate accuracy.

## 5. Conclusion

Despite the importance of early stage estimate, there is dissatisfaction with the current levels of early stage estimating accuracy in Australia construction industry. Project procurement methods, location of project and project size are the three most important project-related factors driving the level of bias and inconsistencies experienced in early stage estimates. Quantity surveyors should note that there may be need for different estimating approach and process when working with project of varying size and complexities, varying procurement method and in different locations. Accuracy of early stage estimate could be improved by ensuring that sufficient information is available at the time of estimating, increasing cost planning and control during the design phase and checking all assumptions with clients and consultants during the estimating period.

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# Techniques for calculating unabsorbed overhead

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*Before 1960, contractors were denied compensation for unabsorbed home office overhead. This changed with the onset of the Eichleay formula for calculating the damages. However, Eichleay has prerequisite criteria from court precedence that makes it controversial to apply. Alternate techniques sprung up and were used in different settings in USA and Canada. The paper describes the evolution and formulation of Eichleay, and presents alternate techniques, as well, for calculating unabsorbed home office overhead. A Direct Method is proposed that serves to make the calculation simple when compensability is undeniable.*

**Keywords:** Eichleay, Compensable, Home Office, Claim

## 1. Background

Home office overhead consists of expenses incurred at the contractor's home office that must be covered by the projects the contractor is engaged in. During the event of a compensable delay, the contractor is normally entitled to recover home office expenses, as well. But, doing so was legally permissible only after the landmark case of *Eichleay Corp. v. United States*[1]. The Eichleay Corp. proposed a formula that is used till today. However, there were many critics of the formula, and case law has admitted other formulas for calculating home office overhead

## 2. The Eichleay Formula

The Eichleay formula is a three-step process as per the following formulae:

(Actual Billings for Delayed Contract x Total Actual Billings for Period (All Contractor Contracts)) ÷ Total Home Office Overhead for Period = Overhead Allocable to Delayed Contract (OACD) - (1)

OACD ÷ Days of Performance = Daily Contract Overhead for Delayed Contract (DCODC) - (2)

DCODC x Number of Days Delay = Overhead Claim Amount for Delayed Contract - (3)

## 3. Acceptance and Criticism of the Eichleay Formula

While Eichleay has been accepted and widely applied, it has been severely criticized, as well. Landmark cases such as *Excavation-Construction, Inc. v. United States*[2], *Wickham Contracting Co. v. Fischer*[3], *Capital Electric Co. v. United States*[4], 1984, upheld and affirmed the use of Eichleay.

But, disputes occurred, centering around the accuracy of the formula, and hence its validity, further claiming that Eichleay was entirely theoretical [1, 2, 3]. Courts in New York and Texas refused to apply it[5,6], while in another case of Capital Electric Co.[7], the judge pronounced Eichleay dead.

Nevertheless, within one year, the U.S. Court of Appeals for the 2nd Federal Circuit reversed the *Capital Electric* decision and reinstated the contractor's right to utilize Eichleay.

## 4. Compensability Criteria

Additional court cases continued to reassert Eichleay, but in the process they developed criteria for application and compensability. Two significant criteria emerged – (1) uncertainty of the delay or standby period, and (2) "practicality" and "possibility" for the contractor to take on additional work, which would "absorb" the home office expenses during the period of delay. Among various cases that established precedence in this regard were *Community Heating & Plumbing Co., Inc. v. Kelso*[8], *C.B.C. Enterprises, Inc. v. United States*[9], and *Interstate General Government Contractors v. West*[10].

## 5. Alternate Techniques

Since there were doubts as to the accuracy of Eichleay, multiple alternate techniques were proposed, used, and accepted by courts. Attorneys and construction managers came up with the Comparative Absorption Rate Method (CARM), Burden Fluctuation Method, Carteret Method, Allegheny Method[11], Canadian Method, Modified Eichleay Method, Calculation based on Actual Records, Total Direct Cost Allocation Method (DCAM), Specific Base Allocation Method (SBAM), and Direct Method – for a total of ten alternate techniques. Interestingly, they do not all yield the same result. The Canadian Method, CARM, Carteret, SBAM and Direct Methods give identical results, but the others all yield different values [4, 5, 6]. For a small example problem studied, applied equally to all methods, the mode and median were $8,000, while the mean was $7,200 and standard deviation of this tiny population was $932. Assuming a normal distribution, the confidence interval to ± 1 standard units ranges from $7,705 to $8,294. All the alternative methods have been used at some time or the other to calculate *compensable damages for unabsorbed home office overhead due to delay*. Each alternative and technique is based on

assumptions, have their own formulas, their individual issues and weaknesses, and they all result in estimates or approximations of the damage. Quite often, however, these alternate methods end up approximating the damages, and often result in some of the same problems alleged against the Eichleay formula.

## 6. Direct Method

The Direct Method stands out as a simple method, since it espouses a one-step calculation.

Planned Overhead Rate x Planned Earnings during the delay period = Unabsorbed Overhead - (4) - (21)

The calculation with this method reflects exactly what the contractor would have earned on the home office overhead had there been no delay or standby. For this particular example, the result of the Direct Method agrees with the Canadian, Comparative Absorption Rate, the Carteret, and Specific Base Allocation Methods. The Direct Method is much less convoluted than the other methods presented.

## 7. Conclusion

The calculation of unabsorbed overhead still continues to dog owners and contractors. Multiple issues and criticism have risen on the use and application of Eichleay. Case law and court decisions that shaped the prerequisite criteria for use of the Eichleay were studied, and alternate methods and formulae for the calculation of damages for unabsorbed home office overhead due to delay were presented.

The alternate methods have similarities and differences. However, an exact method or calculation is probably quite impossible to develop. Therefore, the goal, given the circumstances, is to determine a fair allocation for compensating a contractor for the delay. Consequently, the Direct Method is proposed as an alternate method for the calculation of unabsorbed overhead.

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# Structural and finishing costs in Yemen

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*Construction cost is a key factor in the choice of methods and materials in any construction project. The trend towards modernization in Yemen has caused an ongoing shift from traditional to modern buildings. These modern buildings depend mostly on imported technologies and materials and are relatively costly. Cost reductions can be achieved in practically all cases only by lowering of quality, consequently creating less attractive and less durable and sustainable buildings. Following the over-viewing the construction industry in Yemen, a local survey was conducted to provide a breakdown of construction costs of structural and finishing elements. Proposals are made to contain construction costs in Yemen.*

**Keywords:** Structural costs, finishing costs, construction materials, Yemen and developing countries.

## 1. Introduction

Historically Yemen has established a unique building tradition this rich, characteristic and uniform style of the traditional Yemeni architecture and townscape justifiably admired. (Figure 1)

*Figure 2: Traditional Buildings in Sana'a*

Until few years ago, this tradition had being successfully sustained. The emerging trend of modernization and urgent need for infrastructure and housing project in Yemen has caused an ongoing shift from the traditional to the modern building types. These modern buildings depend mostly on imported technologies and materials, which generally considered costly. Recent history, has demonstrated that it was not possible for the local construction industry to adapt and develop their marketable, managerial and technical skills sufficiently to cope with the rapid growth and vast demand in these modern forms of construction that have been occurring over these last decades. Sultan & Kajewski [1] indicated that some of the specific difficulties associated with the Yemen's construction industry are the unclear and non unified construction technologies and methods, as well the tendency of the clients/owners to minimize their construction costs by eliminating or minimizing the technical and engineering assistance in design and supervision. This tendency to reduce the overall construction cost has only led to over-designs, excessive use of construction materials and site waste, unnecessary structural members and concurrently an increase in construction cost in the modern buildings. As well, there are inadequacies in designs (not in accordance to the local needs or priorities), the absence of project management and supervision, what's more the lack of any approved national system of codes, standards or models have only complicated the industry's problems. A survey by Sultan & Kajewski [2] indicated that the most important factors causing high construction costs were identified as imported materials and construction waste.

A report by Tassios [3] for the United Nations Industrial Development Organisation (UNIDO), indicated that the ratio ( $\lambda$ ) of structural components cost to the finishing components cost, reflect the level of construction development. It was found that in some African countries the ratio $\lambda$ was 1:1; in rapidly developing areas such as Greece $\lambda$ was 1:2 and in the developed countries $\lambda$ was 1:4.

Initially this paper reviews in brief the historical background, transformation phases and the local conditions and difficulties associated with the construction industry in Yemen. subsequently the paper uses the ratio ($\lambda$) primary to pursue that the structural components are the major contributor to the overall construction cost and on the account of the finishing components' quality, in view of that suggests some solutions that could improve the situation and approach justifiable cost and quality.

*Figure 3: Modern/Traditional Buildings*

*Figure 3: Modern/Traditional Buildings*

## 2. Modern construction in Yemen

The modern construction refers to buildings that built recently in Yemen, mostly in cities and towns. In these urban areas, constructions are frequently carried out using modern techniques, and whose main characteristic is the structural reinforced concrete frame. The external walls are made of cement blocks or local stones to simulate the traditional style (Figures 3) a kind of modern/traditional, which is expensive.

## 3. Local Survey

According to Sultan & Kajewski [3], the high construction costs are always coupled with low quality of finishing in most modern domestic construction projects.

*Table 1: Breakdown of Cost by elements of building.*

| | Structural (%) | Finishing (%) | ($\lambda$) |
|---|---|---|---|
| Senegal | 49 | 51 | 1: 1.04 |
| Ghana | 53.5 | 46.5 | 1: 0.86 |
| Kenya | 63.2 | 36.8 | 1: 0.58 |
| Yemen * | 53.1 | 46.9 | 1: 0.87 |
| Developed countries | 20 | 80 | 1: 4.00 |

Sources: Tassios 1992 [4] and *Local Survey

## 4. Conclusion

The pressing need for infrastructures and housings projects and the emerging trend of modernization in Yemen has caused an ongoing, hasty and careless shift from the traditional to the modern building types. These modern buildings considered relatively costly with poor finishing quality. The construction industry in Yemen is assessed in this paper by looking into the construction costs contained by the structural and finishing works. It was found that, the cost of structural components is relatively high. It suggested that any approach to improve the situation should initially unravel the problems associated with the structural components, such as the problems associated with the inadequate designs, inadequate use or inappropriate choice of building materials that is not in accordance to the local needs or capacity. As well as creating clear building technologies, national standards and building models that recognise the history, culture, incomes, aspiration, priorities, local resources and environment of the regions. The Development to the structural components would concurrently lead to the enrichment of the finishing components quality.

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# Factors that Influence Contractor's Risk Response Planning in Controlling Cost of Road Construction Project in Indonesia

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*Infrastructure projects, such as road construction, are one of the most important projects In Indonesia. They contribute significantly to the national economic growth. Data from Indonesian Bureau of Statistics shows that budget for road construction project is still the largest compared to other infrastructure projects. Effective cost control in Indonesia's road infrastructure project need to be done in order to better support the economic development. Controlling cost overrun can be done in several ways. Before-process variance is the most effective way because cost overrun is measured early in the beginning of project phase. This makes contractor can focus to develop option of responses planning to avoid such cost overrun through risk avoidance, risk transfer, risk reduction, or risk absorption. This paper discuss the factors that influence contractor's risk response planning in controlling and monitoring cost of road construction project in Indonesia. The research was done using case study in two major contractors in Indonesia. Data analysis is done by Analytic Hierarchy Process (AHP) method in order to obtain priority of the factors. The analysis indicates that personnel's risk attitude as the most influence factor. Risk identification and macro level external factor have the equal rank in second place, and project level external factor is the least influencing factor in construction contractors' risks response planning. Priority factor's by sub criteria is defined as follows: compliant to conditions and requirements, discipline of project personnel, political condition, resources availability, proactive in identifying problems, preparedness in facing possible changes, local weather condition and economic condition.*

**Keywords:** Infrastructure, road, construction, risk response, cost control

## 1. Introduction

Road construction project is the highest government annual spending in terms of providing public infrastructure. In 2005, for example, road construction projects constitute about 15 percent of government budget [1]. Therefore it is important to effectively control the cost of road construction.

Road construction project is susceptible to risks and uncertainties, which could affect project cost performances. Road construction contractors respond differently to those risks. Decision to select the type of risk response to be performed is influenced by several factors which include attitude toward risk. As contractors responsible for the construction phase of road construction projects, their respond toward risks would affect the project cost performance. The better the risk response the better the project cost performance.

The purpose of this paper is to identify factors that influence contractor's risk response planning in controlling and monitoring the cost of road construction projects in Indonesia. Case studies on state owned construction companies, which specialised in road construction was used to identify those factors.

## 2. Risk Response Planning as a Tool for Project Cost Control

Project cost control is important to project management as it provides early detection of actual or potential cost overruns. This early detection provides the opportunity to initiate remedial actions and increases the chances of eliminating such cost overruns or minimising their impact [2].

According to Zahn [4], based on the timing of their identification, project cost variances can be divided into three layers: before-process variance, in-process variance and after-process variance.

Risk response planning can be used as a tool for controlling construction project cost. As part of risk management activities, risk response planning can be used to deal with risks and uncertainties in construction project cost. It can be implemented in every phase of construction project [6].

Response to risks can be done in the followings [7]: risk absorption, risk reduction, risk transfer and risk avoidance. The selection of the type of response will be influenced by management attitude toward the risks.

## 3. Research Method

Case studies were used to identify factors that influence road construction contractors in developing their response plan.

The factors are grouped into internal and external factors. Internal factors related to risk management aspects of the project, which mainly related to risk identification and risk attitude. The external factors are divided into project level and macro level.

Data collection was done using structured interview to five senior project managers from the two state-own companies. The questionnaire for the interview was designed as such so it can be analysed using Analytic Hierarchy Processes (AHP).

Data analysis was done using a computer application 'Expert Choice', which is an application that was designed to perform AHP analysis.

## 4. Factors Influencing Risk Response

The ten variables that influence the risk response plan, on the descending order, are: compliant to conditions and requirements; discipline of project personnel; political condition; resources availability; proactive in identifying problems; preparedness in facing possible changes; using structured approach in solving the problems; local weather condition; economic condition; and liquidity of project owner.

At the criteria (factors) level, the analysis result shows that risk attitudes is the main factors in selecting a response plan. Risk attitude contribute just above about forty percent toward the risk response plan (Figure 2). It is not surprising as attitude toward the risks would most likely influence selection of response to particular risks. The attitude would be influenced by project team compliance to conditions and requirements, project personnel discipline, proactive attitude toward problem identification and project team preparedness in facing any possible changes.

The external factor at the macro level and the risk identification has the same contribution of about twenty-three percent each toward the risk response planning. The main variables affecting the external factor at macro level are the political and economic condition. Indonesia has just changed from a centralised government into more regional autonomy. This condition, unquestionably, is affecting the way construction companies selecting their risks response as the condition in different region can be different.

The main variables that need to be considered in risk identification for road construction projects in Indonesia include availability of resources and local weather conditions. Road construction is affected by water, therefore weather prediction need to be done intensively and continuously to schedule the activities that required dry condition. As road construction performed across the country, availability of resources becomes important factor.

The least influencing factor in developing response plan is the external factor at project level. The main variable that affecting this factor is the project owner liquidity. Road construction projects are mostly considered public sector project. The fiscal year adopted by the Indonesian government has an effect to budget disbursement which is the main source of project payment.

## 5. Conclusion

Road construction is an important aspect of infrastructure development in Indonesia. It is the highest government annual spending for infrastructure projects, which contribute about 15% of overall government budget. Controlling road construction projects costs is then become very important.

Risk response planning can be used as a tool for road constructions project cost control. The paper shows that risk attitude is the most influence factor in developing risk response planning in road construction projects. The risk attitude is influenced by project team compliance to conditions and requirements, project personnel discipline, proactive attitude toward problem identification and project team preparedness in facing any possible changes. The least influencing factor is the external factors at project level.

The study reported in this paper was limited to two state-owned construction companies that specialising in infrastructure project. The future study need to expand the scope to more construction companies.

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# SECTION III

## CONSTRUCTION MANAGEMENT

# Measuring Quality: how does this improve construction performance?

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*The paper charts the history and development of the Hong Kong Housing Department (HKHD) Performance Assessment Scoring System (PASS) from 1990 to the present day and examines its effect on facilitating change to the quality of construction work of building contractors engaged in the production of public sector housing projects Hong Kong. Organisational culture was measured using a 1994 survey instrument originally developed by Denison and Neale, adapted for the environment of the study, and corporate success was measured by the PASS system mentioned above. The conclusions presented in the paper further underpin the connection established in previous research between strong organisational culture and project and corporate success as the major results of the original study indicate that there is significant linkage between strong organisational cultures and business success. Several opportunities to take forward this research have been identified, including extending the study to other countries and also longitudinally re-evaluating some of the original case studies to ascertain how organisational cultures have changed or further developed in relation to the changing construction climate in Hong Kong.*

**Keywords:** Public housing construction, performance measurement, organisational culture, procurement, quality.

## 1. Background

Public housing in Hong Kong has a fairly modern history, which began in 1953 with a fire at Shek Kip Mei that destroyed a large area of 'squatter' huts housing predominantly families of refugees from China who had descended on the territory between 1947 and 1949 following the civil war on the mainland [1]. The initial response of the government was to construct temporary single storey buildings to house the displaced residents and these gave way to low-rise multi-storey buildings and eventually to so-called 'high rise buildings handed over in the 1960s and 70s handed over. Owing to lack of expertise, poor specifications and inadequate quality control, a decade or so down the timeline, the devastating problems of these buildings would become horrifyingly obvious. Once this disastrous situation became public knowledge, all government departments and especially the Hong Kong Housing Authority (HKHA) and it's executive arm, the Hong Kong Housing Department (HKHD) were forced to reconsider their construction quality control systems to assure a distraught public that this could never happen again. A list of contractors was therefore promulgated in April 1990, which was to be dedicated only to the HKHA works. Using only companies from its own list meant that the HKHA could exercise direct control in the vetting, prequalification and subsequent performance monitoring of these companies. It also allowed the Authority to operate a reward and penalty mechanism for good and bad performance.

## 2. Performance Measurement

The system used to drive this is known as the Performance Assessment Scoring System (PASS). During the period of the research, based on a score-league formed from PASS results, the HKHD on a quarterly basis determines disciplinary actions and rewards its best performers with greater or lesser tendering opportunities. Figure 1 below clearly demonstrates the overall performance improvement of contractors on projects during the first four years of introducing PASS 1997.

As discussed briefly in the introduction of this paper, much of the previous research on organisational effectiveness undertaken since the early 1970s has relied on the use of financial measures to determine performance levels, In an attempt to utilise measures which were determined on a non-financial basis and also reflected 'customer satisfaction', the objective *dependent variables* used to operationalise 'organisational effectiveness' in this research were the success ratings of building contractors employed on public sector housing contracts awarded and operated by the HKHA. These variables were drawn from the component assessments of the HKHD's PASS scores of contractors and based therefore on quantitative and objective evaluation and measurement of the real-time quality of built output against the specification requirements, over the period from 1997 to 2002.

## 3. Organisational Culture

[2] The Denison Organizational Culture Survey (DOCS) was eventually selected as being the most suitable to use for measuring organisational culture in the context of this research, due to its suitability for use in, and wide acceptability by, the business environment. [3] Denison and Mishra (1996) found that the four culture traits have a significant impact on organisational performance and these are, involvement, consistency, adaptability and mission. Figure 2 below shows the operational dimensions of the Denison Organizational Culture model [4] (Denison, Cho & Young, 2000), which has been derived from the DOCS results over a period of years.

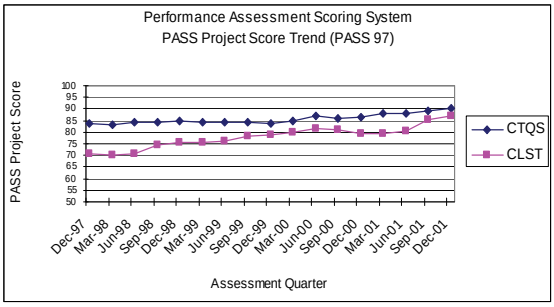


*Figure 4: PASS Score Trend 1997 – 2001*

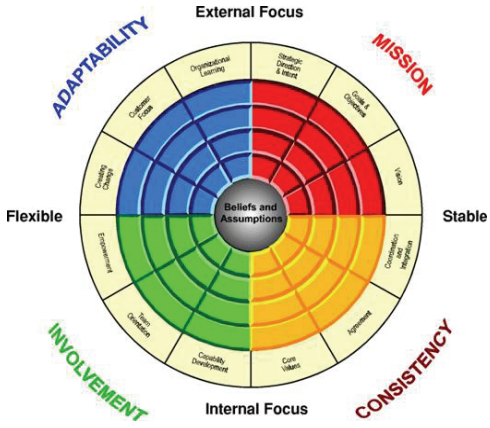


*Figure 2 – Denison Organizational Culture Model*

## 4. Research Questions

Based on the research objectives and main research problem described in the introduction of this paper, the three resultant research questions were:

*Question 1*: Do Hong Kong construction companies possessing relatively high combined levels of the four organizational cultural 'traits' i.e. adaptability, involvement, consistency and mission (as indicated by the Denison Organizational Culture Model) perform more successfully on public housing projects than those exhibiting lower levels of those traits?

*Question 2*: Are any of the four traits more significant in contributing to success levels than others?

*Question 3*: Are any combinations of the four traits, based on a horizontal or vertical split of the Denison Organizational Culture Model, more significant in contributing to success levels than others?

Results were based on feedback received from over 43% of the HKHA's listed contractors, which delivered some 159 responses, which were able to be analysed and tested to arrive at certain significant conclusions

## 5. Conclusion

The main findings from the research are:

A high level of company effectiveness is positively associated with strong organisational culture;

A high level of company effectiveness is positively associated with the cultural traits of 'consistency', 'adaptability' and 'mission' but not with "involvement" trait; and,

A high level of company effectiveness is positively associated with the combined cultural traits represented by the dimensions of 'external focus" and "stable culture'.

These findings support previous research on the links between organisational culture and effectiveness.

Further research is needed to obtain a more detailed and deeper understanding of the organisational culture of the construction industry where study has so far been somewhat limited and longitudinal use of the DOCS and PASS in the research population established for this research would develop and hopefully strengthen the findings described in this paper. The organisational culture (OC) and organisational performance (OC) link.

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# Challenges faced by the construction industry in Sri Lanka: perspective of clients and contractors

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*The construction industry is a major contributor to the development of economies in Sri Lanka. However, it faces significant challenges and difficulties which are unique to the specific industry. Therefore, it is a vital role to recognise them and offer solutions. This paper presents findings of a research which was carried out to identify challenges face by the Sri Lankan construction industry and effective mechanisms to overcome such aspects. Research found forty six critical challenges and 13 mechanisms. Further five effective factors were extracted and recommended for up-lifting the image of the construction industry.*

**Keywords:** Construction industry, Challengers, Sri Lanka, Developing countries

## 1. Introduction

It has been documented that the construction industry is being faced many problems and challenges. In developing countries, these problems are compounded alongside a general situation of socio-economic stress, chronic resource shortages, institutional weaknesses and a general inability to deal with the key issues by inadequate investment plans and changing government priorities due to various sociological, economic and political constraints [1-2]. In Sri Lanka, the fluctuating construction workload, unfair competition by foreign contractors, skills drain and shortages and high cost of developing skills were the main identified problems [3].

However, in Sri Lanka, the construction industry places a vital role in economical and physical development [4]. Therefore it is important to consider the present context of the industry to identify precincts and to get counteractive measures in order to uplift the industry to meet the future challenges. This research has focused to identify critical challengers which need immediate attention and effective mechanisms for development of the construction industry in Sri Lanka.

## 2. The Research

Research was designed to identify its objectives through an industry-wide questionnaire survey. The sample group consists of randomly selected leading consultants and under Grade 1 to Grade 2 category. The sample size for each group was selected as 40. The questionnaire was focused to identify three areas including respondent's profile, challenges and problems of the construction industry and motivators to improve the image of the industry. In this form, 61 existing challenges and problems and 20 possible motivators obtained from the literature were shown [5-7]. A seven-point "likert" scale where 1 represented "very critical" or "very effective", 4 - "neutral", and 7 - "not critical at all" or "not effective at all" was used to solicit the judgment of respondents regarding the criticality, effectiveness and efficiency of the proposed (listed) industry challengers, and motivators.

## 3. Discussion

Forty six significant challengers identified through the t-test. They are grouped under ten different areas as follows.

**Financial –** Six financial challengers were shown as significant - rapid changes in the national economy, inadequate support from the banking sector, high inflation rate, narrow profit margins, high interest rates, and limited credit facilities.

**Government Policies –** Four challengers under government policies were shown as significant - lack of government policies to support the industry, tax policies, political instability of the country, and corruption and favourism.

**Technology –** Four challengers under technology were shown as significant –low level of new technological development, inadequate knowledge, technology transfer, low level usage of IT.

**Management and Co-ordination –** Six challengers were shown as significant - cost planning, documentation management, time management, communication, progress monitoring, administrative issues.

**Research and Development –** Lack of initiatives, funds, opportunities and attitudes were identified as major issues for inculcating R&D culture in the construction industry.

**Resource –** Three resources were shown significant - lack of labour, equipment, and integration.

**Safety –** Six challengers under safety were identified – inadequate safety precautions, undefined specifications, improper implementation, limited funding, knowledge and lack of safety officers.

**Training and Development –** Limited allocation of funds for employee training, not enough training programmes, insufficient support from the institutions, currently practice grading system are shown critical.

**Social –** Three social factors are highlighted in the survey as poor health, hygienic and welfare facilities for the workers.

**Skill –** The construction industry suffers from inadequate supply of professionals, skill development programmes, less skill levels of fresh graduates and less skilled labour force.

From the second phase of the questionnaire, 13 motivators were identified and they were further grouped using factor analysis to explore further relationships. Five factors are extracted as follows,

*Factor 1*: enhancing skills and efficiency

*Factor 2*: adopting incentive awarding mechanism

*Factor 3*: imposing quality practices

*Factor 4*: improving professionalism

*Factor 5*: improving procurement strategies

## 4. Conclusions

The research revealed that currently, there are many problems faced by the construction industry in Sri Lanka. Sixty one challengers were tested and 46 are shown significant. Further, the research identified 13 main motivators to help construction industry participants to improve the performance. Among these motivators, the five important factors were established to enable the construction industry to enhance its image. They are: enhancing industry skills and efficiency, adopting incentive awarding mechanism, imposing quality practices, improving professionalism, improving procurement strategies. These findings will create a momentum to all who are in the construction industry to look back on their existing practices and performance. Further, the recommendations given by identified factors will provide a simple guidance raising the image of the construction industry.

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# Construction project teams and their development: the case in Sri Lanka

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*This paper discusses a new model of team development with regards to construction project teams in Sri Lanka. The model was developed by testing the Tuckman and Jenson Model (1977) in the construction context. It was revealed that construction teams undergo a team development process fairly similar to the model suggested by Tuckman and Jenson but, with some exceptions.*

**Keywords:** Construction teams, Sri Lanka, Construction industry, Team development.

## 1. Background

Teams are currently preferred by most organisations as an important management tool, in order to remain competitive in turbulent and challenging business environments. The construction industry is highly susceptible to benefit from teams as construction products are delivered by a collection of diverse professionals. Various researches have defined the term "team" in various ways. However, amongst the different definitions for team, the following given by Katzanbach and Smith [1] is one commonly cited:

> "a team is a small number of people with complementary skills, who are committed to a common purpose, performance goals and approach for which they hold themselves mutually accountable."

However, teams cannot be created at a stroke, and, they need time and the opportunity to mature [2]. In this scenario, the concept of team development is of paramount importance; and various models have been developed to represent team development. Amongst these models, the Tuckman and Jenson model (1977) (see Figure 1) seemed more appropriate for the construction context since, it is based on the fundamental assumption that teams has a finite life.

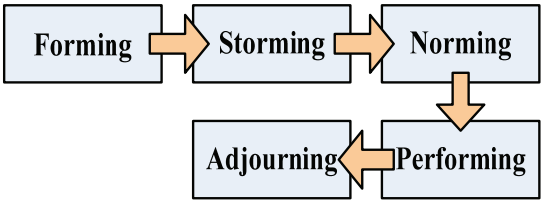


*Figure 1: Tuckman-Jenson model (1977)*
*Source: Rickards and Moger, [3]*

However, until now, no published research has been carried out on team development with regards to construction teams either in Sri Lanka or elsewhere. Therefore, this study explored how the construction project teams in Sri Lanka go through the team development process.

## 2. Method of study

The empirical study consisted of cases studies of three building construction projects, operating under the traditional procurement method with re-measurement contracts and, whose construction duration is more than one year. Data collection was mainly obtained by conducting semi-structured interviews with five key participants of the construction project team. The data gathered from the interviews was analysed by code-based content analysis. Finally, conclusions about the overall research problem were made by critically analysing the findings.

## 3. Research findings

### 3.1 Nature of the construction team

The empirical study identified that the construction team consists of the members from various disciplines. It was further evident that leadership and accountability of construction teams was significantly governed by contractual conditions. Most of the interviewees disclosed that they depended on other team members to higher extent when performing their tasks. The empirical data revealed that construction project teams were not much consistent throughout the life of the project in terms of the parties. The objectives of most of the members were in line with the project objectives. However, there were some situations where the contractors experienced some sort of conflict between the objectives of their parent organisation and the project objectives.

### 3.2 Types of teams in construction

Since, construction teams are geographically, temporally, and/or organisationally dispersed and use information and communication technologies to communicate, it can be viewed as a virtual team. Further, because construction team members have multiple reporting relationships, work together for a limited time and engage in various projects simultaneously, construction teams can be viewed as a cross-functional team as well. Finally, construction teams can also be viewed as inter-organisational teams due to their composition of members from various organisations.

### 3.3 Team development

Issues relating to team development with regards to Sri Lankan construction teams, were identified by testing the Tuckman and Jenson model (1977). The 'feelings and thoughts of the members' and 'observable behaviours of the members' at different stages of team development as suggested by Tuckman and Jenson were questioned during the interviews to understand the existence of each stage. The empirical findings disclosed that the Forming and Storming stages were not experienced by the construction team members to the same extent as suggested by Tuckman and Jenson. The basic linear sequence was almost identical to Tuckman and Jenson but, there were several cycles that existed within that linear sequence. These cycles were created by the conflicts that occurred when the team is at it's performing level. The entrance of new members at various stages of the project; and, major changes to the scope of work were identified as possible causes of these conflicts. The majority of the team members continued with those projects in which they were involved simultaneously; and, some were even assigned to new jobs after the adjourning stage. Since, the team in project B was repeatedly used in the next two phases of project B, they were involved in those two phases. However, the members from the other two projects mentioned that there was no formal arrangement in their projects to gain long-term benefits from the team.

Based on the findings of the empirical study, the Tuckman-Jenson Model (1977) has been revised in the construction context as shown in Figure 2. This can be presented as a new model of team development with regards to Sri Lankan construction teams.

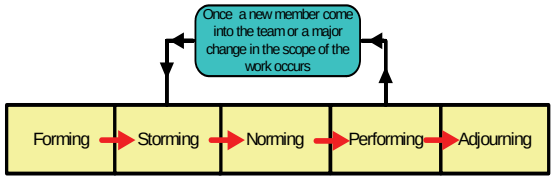


*Figure 2: Revised Tuckman-Jenson Model in the construction context*

## 4. Conclusion

It is clear that construction teams are somewhat different from the ideal teams mainly due to the lack of mutual accountability and common objective. Further, it is also evident that most of the key issues relating to construction teams such the leadership and the accountability were significantly governed by the contractual conditions. Construction teams also possess characteristics of virtual, cross-functional, and inter-organisational teams. Construction teams undergo a team development process similar to the model suggested by the Tuckman and Jenson (1977). However, exceptions existed due to the different forming and storming stages; and the existence of several cycles within the linear sequence. The team development model suggested by this study is important for construction team leaders to have better allocation of resources and leadership support for the team based on the specific challenges that they face in each stage of team development. After carrying out this research it appears appropriate that further research may focus on the team learning process of Sri Lankan construction teams.

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# From project-oriented to process-oriented risk management in construction

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*The paper sets out the results of a questionnaire survey and a series of interviews with clients, contractors and consultants involved in nine construction projects recently undertaken in Sweden. Despite the fact that risk management was a part of each project, many projects suffered from variations in cost for one or several actors. Risk management was not carried out systematically in those projects. Both identified and unforeseen risks often occurred in the projects and generally had a significant effect on the project cost. The objective of the study is to explore the factors that lead, more or less, to effective risk management in the projects. In particular, the involvement of the actors in risk management in individual projects is examined. Risk transfer and communication of risks between the project phases are explored. Finally, the factors that determine whether or not the actors consider an open discussion on risk management and risk sharing as beneficial are analysed. The main conclusion is that a shift from project-oriented to process-oriented risk management is required.*

**Keywords:** Risk management, construction, Sweden, process modelling

## 1. Background

According to a report of the Swedish Construction Commission [1], increased construction costs, project delays and deviations in quality are the most common problems in the construction sector. Risk management is a process that aims to maximise opportunities and minimise the consequences of a risk event and is an important part of the project management process. When considering the effect that risk management has on the project's goals in terms of quality and cost, it would be reasonable to expect that it was an open process across all phases of the project. However, it is often the case that the various actors try to avoid risks as far as possible and let somebody else in the value chain deal with them. Relatively little attention has been paid in the Swedish research community to deeper investigation of the possible changes in the traditional construction process in which each actor focuses on short-term economic results and protects his/her own interests rather than the whole project. The overall purpose of the paper is to examine project risk management in practice and to understand how project risks can be managed from the process-oriented perspective.

The study involves nine construction projects recently performed in Sweden. A questionnaire survey and a series of interviews of clients, contractors and consultants who employed risk management in a given project were conducted. The findings are based on 36 completed questionnaires and 18 interviews.

## 2. Results

Despite the fact that risk management was a part of each project, many projects suffered from variations in cost for one or several actors. Risk management was not carried out systematically in those projects. Both identified and unforeseen risks often occurred in the projects and generally had a significant effect on the project cost. In sections below we present the factors that lead to more or less effective risk management in the project.

### 2.1 Understanding of risk management

The majority of respondents have what might be described as a fair understanding or knowledge of risk management and did not have any special training in the subject. Experience within construction industry is the main source of knowledge. Many companies have a set of procedures to follow in the risk management process. The largest problem identified with the procedures is their complexity and documentation requirements. In the risk management process, simple tools are familiar to the respondents: checklists and brainstorming for risk identification; probability-consequence judgment in risk assessment; and risk transfer as a way to respond to risk. In practice, the use of theoretical tools was limited in the projects.

### 2.2 Participation in different project phases

There was a very low participation in the programming (planning) phase overall. In particular, no contractors participated in this phase of the projects. However, the respondents recognised that the early involvement of the contractor is important for effective risk management. It allows the actors to choose the best technical solutions, decrease costs and obtain a deeper understanding of the potential problems.

### 2.3 Risk identification, assessment and response

Systematic scrutiny of potential and possible risks in the project was identified by interviewees as a very important factor for successful risk management. However, in just one project were these steps in the risk management processes carried out systematically. The design and production phases are critical for risk management. Risk identification, assessment and response

were mostly performed in these phases. Despite the recognised importance of the programming (planning) phase, very little work in risk management was performed.

### 2.4 Risk transfer and communication of risks

The majority of respondents agreed that the risks always are transferred between the project's actors. Clients transfer risk to contractors because they believe that they, the contractors, have better ability to manage risks. The contractor transfers risks to the subcontractors and sometimes back to the client. The majority of contractors are convinced that the client tries to transfer all possible risks to the contractor. Despite the fact that risk allocation is formalised by general contract conditions, which are used in all projects, clients tend to make some changes and include special conditions which imply more risk allocated to the contractors.

The communication of known risks in the procurement phase was very low from both the client and the contractor. One group stated that it is a strategic choice not to show all risks in the procurement phase in order to keep the bid price at a lower level. The other group said that it happens because the actors, especially the client, are not aware of all possible risks. Both groups agreed that there is a need to change the situation. When risks are not communicated at a detailed level, the chance that they will occur is much higher and their consequences can impact more.

### 2.5 Joint risk management

In seven of the projects, the actors had good collaboration in risk management. The actors in two projects stated that there was no joint risk management. Most of the actors responded that collaboration existed in the risk identification and risk assessment processes. The risk response process had a lower degree of collaboration according to the contractors. They stated that contractors are usually forced to manage most of risks alone.

## 3. Conclusion

The findings of our research show that risk management is not carried out systematically in all phases of a project. The actors' participation in the risk management process is generally limited by their roles in the project. The absence of systematic risk management is especially noted in the programming (planning) phase, where it arguably has the greatest potential impact. The production phase is where most interest and activity is to be found. Unfortunately, this can easily prove to be too late in the day to mitigate some risks, including those that might have been avoided at an earlier phase. Whilst this is self-evident, scant attention to early identification of risks confirms this practice as commonplace. As a concept and matter of practice, the communication of risks between the actors simply does not work to the extent that it must if projects are to be delivered with certainty, irrespective of the form of procurement. If risks are to be properly managed, it is also self-evident that the risk management process must be present, transparent and activated within each phase. It is the lack of an iterative approach to risk management that is a weakness in current procurement practices and this aspect must be addressed if the risk management process is to serve projects and, thus, their clients. Implicit in this thinking is that the project's other actors will be better able to cope with circumstances that might threaten the time, cost or function of the project if they can be engaged in the risk management process from the outset. A shift from project-oriented to process-oriented risk management is required in order to manage project risks successfully.

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# Factors affecting the use of sustainable waste management practices in small and medium sized construction enterprises

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*Sustainable construction practices amongst all members of the building project production supply chain are being introduced in an incremental fashion. The paper reports work, funded by the Edinburgh and District Master Builders Charitable Trust, on the practices involved in site waste management amongst the industry participants located in Scotland. The findings from the study found that there was awareness of the significance of good site waste management and recycling practices towards the achievement of sustainability in building production but that overarching factors of organisational size, project specifics, time availability and costs were affecting many SMEs potential to adopt such practices.*

**Keywords**: site waste management, factors, implementation, SMEs

## 1. Background

Work that contributes either directly or indirectly to the implementation of change in the practices and approaches of the UK construction industry is at the core of built environment research. The broad multi-headed research agenda related to sustainability and its application, implementation and evaluation in the practices of the construction industry is well established and tackled by large scale publicly funded research initiatives. It is posited that holistic solutions that address issues across the themes of waste management, energy management, supply chain management and lean thinking are required to respond to the need to achieve cultural change. Nonetheless, individual small scale projects that focus on a single aspect of the sustainable research agenda can also make a contribution. One such study is reported in this paper. This paper reports on an exploratory postgraduate study that was funded by the Edinburgh and District Master Builders Charitable Trust. The work contributes to the agenda on sustainable construction by examining how small and medium sized construction enterprises (SMEs) in the Edinburgh region of the UK can best adopt sustainable practices within their work approaches. In particular, this work places emphasis on exploring factors affecting the implementation of site waste management and recycling practices as a means of making a contribution to the implementation of more general sustainable construction practices.

## 2. Literature review

The effective management of waste has been identified as one of the most important priorities towards achieving sustainable developments. However it is difficult to define waste itself as it is sometimes subjective. Wills, [1] gives a definition of waste as being, "Any substance which constitutes a scrap material or an effluent or other unwanted surplus substance arising from the application of any process; and any substance or article which is required to be disposed of as being broke, worn out, contaminated or otherwise spoiled". This situation is being addressed at high levels in the industry by the introduction of mandatory site waste management plans (SWMPs). There is some evidence of eco-management waste policies being developed at organizational levels and such policies are seen as being aids through which project stakeholders can act in a structured manner to assess construction site activities to ensure that they are carried out to an environmentally acceptable standard Yahya and Boussabaine [2]. These policies if they are to be successfully translated into changed practices should include site activities and encourage industry participants, irrespective of organizational type, size, and classification to focus on the importance of effective waste minimization and its benefits throughout the lifecycle of building asset design, production, and operation. Other work by Dainty and Brooke [3] has demonstrated that careful consideration of waste issues combined with effective education of the workforce and robust audit procedures have the potential to result in radical improvements to waste minimization performance. Denton [4] suggested that "pro-active companies which see the environment as a cost, rather than as a chance to gain a competitive advantage are perhaps missing the best opportunity to develop leverage and gain increased business". Accordingly it was resolved to explore the current practices prevalent within SMEs operating within the geographic area covered by the funding body.

## 3. Research approach and findings

Of the data collection approaches appropriate to this research strategy it was resolved to adopt a case study approach within which semi structured interviews were conducted with key project participants so as to optimise the collection of relevant data. As an approach this research strategy focuses on understanding the dynamics present within single organizational settings (business unit and project environment) and as such the results of the exploration are limited in terms of reliability, validity and generalisability as acknowledged by Amaratunga *et al*, [5]. The respondents interviewed were all industry professionals in the form of three construction managers, three directors of construction, and two site managers. The interviews were conducted and analysed in two waves (1-2) and (3-8).

The interviewees showed general enthusiasm when this topic was mentioned and most of the respondents were also aware of the recent introductions of the proposed site waste management plans by the government. It was the general view that a lot of these practices were already being carried out by their respective organisations. However the approach to waste management

practices were found to be varied. Some respondents highlighted the use of skips to segregate waste on site (which involved the classification of the different wastes generated on site and classifying these using criteria such as hazardous and non-hazardous materials). They also highlighted the use of waste management contractors who took the already segregated waste from their sites to be recycled and processed, and also identified the possibility of partnering with suppliers and sub-contractors in terms of returning packaging and the possibilities of returns of unused materials. They however highlighted that a major factor which affected the effectiveness of site waste management was the size and location of the site. It was found that the larger sized organizations in the study had a wider ranger of operations and not only practiced all the processes identified above but only used their waste management contractors as a last resort. A lot of the organisations in this size category had extensive waste management processes within the organisation which can be associated to recycling at various levels. An example was a respondent organisation who and sub-units within the organisation to reflect its activities; However it was highlighted that major stumbling blocks to the advancement of these opportunities for recycling was the issue of getting these recycled products accredited and approved by the industry. Also another constraint identified was time and cost implications of the recycling operations. A further factor identified as impacting on practice was that pressure on time could sometimes not allow for the proper segregation of these materials on site.

## 4. Conclusion

This small scale regional study has shown that there is general awareness of site based waste management issues and the impact that effective policies could make to the delivery of sustainable construction practices amongst the SMEs involved in the building project production supply chain. The study has revealed the impact that organizational size and project circumstances have on the opportunities to contribute in this area of the sustainable construction practices agenda. The study recognizes the potential that a knowledge based decision support framework could have on the opportunity to improve practice in this area.

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# The role of tacit knowledge in the construction industry: towards a definition

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*Different knowledge-based solutions have been proposed to overcome performance problem in the construction industry. However, the process-based solutions, enhancing personalisation strategies and interactions between construction workers to generate and share tacit knowledge, would be much more relevant to overcome KM problems in construction organisations. As the initial step towards the management of tacit knowledge, this paper examines the nature and importance of such knowledge in the construction industry. Based on research findings a definition for tacit knowledge is synthesised: understanding, capabilities, skills and the experiences of individuals. These are often expressed in human actions in the form of thoughts, points of view, evaluations and advice; generated and acquired through past experiences, individuals, and repositories; and utilised for the benefit of individual and organisational development.*

**Keywords:** Tacit knowledge, Construction industry, Generation and utilisation.

## 1. Background

Recent discussions on knowledge reflect on two perspectives: 'knowledge as an asset' and 'knowing as a process.' When knowledge is seen as a 'thing', codification strategies, which specifically disseminate explicit knowledge through person-to-document approaches, are considered; whilst personalised strategies, which specifically disseminate tacit knowledge through person-to-person approaches, are considered when knowledge is seen as a 'flow'. In the context of the knowledge economy, the utilisation of tacit knowledge is considered to be the real driver for the performance of the industry. As Nonaka *et al*., [1] defined, tacit knowledge represents knowledge based on the experience of individuals, expressed in human actions in the form of evaluation, attitudes, points of view, commitments and motivation. An understanding of what constitutes tacit knowledge would be central to its effective management.

## 2. Tacit knowledge

Organisations' knowledge resources can be described as an iceberg. The structured, explicit knowledge is the visible top of the iceberg, which is easy to find and recognise and therefore also easier to share. Beneath the surface, invisible and hard to express, is the momentous part of the iceberg. This hidden part applies to tacit knowledge resources in organisations. Tacit knowledge could further be classified into two dimensions knowingly: the technical and the cognitive dimension. The technical dimension encompasses information and expertise in relation to 'know-how' and the cognitive dimension consists of mental models, beliefs and values. The construction industry is characterised with on-the-job learning and experience. Kolb's [2] experiential learning model describes learning through 'doing'. Therefore, Kolb's four-stage cognitive model (experience, reflection, exploration and action) is embraced within this study to represent the cognitive process of the tacit knowledge generation and utilisation of construction employees.

## 3. Methodology

Due to the paucity of literature relating to tacit knowledge management, particularly construction industry related, it was decided to carry out pilot interviews to identify the nature and role of tacit knowledge in the construction industry. Four leading academics were interviewed who had extensive knowledge and experience in the subject areas. In addition, the case study approach was selected to investigate tacit knowledge management within a construction organisation. Due to the need of an in-depth, critical, longitudinal examination of the phenomenon, the single holistic case study design was preferred. The selected case study was a UK company employing nearly 8,500 employees, involved with buildings and infrastructure projects. The overall case study investigation included two phases: an exploratory phase and an explanatory phase. However, this paper reports the findings based on the exploratory phase of the case study investigation, where eight interviews, of employees representing different levels of the staff, were carried out. Interviews, both unstructured and semi-structured, were used as the main research technique for data collection. A combination of textual analysis and mapping technique were used as the main research techniques of data analysis.

## 4. Pilot interview results

The interviewees described tacit knowledge as the knowledge that resides within the 'knower' - i.e. the person - which is very sticky and messy, problematic to codify, transfer and share, and also difficult to exploit; which is attributable to the person's experience, exposure and context. According to them, examples of tacit knowledge within the construction industry can be related to project and organisational level, and also from senior management level to operational employee level. The

interviewees agreed that workers will fall back on experiences, friendship and collaboration when faced with real complex projects, as they are the first to know that IT is not working. They considered tacit knowledge as the key to the performance of the industry. Furthermore, interview respondents acknowledged that most of the KM initiatives within the construction industry have concentrated on explicit knowledge, whilst the necessity is for tacit knowledge.

## 5. Case study findings

Concepts were categorised into three aspects of tacit knowledge: what; how; and why. At operational level, understanding and capabilities, hence tacit knowledge, was more concerned with the internally focused activities of the company; whereas at senior level, it seemed to be more concerned with the externally focused activities. However, the ability to provide thoughts, points of view, evaluations and advice was apparent from all levels of employee. Sources of tacit knowledge acquisition included education, training, colleagues, repositories, and prior experiences, whilst new challenges and first time experiences were cited as main triggers for tacit knowledge generation. Overall, it was common among directors of the company to acquire tacit knowledge from external sources (seminars, workshops, training, peers), whilst internal sources (colleagues, peer groups, training, repositories) were widely used by operational level employees. However, reliance on prior experience, both internal and external to the company, was prevalent from all different levels as a source of tacit knowledge. Operational level employees' motivation to generate and acquire tacit knowledge was mainly driven by the desire to perform their tasks more efficiently. The directors' motivation to generate and acquire tacit knowledge was focused on enhancing effectiveness, innovation and business growth. Therefore in general, motivation to generate and acquire tacit knowledge varied from 'effectiveness focused drivers' at senior level to 'efficiency focused drivers' at operational level. However, personal development; through enhanced and broadened understanding, was cited by all levels of respondents as a major benefit from the generation and acquisition of tacit knowledge.

## 6. Discussion

The importance of such knowledge within the construction industry can be highlighted from two facets: due to the intrinsic characteristics of the construction industry, and the popularisation of the 'knowledge worker' concept. The importance of tacit knowledge to the construction industry was further highlighted by the pilot study interviewees. The exploratory phase case study findings added rich insights into different facets of tacit knowledge: 'what' constitutes tacit knowledge; 'how' can tacit knowledge be generated and acquired; and 'why' tacit knowledge should be generated and utilised. The pilot interview outcomes and case study findings provided rich insights on what tacit knowledge is in an organisational context, hence the following definition is synthesised: *Tacit knowledge constitutes understanding, capabilities, skills and the experiences of individuals; often expressed in human actions in the form of thoughts, points of view, evaluations and advice; generated and acquired through past experiences, individuals, and repositories; utilised for the benefit of individual and organisational development.*

## 6. Conclusion

Due to the intrinsic characteristics of the construction industry, the tacit knowledge of the workers and their social interactions gains an increased importance within the industry. As the construction industry is very much centred on tacit knowledge and the experience of construction workers, the industry is biased towards the process-based view of knowledge. Understanding what tacit knowledge is, and its generation and utilisation are central to its effective management.

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# The effect of contractors' learning on performance

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*It has been suggested that the contracting organizations can capitalize on experienced based learning, thus performance change is not simply incidental. There are good reasons to hypothesize that learning plays a part in performance improvement. The lack of reported studies in this regard prompted this study. Learning curves are used in this study to demonstrate the effect of contracting organizations' learning on performance. This involves fitting of longitudinal performance data with a number of well-established learning curve models. Data on performance was provided by a major public housing provider in Hong Kong. Applying the Least Square Curve Fitting Analysis, it was found that the collected performance data fit well with the 3-parameter hyperbolic model. It was found that some contracting organizations in the sample displayed performance deterioration over time until reaching the asymptotic performance level. This is in line with the underlying learning theory of the 3-parameter hyperbolic model.*

**Keywords:** learning effect, contracting organizations, performance

## 1. Introduction

Contractors are responsible for converting design into practical reality. As such their performance is a critical component contributing to the competitive advantages of a construction supply chain. In this context, there seems to be a general view among researchers that performance change of contractors is not incidental [1]. To certain extent, performance change of contractors has been described as an outcome of a subtle learning process [2-3]. Indeed, extensive research has also documented that learning may have positive impact on contractors' performance [2-3]. Nevertheless, such proposition has yet been backed with empirical evidence [4].

Nevertheless, such proposition has yet been backed with sufficient empirical evidences [3].

## 2. The research objectives

This paper reports a study which employs a quantitative approach to make learning effect, if any, observable by fitting longitudinal performance data with well established learning curve models. The analysis may help to deepen the understanding of the relationship between the performance and learning of the contractors. Furthermore, this provides an objective and quantitative means for the researchers to explore the possible learning dimensions that may affect the contractors' performance change.

## 3. Research methodology

Evidence for supporting 'performance change as a learning effect' was evaluated by the degree of fitness of the data in fitting six well recognized learning curve models: log-linear, 2- parameter exponential, 3- parameter exponential, 2-parameter hyperbolic, and 3-parameter hyperbolic models. The method commonly used for analyzing the fitness of performance data to a particular model is called Least Square Curve Fitting Analysis (LSCFA). This study employed the LSCFA to track the effect of learning from the performance data of contractors during the course of construction.

The historical performance data required was obtained from a system called Performance Assessment Scoring System (PASS). PASS has been implemented by the Housing Department in Hong Kong to gauge the performance of the contractors in the public housing projects since the early 90's. PASS scores from 38 public housing projects were analyzed by the LSCFA in this study.

MATLAB 6.1 is used as a programming tool for the LSCFA. Indeed, MATLAB has long been recognized as an effective tool to conduct least square curve fitting analyses. The 'polyfit' and the 'lsqcurvefit' functions of MATLAB are adopted to determine the fitness of the contractors' performance data to various learning curve models. Furthermore, 2–dimensional plots that illustrate the fitness of the learning curve models to describe the tested data in a graphical format are generated.

## 4. Results and Discussions

The results of the LSCFA indicated that performance change of the contractors from the 38 public housing projects in Hong Kong can be effectively described by most of the tested learning curve models. Nevertheless, a relatively unsatisfactory result was found when data sets were fitted against the log-linear model. In search for an explanation, the underlying bases of learning of the models are examined. The log linear learning curve model assumes a linear relationship between performance and time (i.e. the PASS scores are assumed to improve continuously with the same learning rate throughout the project) [5].

Nevertheless, in reviewing the data sets, it was found that contractors' performance change often flattened at the later part of the project. Such performance change pattern matches with the assumptions of the hyperbolic and exponential models. Organizations with these learning patterns would improve or deteriorate over time until reaching the asymptotic performance level [6].

The fitness of the PASS scores to be explained by the exponential and hyperbolic learning curve models in this study suggests that contractors' performance change is not incidental but has a learning element [7]. Furthermore, the 3-parameter hyperbolic model is identified as a comparatively 'efficient' and 'stable' learning curve model in describing the PASS scores. Further investigations on the theoretical bases which make 3-parameter hyperbolic model an appropriate model for demonstrating the contractors' performance change is recommended.

## 5. Concluding Remarks

Whilst studies were based on the perceptive views of the practitioners, findings from previous studies typically suggested that learning may have positive effect on contractors' performance. Research study as reported in this paper employed the LSCFA to track the effect of learning from the performance data of contractors during the course of construction. PASS scores from 38 HKHA projects were fitted to five well-established learning curve models. The findings of this study highlight some interesting patterns displayed by contractors who were subjected to regular performance assessment. PASS scores can be effectively described by the exponential and hyperbolic learning curve models. This indicates that performance change of a contractor may have a learning element. This study paves the path for further exploration on the possible learning dimensions that may affect performance change of the contractors.

## 6. Acknowledgement

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# SECTION IV

## EDUCATION

# Resourcing programmes in the built environment

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*This paper is based upon a survey carried out for the UK Heads of Department group, CHOBE (Council of Heads of Built Environment Departments). Its membership represents approximately 45 departments in the UK that offer programmes in construction, property and surveying. The survey was aimed at finding out the perceptions of these heads of department on a range of topics that influence the resourcing of these departments. The survey asked questions about staffing, students, curricula, research, accreditation and assessment. Respondents were also asked to identify the three most important issues facing these disciplines.*

**Keywords:** Departments, Education, Resourcing, Staffing, Students.

## 1. Introduction

CHOBE's vision is to support and represent with a voice of influence those with strategic responsibility for the development and delivery of these disciplines.

## 2. Staffing

In over half (55%) of the departments, there was no academic staff employed who were under 30 years of age. On average only 3% of the academic staff were less 30 years of age. At the other end of the age spectrum almost half (48%) the staff were over 50 years of age. Ten per cent were aged over 60 years of age. The average age of lecturers in CHOBE departments is about 48 years. A report (HMI, 1992) stated that the average age of built environment lecturers in the former polytechnics was 45. HMI (1989) showed an age profile for comparison with that of CHOBE departments in 2007. The data indicates fewer younger academic staff today. CHOBE Staff under 40 years of age are 22% (HMI, 27%). Today there are three times more staff over 60 years of age than in 1989 (CHOBE 10%, HMI 3%).

There are also difficulties in recruiting staff with the subject disciplines that recorded the greatest difficulties were building surveyors and quantity surveyors.

## 3. Staffing qualifications and experience

Experience of the industry and professional qualifications were the key characteristics and still are today. Surprisingly, over half of all the respondents felt no more than neutral about the research capability of staff and only a quarter rated it as highly important. This raises questions about the interface between teaching and research.

## 4. Students

The shift of undergraduate students from full-time or sandwich modes of study to part-time is most noticeable amongst quantity surveying students. Almost 40% of respondents stated this. Postgraduate education shows that there has been an increase in these programmes. The survey found that somewhere between 10-25% of students will have qualifications other than GCE A Level. Noticeable differences also exist between programmes that are full-time or part-time and across the different institutions.

## 5. Curricula

Departments' responses to Leitch (2006) indicate that most feel that they are already doing what is required. It was felt that employers already effectively influence the programme. Some are more interested in the intellectual capabilities rather than the knowledge base of their employees.

Universities have consistently argued that their main focus should be education. Professional training should be more properly provided through practice. One respondent suggested that universities should be able to develop the curricula that they feel to be the most appropriate. The interference, especially by professional bodies, was considered to be unnecessary.

## 6. Research and consultancy

Those departments that aspire to being more research intensive expressed different views to others who felt that applied research was a key direction for them. One respondent questioned the ability or desire of graduates from these undergraduate programmes to effectively undertake research. Over half of the respondents thought that the RAE had beneficial effects on both teaching and increasing scholarship. A quarter thought it was unhelpful and the remainder that it was not really applicable to them at the present time.

All the respondents thought that links with practice and industry were important in the context of ongoing staff development.

## 7. Accreditation

The survey asked three questions about accreditation. These were about the prescriptive nature of professional bodies, the possibility of common frameworks across the different professional bodies and the continued importance of accreditation.

## 8. Assessment

There was a distinct feeling amongst half of the respondents that assessments under some form of controlled conditions would be increased in the future. This was possibly due as much to the problems of plagiarism. Staff are finding that with the increase in student recruitment, assessment in its current form is becoming unmanageable.

## 9. Other Concerns

The four most identified issues were staffing, industry/education links, students and research. By far the greatest issue was staff. Ellis and Wood (2006) commented that half of all academics under the age of 45 had considered leaving academia. Other issues included; The cyclical nature of education, the recognition in universities about the importance of these disciplines, producing students who were fit for purpose and that these programmes straggle technology and business yet do not fit easily in to either.

## 10. Conclusions

Reading the foregoing could represent a view that all is doom and gloom, yet this is far from the truth. Whereas ten years ago many such departments were under threat of closure today the picture is very different where such departments represent a net gain to universities. But there are warning signs that departments need to address.

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# Academic Workloads and the Socio-Temporal Contract

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*Surveys carried out in recent years in higher education have shown staff suffering from high levels of stress with many finding their workloads unmanageable. This paper reports findings on workload allocation (WLA) practices in higher education based on sixty-two interviews across seven UK universities, two overseas universities and two other knowledge-intensive organisations. The focus is on the social aspects of the process through cross-case analyses of: the role of the Head of Department/School (HoD/S) looking at the consultation process and issues of equity and transparency. The paper concludes with a set of connected recommendations on consultation processes that could assist delivering allocations that are perceived as fair and are effective in practice.*

**Keywords:** Higher education**,** Workload allocation, Consultation, Equity, Socio-temporal contract.

## 1. Background

The challenges facing the HE sector have been much commented on (Middlehurst R 2004) with many pressures within it, not only from resource issues, but from factors such as the move to a mass market, tuition fee increases, and pressures from quality review systems. These have implications for academic leaders, heads of academic units and lecturers. Surveys have been done on academic staff looking at the effect of this pressure (Kinman G and Jones F 2004). Findings show many staff suffering from stress, with 69% agreeing or strongly agreeing with the statement 'I find my work stressful'. However, interestingly the psychological well-being measures used (Goldberg D, 1981,) showed surprisingly low correlations (0.12) with the average number of hours worked in term time (p63). Most pertinent to this study was that in answer to an open question on improvements to minimise work related stress one of the most commonly mentioned items was 'the need for a managed allocation of workloads and transparency in workload planning' (p47).

## 2. Methodology

Despite this problem the subject of workload allocation is a relatively undeveloped field. Out of the initial literature synthesis a loose framework of issues emerged surrounding the issue, but the approach had to be one of theory building rather than testing. Grounded Theory was chosen as being appropriate methodology to such a complex social issue, founded on multiple perspectives on a real world with an emphasis on theory building. Within this a case study framework seemed the most fitting way to capture the interaction between university and department/school level rather than interviewing discreet individuals, and with interviews the best method to capture the rich material. The universities themselves were not selected randomly, rather they were chosen to give a broad picture across the sector, so that size, geographical location and type of university grouping were taken into account. Further to help to get a broad view of the process the interviews were designed to cover a range of staff at each university.

The general procedures set out by Strauss and Corbin (1990) were used as guide. Case studies looking at the different phenomena within universities were written, followed by cross case analysis looking at each phenomenon across them. Cognitive maps were then constructed to show the relationships between these aspects. The study encompassed the technical aspects of workload allocation, covered in another paper (Barrett PS and Barrett LC 2007), and the social aspects of consultations involved in model development and maintenance, as well as the fine-tuning of work to individuals by heads of academic units. In summary the 'technical' aspects of WLA work in a continuum from: *informal models* relying on the HoD/S to share out work, *partial models* that put only some aspects of the work into a model, and *comprehensive models* that included all the main work types, of research teaching and administration, in their models.

## 3. Consultation and Equity

Heads of department/school (HoD/S) did feel workloads were high and felt that workload allocation (WLA) models were needed to help achieve equity. Most HoD/S felt that they had been consultative over the introduction of, or amendment to, WLA models, discussing aspects such as weightings for roles, although this process was not always successful. Even when there was consultation HoD/S noted how difficult it was to know all the issues, size of department was an important element here. Lack of time was often mentioned in relation to fine- tuning the allocation to individuals. HoD/S had often had no training about allocation systems. Staff interviewed seemed to generally have good relations with their Head of department and fairly high levels of trust appeared to be operating, although feelings on the system used were often less positive. The Head was pivotal to perceptions of trust and equity, rather than just the WLA model itself.

## 4. Relationships between factors

The cognitive maps created from the case study led to an understanding of how the various categories interacted and build to a broader picture of the mechanisms and relationships at play. A range of different maps were produced, for the map showing the HoD/s perspective there was a broad split is between 'hard' factors, such as the calculation and allocation of workloads, and

'soft' factors, such as transparency and equity. This finding was then reviewed using data from the case studies. Perceptions on equity and trust surrounding the HoD/S allocations were evaluated in relation to the consultation process involved in the development of a WLA model and also and the fine tuning of allocations to individuals and related also to the technical model types used.

## 5. Conclusions

It must be noted that the findings do not indicate any absolute values and work off comparative, subjective assessments of the researcher, looking across all the data.

- The actual type of technical model alone used seems to be relatively independent of beliefs on equity, as all three model types had cases showing positive perceptions on equity and trust at unit level, although only the informal model had any negative perceptions.
- However a far more complicated relationship appears to be operating beyond the technical aspects that involve perceptions about the HoD/S and areas such as fine-tuning or individualising the allocation, that is, the social aspects.
- The comprehensive and partial models did have higher positive perceptions of equity than the informal model with 57% and 50% respectively, compared to a 40% positive response in the informal cases. These tendencies might be related to more inclusive social procedures involved in the development of complex models. However as many of these systems were fairly recent, the permanence of this effect will need to be assessed.
- A longitudinal case study was carried out and this revealed that the consultation and fine-tuning process had been neglected in the years after the model had been developed and that this had had some adverse effects on perceptions on equity.

Despite the variety in practices there was broad agreement on ideal principles in relation to these methods, for example on equity and transparency. The findings suggest, irrespective of the technical model used, that consultation processes play a large part in forming perceptions on equity. A set of recommendations are made covering both university level, on aspects such as policy and training for HoD/S, and at academic unit level covering consultation approaches such as the use of pilot studies and the informal monitoring of workloads especially at peak periods. This approach could facilitate a wider understanding of the social dynamics involved in allocating work and could form the basis of a *Socio-Temporal Contract*, where work is not viewed in just the one dimension of time, but rather as part of a richer network of relationships that require attention. This type of approach with a broad understanding of what is fair and reasonable built up across the department (the "socio" part) and supported by a consensually agreed model could assist in delivering allocations that are perceived as fair and are effective in practice.

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# Accelerating Innovation in the Built Environment by Research and Education in UK

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*Awareness of climate change and adaptations of building stock play a key role in the UK government's environmental agenda. While funding remains a major constraint research show that a number of detrimental issues and the unexploited markets are major contributing factors. Most of these barriers can be overcome with research, development and information and knowledge transfer techniques. Educating all stakeholders can act as an accelerator for innovation. This paper examines innovation in the built environment and how research and education can stimulate this process. It presents lessons learnt from two action research projects in relation to innovation.*

**Keywords**: Research, Education, Innovation, Built Environment, Accelerators of Innovation

## 1. Background

The current UK government believes that climate change is the greatest long-term challenge facing the world today [1]. This paper examines some key issues that are important in accelerating innovation in the built environment and how research and education can stimulate this process. It briefly looks at the process of innovation, explores drivers and barriers and how research and education in construction, design, engineering and project management can enhance this process. The paper summarises lessons learnt from two EPSRC funded research projects to illustrate factors that promote or hinder innovation. The discussion examines the accelerators of innovation in relation to education and research, the role of the professional and research organisations and the crucial role played by the correct mode of dissemination. The role played by the government in focusing attention on new opportunities for innovation and an organisations capability in absorbing research into practice are also discussed.

## 2. Innovation in the built environment

Innovations in the built environment are often a complex blend of government, business, and market and consumer decisions. The main rationale is economic benefits related to cost reduction and quality improvements. Other rationales include tackling environmental and structural problems and achieving public policy objectives. Innovative processes can be easily adopted in new construction and the complex problem lies with the existing built environment. The UK has a fairly mature building stock which must be taken into account if a significant change in environmental performance is to be achieved. New buildings only add between 1-5% of the total building stock each year [2]. Intelligent application of advanced 'smart' facade technology in conjunction with innovative environmental systems can result in significant energy savings and at the same time, improvement of indoor comfort.

## 3. Lessons from two research projects

Project one (Monitoring Egan compliance in social housing in UK, 2001-2004) monitored a consortium of Register Social Landlords established to provide innovative high quality housing designed and procured in line with the principles set out in the Egan Agenda (1998) [3]. The research methodology was based on case study monitoring, action research and a range of questionnaire surveys. Key lessons learnt from the initiative were: The importance of commitment of all parties; Level of demand had to be ensured and risk management processes in place prior commencement of project; Changed mindsets at all levels within the organisations, The importance of training at all levels, Communication and co-ordination which lead to continuous improvement. Even though the government encourages initiatives, such as that monitored in the research study, there is little flexibility in support systems to assist in sustaining them. A major drawback of the project was that, a continuous improvement process which would feed information from the site and different stakeholders who were involved with the project, was never implemented.

Project two, SUE-IDCOP (2004-2007) programme is responsible for providing the fundamental knowledge to underpin the improved sustainability of existing buildings. The overarching aim is to find ways to improve the performance of existing building envelopes which reduce the consumption of non-renewable resources over the whole building life-cycle in a way that is economically viable and socially acceptable. The results illustrated that: Value for money is a major governing factor in employing innovative environment technologies and the benefits should outweigh the costs incurred. The technology should be proven and fully demonstrated. There are quite a lot of products and systems in the market but very little information about their long-term performance, durability and ways in which they can directly reduce cost. Confidence levels in the new products are low due to high costs in demonstration projects and occupants and organisations are reluctant to take the risks.

## 4. Factors that affect innovation

1) Organisations and their structure have a major influence in the innovation process. The commitment of all parties, a changed mindset and better communications between all levels were crucial requirements to make the initiative a success. 2) The

construction industry has a serious shortage of skilled labour and a skilled workforce is critical to an organisation's ability to innovate. Training and education are essential in the development of a skilled workforce. 3) Risk is one of the main barriers to innovation. 4) Financing innovation has always been a key problem. Small and medium companies find it hard to invest in research and development and hence break into new markets due to financial constraints. 5) The construction industry is heavily regulated by national and local regulations governing land use and planning, infrastructure and buildings. Literature reviews, experiences from the industry and research, indicate that regulations can be a major barrier for innovation.

## 5. Accelerating innovation

Educating all stakeholders and the role of professional institutions are important as professional expertise and skills play a crucial role in supporting the Governments agenda to promote sustainable development. Academic research aim to create new knowledge, but little is done about how research could be put into practice. The objective of the UK's EPSRC, is to generate new knowledge that helps to improve and underpin industrial competitiveness and the quality of life, in collaboration with research users of all types. Dissemination is a key factor in benefiting from any research and development activity. Governments can enhance or slow innovation and incentives in terms of tax benefits and funding can facilitate the innovation process. Science and technology companies usually invest more intensively in R&D than most construction organizations. By other industries' standards investment by government and construction firms in R&D is very low, particularly in the UK; this is not the case in some other countries such as France, Japan or Scandinavia [5]. When faced with the prospects of technological change, the majority of construction firms are recipients of innovation first exploited in other sectors, or by a few construction market leaders. Even when a firm has the technical competence to absorb new ideas, it may not have the internal structure, systems and cultural attributes necessary to capitalize on research results.

## 6. Conclusions

Promotion of renewable energy and innovative environment technologies are essential to meet the environmental targets set by the government. Government support mechanisms in terms of resources, incentives, providing opportunities and access for local and international markets, training and information sharing mechanisms all can foster innovation. The drivers of innovation are economic benefits, performance improvements, environmental upgrading, research, development and information and knowledge transfer techniques and access to markets. Risk is one of the main barriers to innovation. The accelerators of innovation are education, research, development and information and knowledge transfer techniques. Government has a key part to play as a sponsor of higher education, academic research and as a facilitator in bringing academic research and industrial practitioner communities together in collaborative research projects.

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# Knowledge transfer in engineer's business education

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*Management for engineers is a form of additional education, because it provides knowledge and skills that enable engineers to master business processes more easily, and to adapt to globalisation processes more quickly and painlessly. In 2002, the International MBA in Construction programme was launched at the Faculty of Civil Engineering, specially designed and adapted to the construction industry's specific needs, as "general" MBA programmes are not always suitable for engineers holding managerial jobs in companies and/or in construction projects. Problems that have emerged from the introduction of the programme are presented as well as the suggestions for the new teaching methods and the new approach to knowledge transfer in construction management.*

**Keywords:** Education, MBA, Construction

## 1. Introduction

MBA started its life as an "élite" business qualification for potential leaders and senior managers. The title "Master of Business Administration" stems from times when senior management practice was concerned with administration. It started out as an American, then Anglo-American, qualification and in the 1960s it was adopted in Europe. MBA programmes and curricula have developed along "capitalist" market principles and represent a Western interpretation of management and leadership. All MBA courses, according to Kempner (see Kretovicz), have the same objectives: "to develop managers who will run efficient, profitable enterprises in a competitive world for the creation of wealth in society". Boyatzis [2] see the objective of graduate management education as preparing people to be outstanding managers and leaders.

## 2. Why an MBA?

Today MBA is allegedly a global qualification, taught all around the world and also delivered by e-learning, so it is globally accessible. MBA courses and their methods of delivery now differ enormously. There are one-year and two-year degrees, full-time and part-time degrees, campus-based versus distance learning MBAs, "consortium MBAs" with foundation companies, single company programmes and others, including action learning approaches. Should MBA be offered with specialisations, for example, to address certain niche markets (e.g. an MBA in Health Sector Management, or an MBA in Marketing), or should it remain focussed on a generalised, all-round curriculum supposedly applicable to everyone? At the moment, none of the answers to these questions are clear as conflicting views are held both within and between institutions, and for and against the MBAs.

## 3. MBA in construction? Who needs it?

When it comes to the construction industry, the MBA programmes offering "general managerial training" have to be modified, as they are not entirely appropriate for the needs of construction managers. Construction differs fundamentally from all other industries, because in a "normal" industry the product changes its place and the production factors (people and machinery) are static. In construction it is the opposite – the product (the site, the building under construction) is static and does not change its place. When the "production process" is finished "the product" stays where it was made, while the production factors (people and machinery) move on to the next location – to the "next product". The demand for multidisciplinary and interdisciplinary programmes is progressively increasing. H. Fayol [5] speaking generally about the knowledge necessary for managerial work, as early as 1949, established the correlation between technical and other general (economic, sociological, managerial and other) knowledge for various job positions in the management hierarchy. The percentage of "general knowledge" grows as one climbs up the managerial ladder. Through years the perception of manager's functions has changed. More and more civil engineers and other technical graduates are aware that they need additional education in the "management field" and the demand for multidisciplinary and interdisciplinary knowledge is progressively increasing.

## 4. The case – MBA in construction at the University of Zagreb

The International MBA in Construction programme started in February 2003, as a TEMPUS project of Zagreb University (Faculty of Civil Engineering and Faculty of Economics), in cooperation with partner institutions from the EU - Great Britain, Germany and Slovenia. In two generations 44 students enrolled. The average student's age at enrolment was 32, and the average duration of their previous work experience was 5 years and 4 months. Enrolment requirements included the GMAT, which course participants had to pass. The syllabi were classed in three groups [3]: general business management subjects, economic subjects, construction subjects.

The greatest "shortcomings" of the course were: the **duration of studies**, requiring student's absence from work, which employers did not accepted easily; the **dislocation of teaching** (lessons are delivered at the University of Zagreb's Centre for

Advanced Academic Studies in Dubrovnik) which in the employers' opinion, only increases the expenses of the study course – airplane tickets, student accommodation, expenses for food - without providing any visible.

## 5. The new approach – e- learning vs. traditional teaching

What is the "best" way to receive knowledge for our student being a civil engineer or similar, working within the construction industry or related to, 30 – 40 years old, already middle ranked manager, usually with a family, and with no time to spare ? How to maintain the continuity of good quality university education and at the same take into account the reality of the lack of time for education is a problem that faces not only students and their future employers, but in the first place university teachers, who are expected to be the bearers of knowledge transfer.

There are real problems in finding the right staff and probably the only solution for the future is distance learning particularly for the programmes like our MBA in Construction whose "customers" are ambitious executives with willingness and funds, but no time. Comparing e-learning vs. traditional learning Kathawala [4] used SWOT to analyse distance learning MBA programmes and emphasis on the following:

*Hybrid e - learning* proposed in this paper is to introduce a modified e-learning knowledge transfer to next International "MBA in Construction" generation of students at the University of Zagreb. All students and teachers will gather at the beginning of the first semester in CAAS in Dubrovnik for 10 days and there they will become familiar with the syllabi, teachers, programme content etc. Then they will separate and continue to communicate via e-mail (online education, exams). At the end of the third semester they will come together for another 10 days to solve all current problems and to define and finalise the material for the master thesis.

## 6. Conclusion

Modern education implies contemporary teaching programmes, methods and competencies of knowledge transfer as an essential precondition for the development of higher education and of society in general.. The online education is a fast growing business and its growth is supported by the competitive advantages the online education has, and the potential opportunities for students, professors and universities. But Universities have to be careful in offering these programs, as it requires a substantial up-front investment and continuous technical support and lot of efforts from the teaching staff to maintain the required quality of delivered MBA programme.

Being aware of the threats and opportunities of online learning a modified online learning,, so called *hybrid e- learning* to our future International "MBA in Construction" programme has been introduced.

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# Performance measurement in construction research & development: The use of case study research approach

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*The process of finding solutions to the research problem does not follow a clear sequential approach, but often take unexpected turns due to the uncertainties of the research process and its outcomes. However, appropriate research design would be able to identify any problems and pitfalls that the researcher may come across during the research process. In this regard, consideration of the research philosophy pertaining to the study helps a researcher in choosing the appropriate research approach for a study. Not only the philosophical stance, but also the research problem under investigation and its underling circumstances influence the selection of a research approach. Accordingly, this paper discusses the factors which persuade the selection of case study as the research approach with particular reference to the use of single case study to do an in-depth inquiry regarding the impact of performance measurement towards construction research and development. Further, the paper discusses the incorporation of multi-phase, multi-perspective and multi-method approaches within the single case study to build valid theory.*

**Keywords:** Interpretivism, Single case study, Performance measurement**,** Research approach, Research and development.

## 1. Background

Research and development (R&D) activities play an important role within the construction industry by developing advanced and new construction materials, processes and management methodologies to successfully address its stakeholder needs. However, there are number of issues which hinder the effectiveness of construction R&D activities. It was revealed that, to address the issues within construction R&D, effective control and monitoring mechanisms are needed [1]. Thus, this study suggests the implementation of Performance Measurement (PM) within the construction R&D function to enhance its success (see [1]). The utilisation of PM systems within the construction R&D function would generate benefits including: evaluating the success of R&D activities; identifying the future improvement areas and required support for such activities; the proper allocation of resources, and improved communication, coordination and direction of employees towards common goals [1, 2]. Through the literature, it was identified that the concept of PM within construction R&D is not adequately exploited. Therefore, this study intends to address the gap in construction R&D with particular reference to its PM application.

## 2. The research methodological design

To design the research methodology logically and systematically, the researcher used Kagioglu et al's [3] hierarchical model. This model nests the research philosophy, approach and techniques where the outer ring "guides and energises the inner research approaches and research techniques" [3]. Interpretivism can be identified as the most appropriate research philosophy for this study. In terms of the research approach, a case study approach was selected based on the philosophical stance, research requirements, research questions, contemporary nature and by considering the added benefits.

### 2.1 Case study design

As stipulated by Yin [4], case studies can be broadly divided into multiple and single and then depending on the number of unit of analysis, embedded (more than one unit of analysis) and holistic (one unit of analysis). The study under consideration falls under the critical case as it sought to develop and refine a theory on the impact of PM towards construction R&D. The researcher argues that to develop a valid theory, it is important to apply it to the existing situation and refine it. Thus, by taking the critical view, the abstracted concepts will be applied to the existing situation (i.e. the R&D function) and refine it. Furthermore, this study takes a longitudinal approach as the phenomenon under consideration i.e. PM within construction R&D function is a dynamic process. One of the objectives of the study is to develop a Performance Measurement System (PMS) which could be used to identify the impact and influence of PM towards construction R&D function. To identify the actual impact of PM in construction R&D function, the PMS developed through the study needs to be tested on a R&D project, over a time period. Nevertheless, when considering the scope of a PhD, testing the PMS on a R&D project is not practical due to the life span of R&D projects. This is considered as a limitation of this study. As an alternative, it is expected to present the developed PMS to a group of experts through a workshop during the theory refinement stage of the case study, and thereby to assess the impact and influence the PMS could provide to R&D function.

The next rationale for the selection of single case study is based on the depth of coverage from this study. Generally by using multiple case studies, a researcher can increase the breadth of a study. However, the single case study provides the opportunity to explore the phenomenon in detail. Though single case studies are often being criticised for not generalising conclusions, many authors argue that the number does not matter as far as the case study addresses its stipulated objectives [4, 5, 6].

### 2.2 The case study process

The case study took multi-phase approach which consisted of three stages of data collection. The first stage took an exploratory nature by investigating the current status of construction R&D, application and need of PM within R&D, and exploring the success factors of construction R&D in general. For this semi structured interviews were carried out. The second and third stages took on an explanatory nature. Accordingly, during the second stage, the critical success factors of construction R&D function was established by administering a questionnaire survey. The data from the first and second stage lead to the development of the PMS to identify the impact of PM towards construction R&D. During the third stage, it is expected to refine the theory developed through the case study and to suggest solutions for effective PM within construction R&D function.

## 3. Conclusion

The paper explored the use of single case study research approach to evaluate the impact of PM towards construction R&D function. It was revealed that the proper understanding of the philosophical issues followed by a clear definition and design of research strategy are essential elements in developing successful research. Through the use of single case study, the paper emphasised that what matters is not the number of cases, but the appropriate design and selection of methods to investigate the research in question. Therefore, it can be concluded that the application of single case study to investigate the impact of PM in construction R&D function by incorporating multi-phase, multi-perspective and multi-method approaches will enable us to build up a valid theory due to the continuous comparison of empirical data with the study's initial concepts (propositions) and the refinement of the developed theory within the same case study.

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# The Effect of Language of Instruction on Course Results for Civil Engineering Students in Estonia

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*Education globalisation is a reality today. Students from different countries can participate in exchange programmes in universities worldwide. However, this makes sense only if students understand the language of instruction. For large and industrialised nations there is no problem, they teach in their native language and there are always foreign students who can understand the course content. Developing countries and small nations face a more complicated situation: they can choose to teach in an internationally recognised language or in their native language. Both solutions have their advantages and disadvantages and in both cases a large number of students pursue their university education in a foreign language. The research is intended to examine whether language proficiency represents a significant disadvantage for engineering students who do not learn in their mother-tongue. This paper describes research into the performance of Russian-speaking civil engineering students relative to their Estonian-speaking counterparts at the Tallinn University of Technology. Results over eight years for a course taught in the Estonian language are compared to determine whether any trends in the relative performance of students from the two main language-cultural groups and also genders are perceptible. In addition, comparison is made with students' results for a course taught in English in the 2006/7 academic year to provide an indication of the effect of Estonian language knowledge on course results.*

**Keywords:** Engineering education; education globalisation, influence of language; influence of gender

## 1. Introduction

Estonia has a Russian-speaking minority which comprises approximately 30% of the total population. Throughout the Soviet era, education was provided separately in both Estonian and Russian languages but, after the restoration of independence in 1991, Estonian has been the only official state language and, the principle language in state universities is Estonian.

At Tallinn University of Technology (TUT) civil engineering students are taught separately in Estonian and Russian for the first two years. From the third year, students are taught in a combined group in the Estonian language.

In addition, recent years have seen a growing number of courses at TUT being offered in foreign languages (particularly English) and both Estonian-speaking and Russian-speaking students are increasingly being called upon to undertake some of their studies in these foreign languages.

## 2. Problem Definition

Two specific language-related questions arise from recent developments and anticipated future trends:

How has the change to Estonian language tuition affected students whose home language is not Estonian?

How might the increasing tendency to provide modules in foreign languages impact on the performance of students?

## 3. Basis of Research Approach

Numerous factors have been found to affect student performance including: language, gender, ethnicity, culture, aptitude, past performance, prior education and experience, age, attendance (full or part-time) and financial considerations. Findings from previous research in Estonia include that performance differences exist between language-cultural groups and genders and, also, that non-Estonian students taught in Estonian schools perform similarly to Estonian students.

## 4. Methodology

This study compares the performance of Estonian-speaking and Russian-speaking students in a Building Technology course:

for 2 years when the two groups received separate instruction in Estonian and Russian languages, and,

for 6 years after the change to all students being taught the course in Estonian.

In addition, the study compares students' results in the Building Technology course (taught in Estonian) to those in a Project Management in Construction course which was taught in English.

## 5. Results

*Table 2: Average Course Results*

| Group | Average results, % | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | '99 | '00 | '01 | '02 | '03 | '04 | '05 | '06 |
| **a) Building Technology Course** | | | | | | | | |
| Est-F | 79 | 81 | 89 | 59 | 69 | 85 | 72 | 77 |
| Est-M | 71 | 83 | 83 | 79 | 77 | 78 | 78 | 75 |
| Rus-F | 77 | 87 | 83 | 73 | 66 | 59 | 69 | 57 |
| Rus-M | 73 | 80 | 70 | 60 | 67 | 58 | 64 | 62 |
| **b) Project Management in Construction Course** | | | | | | | | |
| Est-F | - | - | - | - | - | - | - | 74 |
| Est-M | - | - | - | - | - | - | - | 76 |
| Rus-F | - | - | - | - | - | - | - | 65 |
| Rus-M | - | - | - | - | - | - | - | 58 |

## 6. Analysis and Interpretation of Results

By analysing the results obtained by individual students comprising each language-cultural and gender subgroup, the statistical significance of the relationships under investigation were tested. The change from instruction in separate languages to Estonian only was found to have negatively affected the performance of Russian-speaking students. A similar difference in the performance of Estonian-speaking and Russian-speaking students was observed for the Project Management in Construction course.

A linear trendline superimposed on the performance differences calculated for the years 2001 to 2006 would indicate that the performance difference has tended to increase over time. It is also evident that the performance differences between the groups which were negligible in 1999 and 2000 are considerable from 2001. Interestingly, the performance difference calculated for the Project Management course results in 2006 is 24.1%, very similar to that shown below for the Building Technology course in the same year.

## 7. Conclusions

This research indicates that students' performances are dependant on their proficiency in the language of instruction and decisions concerning the language of tuition at universities have a profound effect on knowledge transfer to students.

## 8. Recommendations

A more thorough investigation of these performance differences in TUT civil engineering courses is called for.

Instruction in basic and core modules of the civil engineering curriculum should be maintained in students' native languages and, where this is not possible, language support should be provided.

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# A Change in Perspective for Construction Management Education

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*Competency-based training has become synonymous with training per se. It has had a particular and major impact on vocational education and training, and it is unsurprising that professional associations have moved to adopt competency-based accreditation of study programs in construction management. However, this paper will argue that the nature of university education, the constraints on course structure, the traditions of teaching, etc. collectively militate against effective competency-based educational models. At the same time, there are significant questions being raised against the promotion of competencies as an effective measure of professional education. Educational providers, legislators, and professional associations each tend to disagree about what competence means and what the nature of expertise actually is.*
*This paper will draw on the emerging concepts of transformative learning, to propose perhaps a more radical response to what appears to be an ongoing (and ultimately losing) battle to condense construction management programs further and further. The conceptual framework it presents will range across reflective and deliberate practice, situated learning, disciplined awareness, and the ontological structure of disclosure. In essence it calls for a displacement of competency and knowledge as the primary drivers of vocational degree programs in construction management. Instead it argues for a more psychosocial approach to learning, where content is replaced with process as the driver of learning.*

**Keywords:** Education, Transformative Learning, Competency-Based Training, Case-in-Point

## 1. Competency-Based Training

Competency-based training (CBT) has revolutionised vocational training, and now features prominently in workplace training and across the school and TAFE education sectors. One of the most apparent consequences of a CBT-based accreditation process has been a relentless increase in the range and scope of competencies being identified. Program amalgamations have combined what were traditionally separate disciplines into the same program of study. In Australia almost all quantity surveying and building degrees have now been amalgamated in this way. The combined competencies for both quantity surveying and building professional accreditations then have to be contained within a single program. More and more content is being included in/imposed upon the same program structures.

At the same time, teaching traditions have tended to focus on lecture-based presentation and delivery of the content. Changing pressures of larger class-sizes, reduced contact time, lower staff-student ratios, etc. each make it more and more difficult to support competency-based training and assessment. A crisis appears to be developing around CBT in the higher education context. In very broad terms, industry is not satisfied with the levels of competency that Universities currently produce, academic staff do not have the same depth of industry experience as their predecessors, degree programs are already packed with content and do not have the space to accommodate a full suite of professional competencies, and today's students are tending to be motivated to learn only that particular mix of competencies tailored to their individual career aspirations. The strong growth in demand for education is in terms of the graduate attributes associated with dealing professionally with disruptive challenges: problem solving, team work, ethics, creativity, resilience, leadership, etc. These have a very different focus to the bulk of competencies listed by professional associations, and are exceptionally difficult to contain in a competency-based approach to learning. Another approach is called for.

## 2. Transformative Learning

The notion of transformative learning, originally proposed by Mezirow [1], seeks to address the process of change involved when students move from a schooling context to a working context. It is particularly focussed on the more fundamental, personal aspects of this change: moving beyond the learning of facts and information; to learning/identifying the framework of personal values and attitudes within which facts and information are interpreted; to challenging and changing the personal worldviews, value frameworks and 'habits of mind' that drive and constitute our (learning) behaviour [2].

It is notoriously difficult to teach personal transformation, particularly in the context of an undergraduate degree program at University. It is certainly so when operating within the paradigm of teaching that presumes learning to involve knowledge transfer, and to revolve around a process of reading, lecture, expert presentation, formal discussion, note-taking, exams, etc. Teaching based on knowledge transfer is very different to teaching based on the preparation of students to exercise the judgement and skill needed to bring that knowledge to application in practice. It is different again to teaching based on the promotion of self-awareness and the capacity to operate effectively in the face of an adaptive challenge. The role considered for transformative learning in this paper is with regard to this latter teaching ambition.

How might teaching based on the promotion of self-awareness and the capacity to operate effectively in the face of an adaptive challenge be taught to a reasonable large, undergraduate class? A particular approach currently being applied and explored by the author is a technique that uses the classroom as a case-in-point. Case-in-point teaching is an approach to teaching developed by Ronald Heifetz and his colleagues at the Kennedy School, Harvard University [3]. It essentially draws from the expectations, situations, feelings, dynamics, behaviour and discussions that occur within the classroom setting, as an immediate experiential reference point for discussions and reflections on transformative learning [4]. The author has recently taught a

project management course to 160 first year construction management undergraduate students using this case-in-point approach, to surprising good effect.

Case-in-point articulates a rich assortment of terms, each introduced in response to some immediate experience. It has generally been applied to the teaching of leadership, precisely the adaptive leadership needed when responding to complex and uncertain situations, such as those following a catastrophic event. However, the nature of the transformation required to learn how to practice adaptive leadership, is fundamentally no different to that required to improve self-knowledge, become more mindful, autonomous, reflective, able to deal with change, creative, socially responsible, ethical, etc. In other words, here is a teaching process that does emphasise graduate attributes. Less dependence on professional competencies would free space in the programs to include more explicit case-in-point teaching, and thereby more effectively promote graduate attributes.

## 3. Conclusion

This paper has proposed an alternative emphasis away from competency-based training, towards a more transformative learning. Transformative learning is presented as a psychosocial approach to learning, where content is replaced with process as the driver of learning. The psychosocial moves the focus of education away from the individual learner gaining a discrete body of abstract knowledge, acquired and subsequently applied in practice. It treats learning as an interpretive process in which understanding is related to action contexts, and not to prescribed conceptual structures.

A particular method of teaching transformative learning has been identified. The case-in-point method mixes a naming and framing of particular situational features with a sensing, letting-go and presencing approach. Where this is generally applied to teaching adaptive leadership, it is beginning to be applied also to more direct teaching of particular graduate attributes. It is the broad contention of this paper that teaching a full spectrum of professional competencies (in construction management, for example) is untenable in the current University context. A substantially scaled-down set of such competencies, complemented by more explicit teaching of graduate attributes, would appear a more attractive proposition in the current market context.

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# Acceptability of lean concepts to functions of quantity surveyor in Sri Lanka

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*'Lean' is a newly addressed concept for the construction industry and the core of this concept is segregating construction activities into Conversion Activities and Flow Activities. In addition to the processes, lean concepts can be adopted to the activities of professionals such as the quantity surveyor to increase the effectiveness and efficiency of his functions. This study explores the acceptability of the Lean Concept within the functions of the quantity surveyor in the Sri Lankan context, through an expert opinion survey using Delphi Method. The research finds that Sri Lankan quantity surveyors accept the core principles of 'lean' and recommend it as a methodology to be adopted.*

**Keywords:** Contracting quantity surveyor, Flow activities, Kaizen, Lean concepts, Sri Lankan construction industry.

## 1. Background

The construction sector encompasses a wide spectrum of activities including the provision of professional and technical services (Hosein and Lewis 2005 cited in [3]). While providing them, the construction industry is still renowned for chronic problems such as low productivity, insufficient quality, time over-runs and poor safety, which hinder customer delivered value (for example, see Loughborough University press release 2005).

Among the professionals involved in the construction process; to perform, avoid these issues, and provide a good quality service the quantity surveyor plays a major role. Through the QS work, various problems such as low productivity, insufficient quality, poor coordination and high expenses [2] can be associated with the quantity surveyor, and any other construction professional.

In the beginning of the 1990's, a new production philosophy, which is known by several names (world class manufacturing, lean productivity, new production system) was adapted from Japanese manufacturing principles of Lean Thinking and Lean Concepts, aimed at providing solutions for such chronic problems as arise in the construction industry. The core of it is in the observation that there are two aspects in all production systems: Conversions and Flows. Conversion activities produce tangible outputs whilst flow activities bind such conversion activities together during the delivery process of the outputs. Although all activities expend cost and consume time, only conversion activities add value to the material or piece of information being transformed into an output. Thus, the aim is to reduce or eliminate non value-adding flow activities and to make conversion activities more efficient [3].

Lean concepts can be adopted to professionals' activities in the construction industry. Considering the current status of the construction industry in Sri Lanka, this concept seems productive and effective, timely and appropriate at the outset. Still, since any type of application may need to be customised to better suit the local setting, the acceptability of Lean Concepts to role of the quantity surveyor in Sri Lankan context, is indecisive. Therefore, the essentials of this new philosophy should be explored in the domestic environment in order to test its acceptability to Sri Lanka, before any application. It seems necessary first to be clear on a main area of focus in Lean Concepts - such as the prevalence of non value-adding activities - in the profession of Quantity Surveying.

## 2. Acceptability of Lean Concepts to QS

Before applying the concept, 'Lean' should be analysed to check the acceptability as the core principles of are the elimination or minimising of non value-adding flow activities and thus making conversion activities more efficient. Other principles include: increased output value through systematic consideration of customer requirements; reduced variability; reduced cycle times; build continuous improvement into the process; simplify/minimise the number of steps, parts and linkages; increased output flexibility; increased process transparency; focus control on the complete process; balance flow improvement with conversion improvement and benchmarking.

## 3. The Research

An expert opinion survey was conducted using the Delphi Method using 25 experienced contracting QSs, to check and identify the acceptability of Lean concepts. Also the flow activities were identified using five QS activities; pricing of bill of quantities, interim valuations, variation accounts, cash flow preparation and final accounts - are the five functions most common in Sri Lankan context.

### 3.1 Data analysis and discussion

Flows were found using decomposed models of functions and according to the expert's opinions, non-value adding activities were found separately for each function. The degree of availability of flows is high in all functions but ability of minimising

them is much less. This discloses that although the major portion of the activities is of flows, they are needed and difficult to omit from the process.

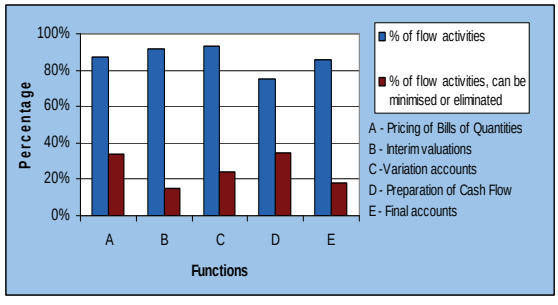
When testing the acceptability of Lean principles 20 statements were presented and tested. With the results of higher mean value and less standard deviation, it was identified that Sri Lankan contracting quantity surveys accept Lean principles.

In addition, with the tests of validity and reliability further confirmed the results of the survey led the researcher to conclude the acceptability of the 'Lean'

## 4. Conclusion

From the obtained data, it can be clearly identified that all selected activities of Quantity Surveying are considered as conversion activities, when taking them as a whole. However, each of them is a combination of sub activities identified as conversions and flows. In accordance with the data analysis, the major portion of the main activities are flow activities which obtained more than eighty five percent (85%) of total sub activities (see Figure 1). This means that the major share of Quantity Surveying activities consume time and other expenses without adding any worth for the process. It was also disclosed that most of the flow activities can be minimised or eliminated and the awareness amongst the Quantity Surveyors regarding these non value-adding flow activities is considerable. This also supports the fact that 'Lean' is a suitable concept for Quantity Surveyors since it becomes easy to adopt with the awareness of the component in it.

*Figure 1: Proportion of flow activities of selected functions of a Quantity Surveyor.*




In order to check whether it is feasible to implement the concept of Lean Concepts within the particular organisation, the company should ensure that there is top management commitment to the implementation; there should be resources provided to the quantity surveyors and that company policies and regulations should facilitate this concept.

Also it is recommended that the QS as the cost expert in the industry should try to quantify these wastes and should try to cost them. As a result he/she would be able to draw the attention of all management and other employees of the company to take necessary actions to prevent these flow wastes. A cultural change for the quantity surveyor and other involved parties is essential to minimise the problematic effects arising through the application of 'Lean Concepts'.

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# A knowledge transfer perspective on research and teaching in higher education

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*Transferring new knowledge created through research into teaching is a primary task in any higher education institution. The research study on which this paper is based on, aims to develop a framework to enable transfer of research knowledge into teaching. This study is different from previous approaches in that it looks into the research and teaching link as a two-way knowledge transfer process in the light of growing knowledge management viewpoints. The framework which is developed through an exploratory case study is validated through five further case studies in different disciplines. Thus, the final framework that is described in this paper can be considered by a higher education institution in creating a formal research to teaching transfer process.*

**Keywords:** Higher Education, Knowledge Transfer, Learning, Research, Teaching

## 1. Background

Research studies that have explored the relationship between research and teaching had revealed different outcomes. The quantitative studies have generally concluded that there is no relationship between university staff research and teaching[1]. The qualitative studies have concluded that a symbiosis relationship exists between university staff research and teaching [2; 3].

According to Jenkins [2], an effective way to link research and teaching is managing staff research to benefit student learning, which will benefit both students and staff; and, also, will improve knowledge development and learning within universities. However, as most studies confirm, research and teaching are loosely coupled activities, which may not have a necessary or an automatic link; and, therefore, it is necessary to create this link to achieve a productive relationship [4]. However, research studies that had introduced different strategies to link research and teaching fail to appreciate useful insights from the extant knowledge transfer and learning literature.

## 2. Knowledge Transfer Perspective

Some pedagogical researchers have identified the importance of knowledge management perspectives on university research and teaching. For example, Jenkins [2] states that knowledge economy demands academics to be creative and gain ability to create; find; and, synthesise new knowledge. Scott [5] laments that in the knowledge society research and teaching are no more separable activities; and, the impact of the knowledge society has been to make research and teaching even more transgressive. Brew [6], while bringing in the concept of academic community of practice, views research and teaching as activities where individuals and groups negotiate meanings and build knowledge within a social context.

More insights can be gained by viewing research into teaching as a knowledge transfer process. According to Sexton and Barrett [7], knowledge transfer is viewed as the movement of knowledge via some channel from one individual or firm to another. According to Davenport and Prusak [8], effective knowledge transfer does not involve mere transmission but also absorption and use following such a transmission. As such, Griffiths [9] emphasises, for an effective transfer and learning, providing students with learning opportunities is insufficient; therefore, it is equally important to evaluate student learning.

## 3. Research Methodology

This research selected case study methodology due to the context-specific nature of the phenomenon under study. The unit of analysis considered was academic departments within a university while the study expanded to individual and university levels where appropriate. The sampling strategy was to identify departments that focus on vocational or social science disciplines. Accordingly, study selected six departments in several disciplines such as information technology; sociology; nursing; geography; and, management.

## 4. Framework Development

A framework (see Figure 1) was developed based on case study findings to create research to teaching transfer. In that, nine activities were identified and divided into four elements: start-up, process-specific, on-going and outcome. The start-up and outcome elements act as input and output activities in the RtoT transfer process. The most significant activities related to RtoT transfer process are grouped under the process-specific element, where the real transformation takes place. The four activities under this are shown in a loop to represent the learning cycles within and in between the activities. Three activities, which should take place on a regular basis to enable the RtoT transfer process, are identified under on-going element. This framework is aimed at providing a step-by-step guide for academic departments to transfer its research into teaching.

## 5. Conclusion

Even though, research-informed teaching is the key to transfer research into teaching, many academics agreed that there should be formal processes to aid natural mechanisms. Such formal mechanisms should not only be implemented in a department but also be properly maintained and evaluated for the success. Further, formal mechanisms should not mislead its members to feel that it is a separate process. Both literature and case studies emphasised that departments should have a research to teaching culture where everyone is actively and effectively involved. Finally, considering knowledge management concepts and views of academics, the transfer should go beyond academic departmental level to a wider community where everyone effectively share and disseminate research knowledge and good teaching practices.

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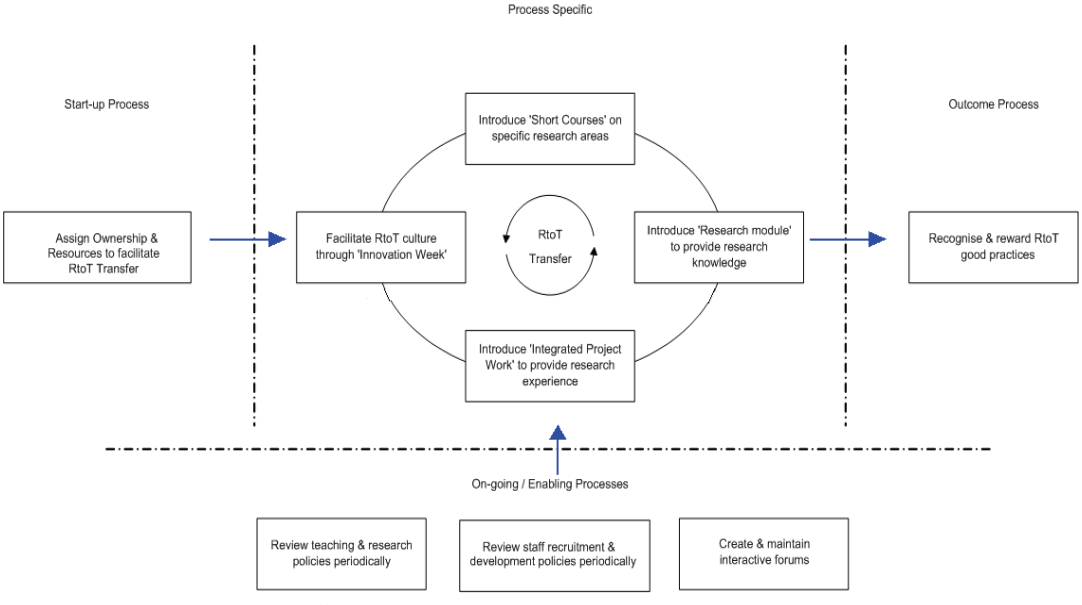


*Figure 1: Research into teaching process*

# Simplistic model for employee selection and evaluation in the UK construction industry

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*Several researchers perceive construction industry as a knowledge based, value creating sector of an economy. As one of labour intensive sectors of the economy, there is an emerging importance placed on the Human Resource Management in the construction industry, Capacity of wealth creation of a company is based on the knowledge and capabilities of its people. Therefore the value addition is done to the organisations by installing such personnel knowledge into knowledge management systems that organisations create and use. Employee selection and evaluation practices can contribute significantly to the organisation gaining a competitive advantage. Hence it is very important to analyse and formulate a suitable set of competencies in a knowledge-centric industry such as construction. This research attempts to construct a simplistic model to help the industry practitioners to rank the suitability of a person/employee for an assigned job, based on their competencies.*

**Keywords:** Employee selection, Human intellectual capital, Research methodology

## 1. Background

There is an emerging importance placed on the Human Resource Management in the construction industry, as one of labour intensive sectors of the economy, which is still considered to be an uncharted territory within construction organisations. Knowledge management is said to bring about the much needed innovation and improved performance in the UK construction industry. Nesan & Holt [1] argue that the issue of the critical role that employees play in fostering an effective construction business has often been overlooked over the years. According to Cooke-Davies [2], "it is people who deliver the projects and not processes and systems", which gains increased validity in the context of labour intensive construction industry. Hence it is prerequisite to define more appropriate and realistic employee selection and evaluation method to establish a knowledge-centric construction industry.

Various authors consider intellectual capital as the combination of human capital, structural capital and relationship capital. Interestingly, of these various categorisations of intellectual capital, human capital is regarded as the most valuable asset [3]. The term human capital corresponds to human resources, consists of education, competencies, values, attitudes and experience components. The advocates of the human capital approach emphasise that many of the assets that individuals bring to the organisation are intangible, premised in individual, tacit knowledge rather than the more explicit, explicated, formal, routine and standardised knowledge. Capacity of wealth creation of a company is based on the knowledge and capabilities of its people. Therefore, the value addition is done to the organisations by installing such personnel knowledge into knowledge management systems that organisations create and use. This focus of the human resource as a strategic resource central will help organisations to achieve competitive advantage in business environment. It also represents an alternative way in which to understand employee selection and evaluation.

Individual competency is anything that an employee brings to a job or acquires along the way throughout a carrier that ultimately contributes to the success of entire organisation [4]. This includes relevant skills, knowledge, abilities, formal education and experience gained on the job. According to Cardy and Selverajan [5] competency model is considered as the set of competencies associated with a job or role in an organisation. Perhaps the dominant model to date is the development on generic competencies. Perhaps, one way of looking at this is by understanding various 'human intellectual capital measures', which represents the areas where personnel knowledge can add value to an organisation to achieve competitive advantage in business environment.

## 2. Model development

From the analysis of various 'human intellectual capital measures', it is evident that qualification and work experience are perceived as the most important factors in determining employee competence/human capital. Most of the authors on this area agree with the importance of these two factors and suggested other factors which would also help the organisation in improving its culture and competitive advantage. Few informal communications conducted with academics and industry practitioners suggest the same. Especially the employee selection and evaluation based on qualification and work experience is found to be very common in practice. However, there is a concern over the class of qualification, relative importance of work experience to qualification, decay of 'knowledge from qualification' over the years and relevance of qualification and work experience. Having these in mind, this research proposes a simplistic model for knowledge based employee selection and evaluation in the UK construction industry.

Research intends to develop a simplistic model based only on easily observable major human intellectual capital measures, qualification and work experience. Furthermore, an additive model is found to be appropriate than a multiplicative model. Multiplicative model will result to zero 'human intellectual capital' without either qualification or work experience. Based on the presented arguments following model is constructed for knowledge based employee selection and evaluation.

$$Y = r_1 dQ + r_2 cE$$

Where,

$Y$ = Human intellectual capital

$r_1$ = Relevance of the qualification

$d$ = Decay of 'knowledge from qualification'

$Q$ = Qualification

$r_2$ = Relevance of the work experience

$c$ = Relative weighting of work experience to qualification

$E$ = Work experience

Here, $Y$ is proposed to be measured in human intellectual capital units, particularly to assist the ranking of suitable personals. Human capital measures are dependent on several organisational characters and decision maker. Especially, relevance of the qualification ($r_1$) and work experience ($r_2$) are very subjective and they are left for the management/decision maker for a suitable employee selection and evaluation. This research attempts to determine 'decay of knowledge from qualification over the years' ($d$) and 'relative importance/weighting of work experience to qualification'($c$) to help the practitioners with easy and general decision making process. However, it is prerequisite to quantify qualification ($Q$) and work experience ($E$) to measure human intellectual capital. 'Credit requirements for each qualification' can be considered as directly proportional to the 'amount of required knowledge acquisition' which enables scaling of qualifications against credit requirements.

## 3. Research methodology

An exploratory, first phase of the research focuses on quantifying qualification ($Q$) and work experience ($E$). This qualitative, rich data is expected to provide guidance to understand the influence of different methods of scaling. The main, second phase of the research will concentrate on estimating $d$ and $c$ which are more quantitative. The details and scaling of qualification ($Q$) and work experience ($E$) will also be confirmed in this phase. For this a survey method would be more appropriate to collect quantitative data which would be analysed with regression analysis. In the third phase of the study, case study employer will be asked to rank a list of employees and the ranks will be compared to the ranks achieved from the list created from the usage of the constructed model. Significance of this ranking will be evaluated against 'degrees of freedom' to determine the level of significance, which would help the hypothesis testing in this phase.

## 4. Conclusion

This research attempts to construct a simplistic model to help the industry practitioners to rank the suitability of a person for an assigned job based on their competencies, particularly knowledge. From literature synthesis and informal interviews, qualification and work experience are selected as major competencies. With the usage of an additive model and scaling of qualification based on accumulative credits, a simplistic knowledge based employee selection and evaluation model is formed. Appropriate research methods and techniques are selected to build and test this model and to improve its validity for the use of the UK construction industry.

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# Performance of Mature Entry and Matriculation Entry Students focusing on the National Diploma in Building at the University of Johannesburg, South Africa

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*Developments in the teaching of the National Diploma in Building students should be geared towards meeting the needs of the construction industry in South Africa. These needs are usually in the form of skills and knowledge required to resolve thorny issues encountered in practice. The lack of capacity in the construction industry needs to be addressed from the basis of ensuring that the education system caters for both mature entry and matriculation entry students. The paper looks at a comparison in performance between mature entry and matriculation (just finish High School) entry students focusing on the National Diploma in Building students at the University of Johannesburg. The paper will make a comparison between those students who work first before enrolling for their first year National Diploma in Building and those who are directly from high school. Cooperative education involves training and systematically developing students through the acquisition of the requisite skills, attitudes, values and knowledge required to adequately perform in their chosen careers. The paper describes the problems and experiences that have been encountered by both mature and matriculation entry students in their three years of study which affects their performance. The paper will then look at the value of prior experience in enabling students to finish their National Diploma in Building within a three year period. The paper closes with some recommendations for the future.*

**Keywords:** Building, Construction, Education, Mature, Matriculation, Skills, South Africa.

## 1. Introduction

The University of Johannesburg was founded on the proud academic traditions of the former Rand Afrikaans University, Technikon Witwatersrand and two campuses of Vista University. The UJ has approximately 46 000 students, who attends classes on its five campuses, spread over the industrial landscape of Johannesburg. The UJ is focussed on maintaining high academic standards, while boldly embracing change and empowering its students to contribute knowledge and skills to this city and our beautiful country. In South Africa the levels of unemployment and poverty are extremely high and unemployment is one of South Africa's most pressing problems. Acceptable levels of social development, economic growth and a decrease in high crime levels will only be achieved if the 28 per cent unemployment is decreased dramatically. The high unemployment rate can undermine the democracy if it is not reduced. At the same time there is a great need for physical infrastructure in both urban and rural areas. According to the World Bank [1] infrastructure can deliver major benefits in economic growth, poverty alleviation, and environmental sustainability - but only when it provides services that respond to effective demand and does so efficiently. In addition there is a lack of capacity and skills at institutional, community and individual levels.

From a theoretical perspective supported by experience elsewhere in Africa and the world at large, there is a huge role to be played by tertiary institutions in addressing skills development in South Africa. One of the main thrusts of the RDP White Paper remained "to link reconstruction and development: to reduce poverty and create employment through programmes of infrastructure construction and maintenance." The Reconstruction and Development Programme is a programme that seeks to redress the inequities and deprivation caused by the former government's apartheid policies. The programme is founded on six basic principles, linked together which make up the political and economic philosophy that underlies the whole RDP: the use of all available resources in a coherent and purposeful effort that can be sustained into the future; a people driven process; peace and security for all; nation building; reconstruction and development; and democratisation of South Africa [2]. These principles are indicative of a strong emphasis the RDP places on community participation methods.

There is an urgent need to address the skills and unemployment challenges in South Africa. The levels of unemployment have been rising steadily over the years. The unemployment rate is an extremely important indicator of economic and social health. The level of unemployment was 7% in 1980; 18% in 1991 McCutcheon [3]; 15.7% in 1995 Statistics South Africa [4]; 30.2% in 2002; 27.4% in 2003; 25.6% in 2004; and 26.5% in 2005 Labour Force Surveys (LFS) [5]. The unemployment rate rose rapidly over the 1990s, then fell in 2003 and 2004 and rose again in 2005. This is due to the drastic fall of the demand for unskilled labour in the formal sector caused by structural changes in the economy as a result of a decline in the importance of the primary sector.

## 2. Results of the Survey

There were thirty questionnaires that were sent to thirty students to complete and all the thirty questionnaires were completed and returned. There were twenty seven male and three female students. The age of the students ranges between 22 years and 44 years. Out of the 30 students only 4 were from outside South Africa. 40% of the students came from the Gauteng Province; 20% Limpopo Province; 15% Eastern Cape Province; 7% from Lesotho; 7% from Botswana; and 11% from KwaZulu Natal. The average years of experience in the construction industry before doing the first year in Building is 6 years. More than 80% of the students had worked for the private sector and 20% for the public sector. 50% of the respondents alluded that they work first before going to the University to further their studies after completing High School because they wanted to learn more about the construction industry before choosing the right course; 20% of respondents had no money to further their studies and they had to work first to raise money to pay for the studies. 20% of the respondents were offered a job opportunity immediately

after High School completion. 10% of the respondents were encouraged by their parents to enter the construction industry as they were employed by the industry themselves.

90% of the students were employed as Trainee Site Agents and 10% as Trainee Technical Officers. 80% of the students alluded that they were adequately prepared and 20% were very well prepared for their first year. They were exposed to a variety of construction projects; project management skills, site management skills, human resources management; construction skills; communication skills; report writing; team work. The students were also able to make a right choice between construction management and quantity surveying course. All the 30 students alluded that it was easy to complete their studies on record time. The 30 students had not repeated any subjects in their Diploma in Building Programme. 80% of the students believe that all students must work before doing their first year. 20% of the students believe that students should be exposed to the construction industry in their first of study.

80% of the students received good support from their supervisors and 20% of the students received poor support. 80% of the students attributed their support to good communication channels between themselves and their supervisors. The 20% of the students were neglected most of the times and left alone. The supervisors were to busy to give guidance to the students. As a result team members were the one who assisted them in addressing the challenges they faced while undertaking their work. All the students were very positive about the future of the construction industry and the construction profession in South Africa. They believed that more people must be trained in order to improve the construction industry. 90% of the students alluded that their industry exposure made them to understand the construction industry better and they were able to choose construction as their career. The students who come direct from high school encounter the following that makes them to repeat some subjects: lack of communication skills; lack of computer skills; unable to work in a team; no practical knowledge of the construction industry; lack of skills to write and present report properly; lack of problem solving skills; and unable to relate theory to practice. From the research it can be concluded that prior work experience among Diploma in Building students reduces the failure rate. This also improves the through put rate.

## 3. Recommendations

- Students who are admitted straight from Matric (High School) must be encouraged to work during university vacation in their first year.
- Potential students who undertake work based learning first must be encouraged to keep a daily log book which will contain details of the work they have performed during their stay in that company. A major benefit of this approach will be the positive development of the potential student's attitudes towards responsibility and accountability in relation to the project in which he or she is engaged.
- Encouraged more female students to engage in the construction industry
- Each potential student must be assigned a supervisor from the first day they are employed. The supervisor must check and certify the correctness of the record for each task performed.
- The supervisor must have appropriate qualifications and experience and should ideally hold the position of either a registered quantity surveyor, construction or construction project manager, or a site agent or a construction surveyor. Any other person provided that he or she holds a responsible position in the company being represented, and is actively pursuing continuing professional development in a built environment field of study.
- The learning outcomes must be clearly defined from the beginning when the person is offered an employment opportunity.

## 4. Conclusion

The research revealed that those who worked first before doing their first year of study all of them completed the Diploma in Building in record time (three years). The high failure rate is caused by lack of knowledge about the construction industry. The foregoing examples provide a range of options available to assist in providing world of work experiences for students in the different disciplines. Academic institutions must be relevant as the industry requirements changes industries must also play a major role in affording graduates an opportunity to learn, as you cannot buy experience.

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# The relevance of professional institutions to students and early career practitioners in the property and construction industries within Australia

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*The role of professional institutions and the transition from student membership to full professional member among real estate and construction students in Australia is examined. Students' perceptions of professional qualifications and institution membership is explored to show that graduates seek networking and career advancement opportunities over professional training and development opportunities. The expectation of many young practitioners is that they will work outside Australia during their career and this has significant implications for the future policy development of professional bodies. The paper provides a valuable insight into the aspirations of young professionals and goes some way to identifying the reasons for the low level of transition from student member to full membership of the national and international professional bodies.*

**Keywords:** professional institutions, student membership, real estate and construction education Australia..

## 1. Background

The property and construction industry has relied heavily on its professional bodies to maintain educational and professional standards among its members and to regulate the profession for the benefit of its members and the public. It is widely recognised that professions fulfil an important role in society and much has been published on these benefits over the years. Grimshaw (2001) writing on the facilities management profession identified a number of underlying characteristics of a profession. He posited the hallmark of a profession to be; 'specific and have a definable knowledge and skills base that has to be acquired and tested; a high degree of self-control of behaviour via codes of ethics; and a recognised social responsibility that gives a primary and selfless orientation to the community interest.' (Grimshaw 2001;55).

The regulation of ethical standards by professional bodies is recognised as a cornerstone of professional practice and, in many jurisdictions around the world, it is the professional bodies, with their well established codes of ethical practice, that provide a regulatory buffer between the professional in practice and the role of the state in protecting the public. (Grimshaw 2001; Jamal & Bowie 1995).

While the importance of professional body membership has not changed, there is an apparent change in the attitude of young members towards membership. The value for money and the need to belong have been questioned Wilson (1997). A reluctance to join is echoed in many professions where the benefits of membership are weighed against the financial costs to the individual or the organisation (Dalton & Dignam 2007). Yet other research in the USA points to an increasing membership of trade associations by 'generation x', with a focus on what they can get out of the membership in terms of career advancement and the benefits of networking that can be achieved (Amer 2006;11; Wallace 1995).

There is little research in the property and construction professions with respect to the value of membership to young graduates. As the professional bodies seek to become global organisations the need to attract new members is a quintessential element of the growth strategy.

## 2. Methodology

The research methodology was based on a questionnaire which could be easily distributed among students studying property and construction courses in Australia. The universities selected to participate were leading course providers in Sydney, Melbourne and Brisbane. The students were drawn from all year groups within the undergraduate program and from postgraduate students undertaking master level study. A total of six hundred and sixty one completed surveys were returned.

## 3. Data analysis and results

Analysis of the data from three separate universities in three major Australian cities show that many students intend to work overseas during their careers. The survey asked a number of questions relating to the importance of professional qualifications and membership of professional institutions. This data shows that students while some are student members of professions a limited number have considered their choices in terms of institution membership. They see the benefits of membership as career advancement rather than a source of knowledge and training opportunities.

## 4. Conclusions

The results of this survey of student perceptions of professional organisation membership within the built environment profession have provided some valuable insight. What has emerged form the research is that students do value professional qualifications but that there is a distinct lack of understanding about the role of the professional bodies in their careers.

The level of international outlook for students in their careers, with many expecting to work overseas early in their careers, is encouraging for globalisation of built environment professional practice. This result has implications for the recruitment of students into professional bodies and clearly shows the need for international links between professional bodies and the establishment of global professional recognition.

The move by some professional institutions to establish themselves as global profession bodies may go some way to addressing this challenge, although the results of the survey clearly show that, in the Australian context, local institutes are a preferred option over international options. This local preference becomes even more significant when taken within the context of membership fees. If student perceptions are correct, and employers are reluctant to pay more than one professional membership fee, if any, then the growth of international professional bodies is likely to be restricted. There are lessons to be learned in terms of international versus local that should influence institutional policy moving forward.

The area of most significance in terms of why students are not progressing to full membership of professional bodies is demonstrated at a number of levels. While professional qualifications are seen as important by young practitioners, membership of a professional organisation is seen as less important. Membership is perceived as taking too long to achieve, with a complex joining process over two years. It is apparent from the results that student perceptions of the importance of the APC is not in tune with the importance that professional bodies place on this period of practical experience. If student conversion to full membership is to be achieved then some considerable education of the need for, and importance of, this training needs to be undertaken by the institutions. The period of training required by professional bodies needs to be seen to add value both to employers and to young members seeking advancement of their careers. It is also clear that in order to assist potential members to successfully navigate their way to full professional institute membership, the expectation among students that mentoring programs exist needs to become a reality.

The message that can be taken from this research is that young professionals entering professional practice are focused on career development and will only seek to link themselves with professional bodies where that membership delivers clear value for money in delivering career goals and opportunities for advancement. This finding echoes those cited at the beginning of this paper pertaining to other professions and the challenges that member professional institutions will face in the future.

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# The relationship between research and teaching in built environment undergraduate education

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*The research-teaching nexus debate is a complex and often contentious one which has received a good deal of attention in the UK in recent years. Based on an international survey of built environment academics and practitioners this study explores the importance and relevance of research to Surveying undergraduate education. A key finding is that although the research process and outcomes can nourish undergraduate studies, they have a much greater impact upon postgraduate provision. There is a consensus amongst those surveyed that (UK) Research Assessment Exercise type research may have only marginal relevance when compared to case study, market-based or professional development type activity. Many respondents believe 'blue sky' research to be of limited use to undergraduate studies.*

**Keywords:** Research teaching nexus, undergraduate education

## 1. Background

### 1.1 Research and research funding

The UK Government currently funds Higher Education Institutions' (HEI) research through a dual support system, providing distinct but related sources of income. Firstly, the four UK Higher Education (HE) funding bodies allocate 'quality-related' (QR) funding on the basis of performance in a periodic Research Assessment Exercise (RAE) in the form of block grants to universities. The most recent RAE was in 2001 and it rated HEI departments on a scale of 1 to 5*. The next RAE is in 2008. Secondly, the Research Councils, for example ESRC and EPSRC funded through The Office of Science and Technology (OST), award grants for specific projects or programmes on a competitive basis. The Government is committed to this system and to rewarding excellent research, and the correlation between an HEI's QR and OST income streams is very strong: between 2000 and 2005 the average correlation was 0.98, with no variation across years [1].

Whilst acknowledging that the RAE has led to an increase in the quality of research, the UK Government's White Paper *The future of higher education* [2] clearly argues for a change in strategy. One of the stated aims is to reward research intensive institutions by funding research in larger, more concentrated units – notably through the RAE in 2008. It also confirms that research council grant funding, will follow a similar pattern.

Analysis of Royal Institution of Chartered Surveyors (RICS) statistics indicates that in 2005 approximately 9000 students were registered on accredited UK courses. The cumulative totals show that 47% of students are currently studying at research funded institutions (i.e. those rated 3a and above). If the threshold is raised to 4 (or the equivalent score under RAE 2008) following RAE 2008 then, all other things being equal, this would drop to 26%. If, as some experts are suggesting, the bar is raised to 5, then only 17% of students would be studying at universities funded by research grants through their relevant HE body. Such a funding regime could create a polarisation of Surveying Schools/Departments which could in turn be reflected in recruitment policies i.e. some (relatively few) universities will seek to develop and recruit research-focussed career academics, whilst others (the majority) require experienced practitioner/teacher staff. So, how important is departmental research activity to undergraduate students and what balance of expertise is actually required for an effective Surveying academic?

### 1.2 Research and teaching

Dearing's report *Higher Education in the Learning Society* [3] concluded from the evidence received by the National Committee of Inquiry that a total separation of research from teaching in HEIs had little support. In contrast, the Government's White Paper [2] outlines a policy that encourages such a separation. Many authors, such as Brown [4], argue strongly that the research-teaching relationship in universities is crucial because it is that which sustains the HE sector's claim for distinctly better resourcing, when compared to Secondary and Further Education (FE). If there are no benefits to teaching, he argues, there is no case for doing research in universities at all. Indeed, the research-teaching nexus debate is a complex and often contentious one, but the notion that links should be developed has received a good deal of attention in recent years.

As part of a more broadly based research project funded by the RICS Education Trust this paper aims to explore the following questions:

What are the essential criteria for an effective academic in the Surveying field?

What is, or ought to be, the relationship between research and teaching in a Surveying context?

### 1.3 Methodology

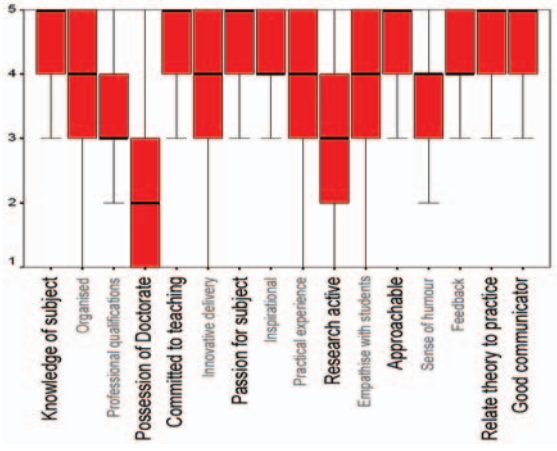
A questionnaire was widely distributed to all World Regions and 433 respondents, working in academia and practice, took part in the survey.

# 4. Findings

## 4.1 Essential criteria for academic staff

The greatest contrast in opinion relates to the importance of professional experience in comparison to research capability. Interestingly, teaching experience is mentioned relatively infrequently.

The results indicate that the majority of the attributes extracted from the literature are rated as either very important or of great importance, although possession of relevant professional qualifications and commitment to research are considered as quite important and the award of a doctorate degree of little importance.




[5 = great importance . . . 1 = not important]

## 4.2 Research and teaching

Common themes to emerge from an analysis of the positive contributions that research can make to teaching are that it: Enriches the curriculum: currency, context, breadth and relevance; Promotes staff development: pedagogic, intellectual and vocational; Provides funding: capital and revenue; Develops key skills: problem solving, creativity and communication; Creates a progressive learning environment and school culture; Promotes innovation: new knowledge and ideas; Stimulates staff and increases retention; Encourages collaboration, team-working and internationalisation; Enhances staff credibility and role model for life long learning.

Whilst some respondents considered that research has no negative impact upon teaching, the majority used the opportunity to identify research-teaching tensions i.e. research can: Limit time available for student education and welfare; Lack relevance and be overly theoretical; Distort course content; Lead to isolation and a preoccupation with a personal research agenda; Devalue teaching; Take funding and experienced staff away from teaching; Polarise teaching and research activity; Adversely affect the student experience; Overload academic staff.

In addition, respondents suggest that undergraduate curricula are unlikely to reflect staff research interests, and that research is of less value to undergraduates than postgraduate students. The majority of academics either agree or strongly agree that the pressure to be research active is draining the value placed on teaching and that the synergy between teaching and research is undermined by the fact that they are managed, assessed and funded separately.

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# A QUT Experience in Combining Sustainability Research with Educational Activities and Professional Practice

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*The paper discusses the development and delivery of a university subject on sustainable construction, using related research projects as case studies and learning materials. It exposed students from a variety of disciplines to real life scenarios, to group around project cases, and learn to work with one another in solving sustainable development problems. The problem based learning approach directly responds to the new trends of learning by practising which, in the area of sustainability education, is particularly appropriate because of the need for multi-disciplinary approach to complex issues, and the impetus for research and development to provide timely input for education in this growing discipline with a relatively short history. Collaboration of students from cross-disciplines, the engagement of industry and practitioners, the concept of using project cases and student design competition, and the tangible improvement of students' comprehension of the sustainability phenomenon as a whole, have been the highlights of this Australian experience.*

**Keywords:** sustainability, education, problem based learning, construction research, practice

## 1. Introduction

Climate change, rising oil prices, increasing energy and resource demands have become issues of priority around the globe and major impacts on everyone's life. Naturally this further raises the high level of concerns over sustainable development and living among our societies. Such awareness is not only reflected through intensified media reports and evolving policies and strategies from governments, but also shown in the level of sustainability coverage in all levels of education as a whole.

In Australia, the educational focus on sustainability coincides with the UNESCO's initiative for a wide-spread global implementation of sustainable education. Nowadays school children of all ages tend to get early lessons on sustainable living through a variety of exercises and projects, ranging from tips of reserving water, to the use of alternative energy to designing model cars. At the university level, many academic disciplines have developed subjects and courses that cover relevant sustainability issues. For planning, design, engineering, and construction education, the need to respond to this global challenge is particularly strong, as graduates from these disciplines work on the front end of the issue, directly on projects with sustainability deliverables.

Despite of the flurry of activities on sustainability curriculum development by many disciplines from Business schools to Science departments, existing trends of these subjects tend to tends to be restricted to the elaboration of sustainability principles, environmental management concepts, and methods and systems of assessing performances, while professional disciplines home in on the specific technological innovations. Few had the opportunity to allow students to "put the ideas altogether" as they will undoubtedly be accustomed to do in the real world of professional practice after they graduate [1]. This requires that we not only teach students 'what" as the technical know-now, but also the 'why' to encourage them think and act in the appropriate way for the rest of their life.

The need to introduce real-life experiences to classrooms in order to promote "deep learning", was also emphasized by a number of earlier research [2][3][4]. It will be much easier for students to relate to and leave with better impressions when their course work study is integrated with the learning of practice under supervision.

This paper discusses the importance of the shifting sustainability foci and how they will impose on sustainability curriculum development in higher education. An example of an integrated approach to combining research, learning, and practical experiences at an Australian university was introduced as a better way for students to learn to practice sustainable design, engineering and construction.

## 2. Conclusion

The rising level of sustainability awareness and concerns in our society demands changes in the way industries and businesses operate. This in turn requires universities to prepare our students with the knowledge and skills to take on the sustainability challenge technically and mentally. Traditional classroom teaching has the danger of turning students to be technical experts in a topical area, while still not believing in the general philosophy. We will need to promoting students own belief and self-discipline, and the ability of taking on complex problems of sustainability by teaming up with other professionals. New curriculum development needs to introduce the theory of sustainability in a more tangible and practical way by combining disciplinary specialties together, as required in real life practices. The learning by practising approach, as demonstrated in a case of subject design and delivery in this paper, will present such potential. The engagement of stakeholders in high education, from the industries to researchers, and from professionals to academics and students, will provide more opportunities for a win-win situation for the "sustainable" education of sustainability.

# SECTION V

## CAPACITY BUILDING

# An assessment of municipal development and program management

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*Palestinian local government has been amongst the most committed bodies responsible for the provision of services that have a direct impact on the quality of life of Palestinians. Three municipalities in the Gaza Middle Area enjoyed high profile funding from Danish International Development Assistance in order to improve the level of environmental infrastructure and services, and through this, to build the managerial and administrative capacity of the municipal councils. The objective of this paper is to evaluate some of large scale infrastructure projects and small scale projects that are implemented in Gaza Middle Area.*

**Keywords**: Local government, development, infrastructure services, management.

## 1. Introduction

Palestinian municipalities bear the greatest responsibilities concerning the delivery of services that affect citizens' lives, services which include water, wastewater, solid waste management, building licensing, local roads, public health and environmental protection among others. Municipalities in the Palestinian context lacked of well-established service delivery functions following year 1967.. Such municipal performance has an impact on how the public views the effectiveness and efficiency of government in general, in addition to municipal performance's direct and more visible impact on the quality of life of the residents.

In pursuing municipal functions, and given the absence of large national government and regulatory bodies for extensive periods of time, Palestinian municipalities have grown more organically than systematically and structurally in an attempt to fulfill the requirements of a very demanding public. This is especially true for the municipalities of Gaza Middle Areas, municipalities that are also relatively newly-established and whose residents are even more demanding. This is because three of the four municipalities (Breij, Maghazi and Nusseirat) embrace refugee camps, and because of the associated municipal services deficit backlog and other related socio-economic and political difficulties. The upside of this organic organizational growth has been well demonstrated municipal resilience in service delivery modes in response to intensive changes in the political environment. The downside has been however, a lower consistency, hence a lower quality of service, and municipal management's inability to exercise effective and systematic control over service delivery, control being the undisputed prerequisite to municipal service improvement.

## 2. Background

According to the current administrative divisions, the Palestinian territory was divided into two geographic regions. These are the West Bank and Gaza Strip. The West Bank was divided into nine governorates and two districts (Jenin, Tulkarm, Qalqiliya, Nablus, Ramallah & AL-Bereh, Jerusalem, Jericho, Betlehem, Hebron, Tubas, and Salfit districts), while Gaza Strip was divided into 5 governorates (North Gaza, Gaza, Middle area, Khan Yunis, and Rafah). The Gaza Strip is bounded by the Mediterranean sea from the northwest, by AL-Naqab Desert from east and south and by Egypt from the southwest. The Gaza Strip has an area of only 365 $km^2$ with a total population of 1.1 million. Its length about 45 km, the width is 6 km in the north with maximum 12 km at south [1, 2].

Gaza middle area consists of 4 municipalities: Breij, Maghazi, Nusseirat and Zawayda. The four municipalities serve 125,887 people, distributed over 26,325 donums under municipal jurisdiction. Population density ranges between 1.5 persons/donums, the lowest in Zawayda municipality, to 7 persons/donum in Maghazi Municipality. In the four municipalities combined, there are 186 municipal employees, of whom there are roughly 32% contracted and daily laborers [3, 4].

## 3. Municipal projects assessment

Sixteen projects were studied by means of reviewing project documentation and meeting with key personnel like program manager, mayors, local political leaders and technical staff responsible for implementing the projects. The population of covered area is approximately 96,000. Nearly all residents are refugees or related to refugees of the 1948 war. It has been found that little evidence of program-wide planning of infrastructure in Gaza Middle area. However, program-wide planning was not viewed as being critical to the success of the program by the donor. Project selection is well organized but not as obvious as it might be.

The project selection process consists of the individual municipalities creating lists of projects to be carried out and then prioritized them in order of perceived need. The mayor then prepares a written proposal for presentation to the higher Project Steering Committee (PSC) for funding approval. Once the project is approved oversight and funds are transferred to the local agency for implementation. There is an active financial audit function exercised by the cognizant Palestinian Authority agencies. In particular the Ministry of Local Government and the Ministry of Finance conduct joint financial audits. An

interesting point is that the funds are transferred directly to the local municipalities by DANIDA rather than through the national ministries. This ensures that the money actually gets spent on the intended projects.

The contractor selection procedure is clear, organized and follows the local regulations for all projects. In most situations the lowest bidder was the successful bidder. Some contractors were not selected because they didn't satisfy the general specification requirements. It has been observed that the price for supervisory consultant services within the time frame of the contract is fair provided that a professional representative of the consultant's office is assigned to the job. However, delays occurred on all projects due to a number of factors that resulted in a cost increase. One of these factors was the experience level of the supervisory consultant representative.

Concerning project's health and safety requirements and the implementation of these requirements, a complete section about health and safety was included in the general specification. The contractor was ordered to follow the health and safety regulations on all the projects. It is noticed that there are many letters from the municipality engineer and the consultant to contractors to follow the health and safety regulations. These are particularly related to the wearing of shoes and safety helmets. Given the number of letters sent to some contractors it is evident that compliance with health and safety regulations needs to be strengthened.

The quality of the finished work is appropriate for the invested cost when compared to other projects in the Gaza Strip. The overall functional quality appears to be adequate for the purpose intended. For the projects there is no submitted document from the contractor requesting approval of their independent laboratory. For some daily reports the consultant requested the contractor to send materials for testing. This is not normal practice. Normally the consultant requests the independent laboratory to collect the samples for testing. Results from the laboratory weren't discussed by the lab technician or the consultant although some results are less or approximately equal to the required strength or quality.

## 4. Conclusion

The living conditions in the neighborhoods affected by the projects have been improved substantially. There is considerable evidence that the people living in the project areas have received a substantial benefit in the form of improved quality of life. Therefore, the selections have merit. However, program-wide planning could be improved. There is a need for a master plan treating the entire service area as one entity to assist the municipal leaders in developing projects. The procedure used for selecting supervisory consultant is to some extend sound. DANIDA should be more involved on the periphery of the projects it funds to provide encouragement toward improving management and direction of projects. Documentation of calculations is often missing from plans, designs, and project development planning. The staff of the municipalities would benefit from additional training in project development. All municipalities would benefit from adopting pre-qualification of interested consultants and contractors.

More training of the municipal staff is required to strengthen their ability to provide oversight of the consultants and, indirectly, to the contractors. Guidance should be provided to the top management and councils members of the municipalities encouraging them to support their professional staff in dealing with the consultants and contractors. Guidelines should be established specifying documents that should be made available in Arabic and English. More attention needs to be directed toward maintaining complete construction records, log books, letter files and written directions among the municipal engineers, consultants, and contractors. The health and safety written requirements are realistic and reasonable. However, compliance with health and safety statutes and regulations could be improved. There is considerable evidence of violations witnessed by the municipal engineers and consultants that were not corrected by the contractors involved. This indicates a pattern of violations. The site quality control needs improvement. Documentation of proper quality control procedures and standards is acceptable. Evidence of follow through on correction orders is sufficient.

There were design flaws, some outside the ability of the individual municipality and consultant to avoid. As experience was gained design issues became less of a problem indicating that as experience is gained, better designs can result. Although not of a magnitude to cause severe difficulties, bills of quantities were improved, time extensions granted with ordinarily acceptable reasonable cause but in some cases cost analysis was missing. There is evidence of claims being approved without sufficient documentation to justify the claims. There are also indications of positive changes in managing construction problems and claims on later projects.

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# Living laboratories to support collaboration

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*Through a case study analysis, this paper discusses the essential elements of successful industry-university partnerships in the context of the integration of the scholarships of teaching, research and application. This scholarly integration is advocated as*

## 3. Critical Success Factors of Recruitment Practices

The results indicate that contractors ranked the following as the most important aspects that influence recruitment decisions and employment practices (ranked by the means of their responses); Adaptability to changing work environment; and ability to work in teams or crews whereas Consultants ranked ability to work in teams or crews and continuity of work as the two most important factors of recruitment practices.

## 4. Discussion of Findings

The findings are consistent with the literature review, for example the study [10] conducted in the West Yorkshire Construction Sector regarding the barriers to training drew similar conclusions as common barriers being related to costs associated with training. Visagie [6] further opines that lack of training / development as a generalist which inhibits the ability to deal with the SMMEs as a composite whole. The views of the contractors and consultants confirm the findings are supported by literature conducted by Dainty et al [13] who argued that tight labour market conditions a shortage of high quality skills have forced construction employers to discard training and workforce development activities in favour of aggressive recruitment practices. Holt et al [2] citied poor labour retention, the failure to develop and train workers, inability of workforce to keep up with change and the introduction of new technology as the primary causes of skills shortages.

## 5. Conclusions

The use of analysis of variance (ANOVA) will enable the research to examine whether there are significant mean differences for two groups (Contractors and Consultants) in the variables of interest, namely training and recruitment practices. Although this research focuses on organisations within the Western Cape province of South Africa, it is anticipated that the antecedents indentified in this study can be used on a global construction context in developing appropriate mechanism for addressing the skills shortages. In terms of ranking, contractors rated the collapse of the apprenticeship scheme, company operations or ambitions to grow and diversify and project costs and over-runs as being the main causes of a shortage of skilled workers. Their reasons for the basis of skills were given as a lack of artisans, operators and skilled labour. Contractors ranked the lack of training, the lack of financial incentives to train, the quality of available training, profit margins and qualifications that are broken down in narrow-task related units as the factors that had the most negative impact on skills shortage. The factors that had the least impact on skills shortage were the effects of higher education, recruitment policies, skills gained experientially without formal training, labour saving methods and self-employment. The limitations of this study are due to the small samples and the usage of cross sectional data made it difficult to generalise the findings.

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# Up-skilling the New Zealand construction industry: a critique of the learning options

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*Education for the building and construction industry in New Zealand is facing a considerable shift in scale because of the requirement for builder licensing by 2010. The Department of Building and Housing has authorised five educational options for the industry up-skilling programme. This paper questions the efficacy of two of the options based on research that was undertaken in 2005 to identify the preferred learning styles of those in the construction industry. We conclude that the options 'self-directed learning' and 'reading materials provided by the Registrar' will not provide pathways to educational qualifications, but may be barriers to the success of the upskilling project.*

**Keywords:** Learning styles, Builder licensing requirements, New Zealand

## 1. Introduction

In 2006 less than 50% of the construction industry had formal qualifications, but only 35% of carpenters and builders so 65% will require some educational support. The DBH [1] has determined a programme for up-skilling the building and construction sector which includes a number of learning options. The balance of this paper attempts assess the efficacy of two proposed learning options; self-directed learning and reading materials provided by the Registrar, in light of available data concerning the preferred learning styles of the building sector [2]. Section 2 describes research undertaken in 2005 concerning the preferred learning styles of a sample of the building sector. It is a brief overview of the learning styles literature that underpins the research objectives and methodology. Sections 3 and 4 discuss the findings of the study in relation to the two of the proposed learning options. Section 5 speculates on the outcome of the industry up-skilling project.

## 2. New Zealand building sector learning-styles study

In 2005 a team of researchers explored the learning preferences of the building industry [2]. The participants included four stakeholder groups within the sector: apprentices, experienced trades people, building company principals and building control officers. About 250 questionnaires (PEPS) were completed. However information concerning individual education qualifications was not requested, so we do not know how many people in this sample would be involved in up-skilling. Therefore, in this paper, we use the data obtained from 153 building and construction students as a proxy for people who would undertake additional education as part of the industry up-skilling programme.

Self-directed learning is the first education option proposed by the DBH [1]. A cluster of four PEPS factors; *Responsible, Structure Alone/Peers and Authority Figures* [1] provides insights into learning preferences related to self-directed learning.

## 3. DBH option 1 and PEPS Factors

| PEPS factor | >40 Low score independent learning | <60 High score dependent learning |
|---|---|---|
| **Alone/Peers** | learner prefers to work alone; other learners may be distracting | learner has a strong preference for learning with peers |
| **Authority Figures** | learner does not want continuous guidance | learner prefers to work with an instructor present |
| **Responsible** | learner is less willing to follow instructions | learner requires detailed instructions |
| **Structure** | learner prefers to work out the details and interpret the necessary requirements | learner wants the instructor to provide detail so no interpretation is required |

*Table 1: PEPS factors indicating self-directed learning preferences*

The PEPS factor *Alone/Peers* has highest level of preference in this study. 80 individuals or just over half of all students (52.3%), the largest single group in this study, prefer learning with their peers. Only five students in this study indicate a preference for *learning alone*. The next highest number of students indicating a high level of preferences is for the PEPS factor *Authority Figures*. 76 (49.7%) of the 153 students have a strong preference for learning with authority figures close at hand to constantly provide feedback on student progress.

There appears to be little tendency within the sample towards taking individual responsibility for learning. In relation to the PEPS factor *Responsibility*, only about 12 % of respondents, 24, have a score below 40 indicating a preference for personal decision-making in relation to learning. On the other hand 64 students (41%) have a marked preference for following detailed instructions to completion of learning tasks. The PEPS factor *Structure* has a similarly high level of preference in this study. 74 individuals (48.4%) of all students prefer learning materials to be structured. In addition, the trend line is 60. Taking these two factors together implies that the majority of students in this study want well-defined learning outcomes, task completion timetables and assignments with an absence of ambiguity. As well as they want instructors close at hand to check the progress of learning tasks that have a single learning outcome.

## 4. DBH option 2 and reading factors

The second suggested education option to up-skill the construction industry in New Zealand is 'reading materials provided by the Registrar' [1]. Learning-styles theory suggests that if information is not presented in a format that the learner prefers, then the information is probably ignored [3].

As noted in Figure 1 a significant number of students in this study appear to have rejected *Visual* as a preferred mode of accessing information. Fewer than 5% of students preferred the *Visual* mode, but almost 15% rejected it outright and the majority of student scores were below the mean [10].

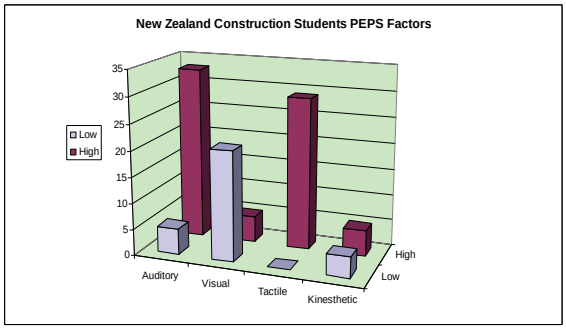


*Figure 1: Information accessing modality preferences of New Zealand building students*

Figure 1 shows that the students in this study did not indicate an obviously negative response to *Auditory, Tactile or Kinaesthetic* modalities. Although the number of students with decided preference for *Auditory* and *Tactile* are not great, only about 20% each, the mean for both was toward 60 rather than 40. And indeed not one student rejected *Tactile* as way of accessing information.

Many of the students in this study appear to outright reject reading as a way of learning. But the extent of the problem appears to be more wide-spread because all groups in the exploration of construction industry learning styles indicated an aversion to visual information accessing [2]. Thus, educational options available for up-skilling the New Zealand industry need to use other information accessing modalities.

## 5. Conclusion

It appears that DBH option one and option two are exactly the opposite of the educational alternatives that would provide successful pathways to up-skilling the building sector. There are significant numbers of New Zealand builders who need to be given an opportunity to gain formal education qualifications. This paper suggests that success of the construction industry up-skilling programme is more likely if an education opportunity takes into account the preferred learning-styles of the sector.

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# Diffusion and implementation of innovation in construction industry: Case studies for an institutional framework

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*Emerging countries have to develop their own specialised institutional frameworks in order to diffuse and foster innovation in their construction industries. In establishing new institutions, developing countries can take the industrialized countries as a model. However, the differences should be analysed in detail, and the model developed should be adapted to the environment in which the new institution will work. Examining the UK construction industry within this perspective, in this study, universities are taken into consideration as one of the major elements of innovation diffusion and two of the enterprise centres of University of Salford, CCI and SCRI are analysed with the case study method in order to reveal its success factors with an institution building conceptual model. As a result, the important role of these centres in fostering innovation in the construction industry is explored and lessons are driven for emerging countries on how to develop appropriate institutional frameworks.*

**Keywords:** construction, innovation, institution building

## 1. Introduction

Higher education institutions play a significant role in the production of knowledge and stimulation of innovation within the industry. From the perspective of the construction industry, however, the literature indicates the poor relationship between the universities and the industry. The Fairclough Report [1] describes the construction industry as wary of academia. In order to overcome this barrier for innovation, engagement mechanisms play a crucial role in bringing together the knowledge of the higher education and the construction industry. Building specialised institutions is a more holistic approach which comprises a variety of mechanisms designed for bringing together the universities and the industry. In this context, the success factors for an institution in diffusing and implementing innovation will be explored according to an institution building model and the applicability of this model for developing countries will be set up for further discussion.

## 2. Innovation and the Construction Industry

Competitive needs and spectacular achievements of the high-technology sectors of the economy have driven interest in the generation of new ideas and its implementation, i.e. what is now being considered innovation [4]. Most of the literature on technical change and innovation focuses on creation and development, but the real gain will be achieved when they are widely spread and widely diffused [14]. Moreover, innovation theories and diffusion is extensively discussed in the literature but most of these discussions treat diffusion as a non-integral part of the innovation process. Innovation theory and particularly diffusion theory has a gap for project-based sectors such as construction [15].

## 3. Institutional Development for Innovation in Construction

Without diffusion, innovation would have little social or economic impact [14]. Industrialised countries have an evolved construction industry with specialised institutional frameworks where it relies on the interaction of a variety of institutions, each with its own specialist priorities like training and development of professional skills, organisational management, regulating the industry through contractual procedures, standard setting and implementation. Developing countries have to create their own frameworks by establishing dedicated institutions [17]. Policies affect which institutions evolve – but institutions too affect which policies are adopted. Developing countries have to find ways to accelerate this evolutionary process, and this usually implies the establishment or development of dedicated institutions. The question to be asked here is if these institutions are accepted as successful in terms of their clients' needs and priorities, how they managed it and whether the seeds of the success be identified and planted elsewhere. In order to answer this question, it is necessary to analyse the institutional factors which lead to success in this specialist area of institutional development and in particular examine the dynamic linkages that must exist between such an institution and its operational environment [17].

## 4. Research Methodology

This study is structured as a multiple case design with embedded units of analysis. Case studies rely on multiple sources of evidence which are: archival records, documentation, interviews and direct observations. Agendas, announcements and reports online from the centres' web pages are used as present documentations. Director of CCI and Centre manager of SCRI are interviewed by open ended questions. Case studies are explored by Esman's [24] institution building conceptual framework.

## 5. Case Study 1: Centre for Construction Innovation (CCI)

CCI was formed in 2000 for the promotion of the Rethinking Construction agenda of UK. CCI is a 'not for profit' enterprise, has a strong leadership, directed by a professional from the industry. The main aim is to provide industry and its clients act

collectively to improve performance in the means of productivity, profits, defects and reduced accidents, through the application of best practices and create a 'movement for change'. CCI has a wide range of activities like training, coaching, consultancy, mentoring, procurement and event management services. Total number of employees is currently about 20, including management team and project managers. The ratio of the professionals to the academics is %70 to %30. CCI does not have a complex organisational structure. Centre keeps good relations with all the participants of the Industry and is part of a wide industry network including research centres, governmental and regional policy bodies, training organisations, professional organisations, private sector companies and clients.

## 6. Case Study 2: Salford Centre for Research and Innovation (SCRI)

SCRI was established in January 2002, and it brings together a diverse group of leading international academics, collaborating closely with more than 60 national and international companies and institutions. SCRI is a major influencer of the international research agenda, targeting an institution that will reveal the long term needs of the industry and society to challenge current thinking and develop integrated solutions as well as exploiting research outputs. Consistent with the doctrine of the Centre, research is conducted with four themes: process, people, IT and integration. Their five programmes are: revealing long term needs, challenging current thinking, developing integrated solutions, building research capability and exploiting research outputs. SCRI is funded by the Engineering and Physical Sciences Research Council (EPSRC). They have strong relations with national and international scientific borads and industry intermediaries that diffuse knowledge from academia. Relations with government and policies, internationally complete the picture of linkages.

## 7. Conclusion

These two case studies show the importance of the efficient governmental policies and support of public and private bodies for their common interest. University/research link provides prestige and gravity to the institution. Strong leadership, close relations with public and private bodies as well as the industry, wide range of activities, not for profit structure of the centres are all important issues for being leading institution examples. However the governmental policies and the movement for change agenda shapes the UK construction industry and requires a good understanding to form similar institutions in developing countries for the diffusion and implementation of innovation in construction. Further examples should be studied and number of case studies should be increased for further decisions.

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# Skilled workforce in Sri Lankan construction industry: production vs. acceptance

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*As a predominantly labour intensive industry, construction is highly dependent on the benefits of a skilled labour force. In this regard, effective training programmes that enhance the skill levels of workers are of paramount importance to the industry. By understanding this issue, several training institutes have been set up to produce the skilled workforce required for construction, both in Sri Lanka and overseas. Since literature revealed contractors do not treat the skills gained from such training programmes on their merits during the recruitment of workers, this research was undertaken to answer the research question - "how is skilled labour production catered for and accepted in the Sri Lankan construction industry".*

**Keywords:** Contractors, Recruitment, Skilled workforce, Sri Lanka, Training

## 1. Background

The construction industry depends on a number of groups of people to achieve project objectives, such as architects, engineers, quantity surveyors, developers, general contractors, sub-contractors, a skilled workforce and many others. Among them, one of the groups less discussed than others is the skilled workforce who put great energy and skill into the assembly of building products and systems. These are the carpenters, electricians, plumbers, masons, labourers and many other craft workers who together physically create a product that exists for centuries. Skilled workers are defined in various ways. As per the definition given by Tradesmen [1], "a tradesman is a skilled manual worker in a particular trade or craft. Economically and socially, a tradesman's status is considered between labourer and a professional, with a high degree of both practical and theoretical knowledge of their trade."

Construction is a labour intensive industry that places heavy reliance upon the skills of its workforce [2]. Paucity of a skilled workforce results in poor quality, high wastage and long-term productivity decline in the industry [3]. Therefore it is evident that the recruitment of skilled construction workers emerged as one of the key concern of the contractors. Since training provides an indication of the skill level of the workforce [4] some employers tend to consider qualifications acquired from undergoing formal training course as the basis of recruitment and selection of workers. Literature revealed that there are several training institutes have been set up to produce skilled workforce for construction, both in Sri Lanka and overseas. Thus, this research intends to fill the research gap by studying skilled workforce production and acceptance in the Sri Lankan construction industry.

## 2. Method of study

Desk study was carried out to collect secondary data regarding training programmes available for construction workers in Sri Lanka. A survey approach was adopted for the study. Questionnaires were distributed among 77 recruitment officers (project managers, site engineers and human resource managers) and 34 sub-contractors in six distinct trades (masonry, carpentry, bar bending, painting, electrical and plumbing). Descriptive statistical methods were used for the analysis of data collected from the questionnaires.

## 3. Research findings

### 3.1 Skilled workforce production

The desk study revealed that there are a number of training programmes available for construction workers in Sri Lanka, which were structured in various trades. Some organisations have widened their spectrum to include island-wide training programmes that focus on both rural and urban youth; while others are limited for urban trainees only. Furthermore it was discovered that all five selected key organisations such as ICTAD, NAITA, DTET and CCI are not providing training programmes for every trade. The study identified two schemes for establishing skill levels of construction skilled workforce namely, NTT and NVQ. NTT can be identified as a programme set to test trades and issue "certificate of proficiency" at three levels to those who possess the relevant skills. Informally trained practising craftsmen mostly use this scheme to obtain a recognised certificate. National Vocational Qualifications (NVQ) systems are designed to measure the competency of different vocational skills with the intention of producing a globally competitive workforce in order to suit industry specific, through a standardised technical and vocational education system.

### 3.2 Skilled workforce acceptance

The data analysis revealed that site engineers from medium size contracting firms were more knowledgeable regarding training institutes than the large size contractors. However, it was found that HR managers in large contracting firms possessed higher

awareness regarding training institutes than those in medium size contracting firms. The empirical findings further disclosed that HR managers have ascendancy over site engineers/PMs in terms of awareness regarding training institutions both in medium and large contracting firms. In the case of sub-contractors, electrical and plumbing trade contractors held the upper hand in terms of awareness on training institutes whereas, bar bending and painting sub- contractors were less aware of training institutes.

With respect to the level of awareness, it was disclosed that site engineers of large contracting firms have some awareness regarding training organisations while HR managers' higher level of awareness was alike in both large and medium contracting firms. Considering sub- contractors' awareness, the study found that masonry, carpentry, plumbing and electrical sub contractors are 100% aware of training institutes in Sri Lanka while bar bending and painting counterparts are less so. NAITA was found to be the most popular training organisation among carpentry, electrical and plumbing trades. ICTAD is the most popular training institute among them and DTET was most popular amongst painting sub-contractors.

The study further discovered that recruitment officers often consider formal training qualifications for electrical and plumbing trades while some times they consider it for masonry and carpentry trades. The empirical findings further disclosed that the recruitment officers rarely give consideration for formal training qualifications when recruiting workers in trades such as painting and bar bending.

## 4. Conclusion

It is clear that most of the Sri Lankan contractors and sub-contractors were aware of the available training institutes and courses for construction skilled trades. Through looking at the results, it is obvious that contractors were familiar with training courses rather than training qualifications. According to literature, the general presumption was the contractors' acceptance of formal training courses is not of a significant level. However, this study revealed that contractors consider training qualifications at the recruitment stage as a significant basis for trades like electrical and plumbing. The higher intensity for technical knowledge for the trades such as plumbing and electrical were identified as the reason behind this. However, the results proved that contractors did not give much attention to trades like masonry and carpentry; since, these trades are still enclosed within their traditional boundaries and have undergone lesser improvements in terms of technology.

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# Managing knowledge to produce innovation in Sri Lankan consultancy firms

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*Innovation is one of the major issues identified as important to improve the performance of the construction industry. Construction firms are increasingly being challenged to successfully innovate. The knowledge resources such as human, structure and relationship of the firms are taken as a significant part in the process of innovation. Managing these capitals to achieve innovation is a challenging task for any firm's management. Thus, the aim of this study is to explore how consultancy firms in Sri Lanka, manage this knowledge capital towards innovation. Multiple case studies were conducted by direct observation and interviews with top and middle level managers of the firms. During interviews the documents and archival records were examined. Nvivo software was used to codify and content analyse the transcripts. The findings explore the nature of innovation in Sri Lankan consultancy firms. The results indicate that in the process of innovation, a clients' requirements is a key factor. The study further revealed key focuses, outcomes, drivers, barriers and knowledge capitals in the innovation process of the case study firms.*

**Key words:** Construction innovation, Knowledge capitals, Consultancy firms, Sri Lanka.

## 1. Background

Innovation is one of the major issues in many industries around the world. It is essential for the success in industry performance and for development. Innovation is one of the key activities identified as important to improve the performance of the construction industry [1]. The construction industry faces major challenges, including that of improving its environmental performance and every new construction project has its specific new requirements depending on the demands, existing knowledge, technical and other developments combined to form something new.

The generic innovation model developed by Sexton & Barrett, shows that successful innovation outcomes are achieved through an appropriate innovation focus that is responsive to contextual factors, realised by appropriate organisational capabilities and channelled through effective and efficient innovation processes [2]. There are two principal clusters of thought in the general innovation literature concerning the process of innovation in firms: multi-stage process which comprises recognition, invention, development, implementation and; diffusion stages (for example, see [2]) and non-linear cycle process of different and convergent activities [3]. The innovation process in the firms depends on the internal and external driving factors as well as the barriers.

Managing knowledge is a critical challenge for knowledge intensive firms in bringing about innovation. As Lu and Sexton [4] suggests, appropriate human capability within construction firms is vital for successful innovation and performance improvement. Lu and Sexton [4] recognise knowledge capital (KC); combination of human capital (HC), relationship capital (RC) and structure capital (SC) is the driver for innovation in knowledge intensive firms. By effectively managing these HC, RC and SC firms can achieve successful innovations. Innovation in consultancy firms can be a new idea or new process put to use. Managing the human knowledge (HK), structure knowledge (SK) and relationship knowledge (RK) is a major challenge for these firms to produce innovation.

The literature findings were synthesised, in particular, Sexton & Barrett and Lu & Sexton work, in developing the framework. In this, the organisational capabilities and context components were represented by drivers and barriers. Knowledge capital was added to explore knowledge-based innovation. The research focused on consultancy firms in Sri Lanka and studied three cases, as it provided multiple sources of evidence and probable replication of findings. The data was collected from key participants of organisations such as architects, engineers and quantity surveyors through semi-structured interviews. These followed previously prepared interview guidelines. While conducting the interviews, documents were assessed to strengthen data collection. The organisational culture, communication system and flexibility of the organisational structure were observed. The interview data was analysed using content analysis with Nvivo software.

## 2. Case study findings

As per the innovation focus the key factors of a consultancy firm's focus, identified through the research, could be summarised as: survival in market, keeping competitive advantage, intention on multiple projects, client satisfaction and problem solving. Survival in the market and multiple projects are the most dominating focus in each case. The **client's satisfaction or client relationship development** was identified as the most dominant outcome. Other than this, the opportunity to carry out mega-projects and technical improvements were highlighted as important to the case study firms.

**Client's requirement -** is identified as a key driver from outside the organisation. The study identified that from the architects, engineers and QS views; the **client's requirement, professional's skills and taking on challenges** are the key internal and external drivers to innovation. The barriers to innovation in consultancy firms can be summarised as: **inadequate resources, no proper response from clients, less management intention** and **lack of communication.**

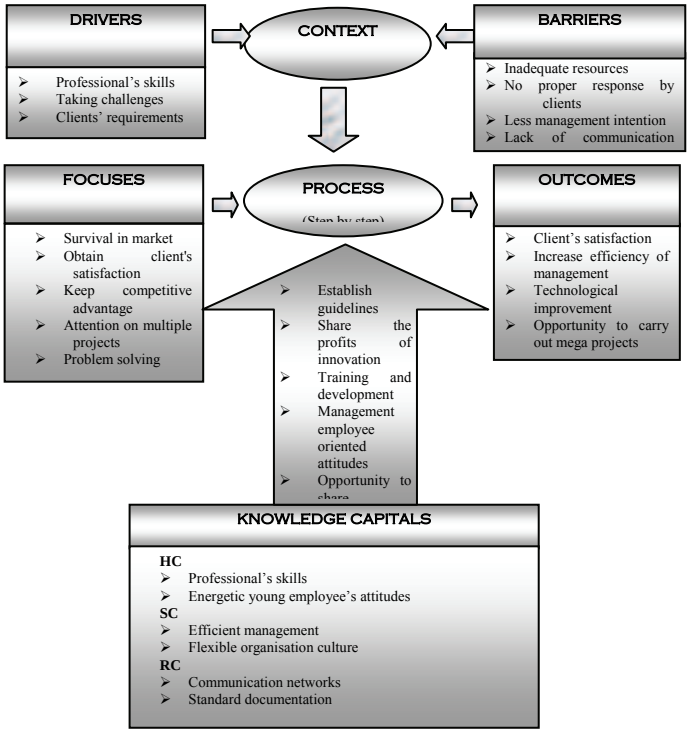
The case study organisations have **professional skills, knowledge from education, and young energetic people's attitudes** - are recognised as human capital. Structural capital such as **standard documentation, established systems and an efficient organisation structure** were identified through the interviews and observation. **Communication networks, a flexible friendship culture and informal get-togethers** were recognised as good relationship capital. The relationship capital used to integrate the human and structural capital.

The development of a **training and development programme** is a key way to increase innovation. The next important management activity is **establishing standard guidelines** to carry out the tasks as a way of managing relationship capital. Other management activities identified from the cases include; **giving adequate responsibility; developing a database; and planning costs**. Within these activities, the allocation and giving of adequate responsibility to employees to suit their skills, increased productivity and lead to innovation.

## 3. Conclusions

In Sri Lankan consultancy firms, innovations have been taking place through their operations. However, they could not be recognised as innovations as such. Since they could not identify the performance lying on that, the process was not successful all of the time. In this context barriers have more power than drivers. To balance this, top management needs to manage knowledge capital. This research explored a framework for successful innovation in the Sri Lankan context (see Figure 1). This framework may be used as a decision making tool by top management in leading innovation.

*Figure 1: Framework for successful innovation in consultancy firms.*

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# Researching "Construction Client and Innovation": pilot study and analysis

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*Clients or users of products, processes or services are being identified as potential sources of innovation in research conducted in various sectors (e.g. IT, aviation, and laboratory equipment). At present there is concern about the construction client's potential to be an innovation promoter within the construction industry. Several researchers have recommended proactive client involvement in construction. Within this background, the authors have designed a research with the aim of 'improving the role of the client in promoting innovation'. In this context, this paper is an attempt to elaborate on the initial findings that emerged from the initial pilot case study*

**Keywords**: Construction industry, Construction client, Innovation, Case study design.

## 1. Background

Lack of coordinated effort has been identified as one of reasons for that the lack of innovation within construction despite having the capabilities and potential. Within this scenario the construction client is looked upon as a person who can coordinate and direct the construction process towards innovation. This background drove the authors to formulate a research with the aim of "improving the role of the client in promoting innovation". To achieve the aim of the research in line with epistemological, ontological and axiological assumptions, the authors have selected the case study method as the best fit research strategy. This research paper highlights the criteria behind the case study process and discusses the main themes that emerged from the pilot case study

## 2. Case study design

### 2.1 Definitions

The authors have selected 'the client's role in innovation' as the unit of analysis within the case of innovation of the project. In line with established definitions in literature (see [1]) the authors have adopted the 'application of knowledge to a given context in order to implement significantly new processes, products or management approaches that will lead to increase efficiency and enhance rate of return' as the definition of innovation for this particular research on innovation. The authors take this view that the client is the one who funds the project [2]. However the authors narrow the definition of client to member(s) of the funding body who directly interact with the project whereas the funding body can be an organisation or an individual.

### 2.2 Case selection

The authors have selected the holistic multiple case study method [3] as the suitable approach to case study design in line with the type of study, research questions and the unit of analysis. Case selection was selected deliberately based on the partnering environment as the partnering contracts provide opportunity for better communication, learning and innovation [4] as well as better opportunity for the client to participate in innovation process

### 2.3 Data collection and analysis

Researchers devised semi structured interviews as the main data collection method for this study due to its ability to facilitate in depth inquiry into the issues [3]. The data collected from the pilot case was categorised or coded as the initial step of data analysis (see [5]) using computer aided qualitative analysis software packages. General themes were identified from the set of data collected as well as from literature. These themes identified are discussed in the section below followed by a description of the background of the pilot case study; Project Y.

## 3. Findings from pilot case study

Case study Y is about the client's role in the development and execution of an innovative repair solution to a condemned central pier of a bridge in the North West of the UK. In the following sections findings and major themes revealed are discussed in a logical sequence.

### 3.1 Client as a manager of the innovation

This particular research on the client's role in innovation confirmed that the client is performing a role of a manager because he was engaged in basic functions of management which are planning, organisation, direction and control. With this view of the

client as a manager the authors have discussed the client's characteristics under three broad categories i.e. interpersonal, informational and decision making roles of the client, by adopting the roles of manager identified by Mintzberg.

### 3.2 Interpersonal role of the client

The client's ability and willingness to be a team player was identified as one of the most important contributory factors to the innovation by the interviewees in the case study. Relationships built between the client and the rest of the project team strengthened by mutual trust and understanding, respect for people and client's proactive approach resulted in highly satisfactory achievements. The mutual trust developed gave courage to other team members to make bold and inevitably risky decisions that formed the backbone of the innovation. Coordination is another important interpersonal role performed by the client that helped to raise the innovation culture among the team members. The effective coordination mechanism set by the client enabled the designers to directly liaise with relevant personnel in other offline divisions (divisions of client organisation that are not directly linked to the project but essential, such as technical approval divisions) without going through the lengthy bureaucratic route. During the interviews it was asked whether the client could be seen as the driver of the innovation as it is a well debated topic among scholars. However, most of the participants were doubtful about considering the client or any one person as the driver – instead a collective team effort was emphasised. Even though the client half-heartedly admitted after some thought "y*es I like to think so (as a driver)...yes*" he went on to acknowledge the designers and the specialist contractors as the main source of innovation.

### 3.3 Informational role of the client

It became evident that client is engaged with large amount of information processing and monitoring activities which has a bearing on the innovative outcomes.

The client's willingness to be kept updated with the scheme development rendered positive outcomes as it reduced approval times because client did not need to spent time on understanding what designers were asking. Furthermore the client brought in the knowledge about procedures and processes of the client organisation that helped the design team to direct the design towards the correct goals that determined the project's success.

Even though the client did play a highly appreciated role in providing and processing information, the client identified effective transfer of lessons learned from this project to future projects as an area where they have failed.

### 3.4 Decisional role of the client

Within the context of the project the client was required to make decisions based on authority vested and the information received. The participants to the interviews were impressed with the client's ability to make timely decisions and the ability to face the risk involved with those decisions. However the client admitted that the strength to face risks stems from past experience and competence.

The client's ability to look forward at different angles was identified by the project participants as a major advantage. The vision of the client led the designers towards the innovative solution and the saving of a considerable amount of time and money.

## 4. Way forward

The authors identified the collection of data from further cases as an essential next step in the research. The data collected will enable the researcher to carry out a further in depth case data analysis as well as cross case data analysis which will improve the reliability and the generalisability of the findings.

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# Capacity Building for Sustainable Enterprise Development

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*The importance of 'Capacity Building' across industries was realised in the last decade. The concept is rarely concerned in contracting organisations due to the nature and features of the industry. The study focused to develop a framework by identifying the relevant capacity building in contracting organisations towards the sustainable enterprise development. It focused the organisation's vision and mission which ultimately drives towards the enterprise sustainability.*

**Keywords:** Capacity Building, Sustainable Development, Contracting Organization, Sri Lanka.

## 1. Background

The term 'Capacity Building' often implies, the activities, which are carefully planned and executed, in order to build the capacity. It encompasses the country's human, scientific, technological and resource capabilities [1]. It provides organisations to access the current knowledge sources and skills, innovative and proven methodologies; networking and funding opportunities, replicable models for addressing community needs and managing resources, options for organizational management and governance and strategies for advocacy, government relations and public outreach. Therefore it was recognised the capacity building is one of the most decisive issues that need to be addressed in world wide scale in construction organisations. In simple terms, an organization's capacity is its potential to perform its ability to successfully apply its skills and resources to accomplish its goals and satisfy its stakeholders' expectations [2]. It can be expressed in terms of effectiveness, efficiency, relevance, and sustainability [3].

### 1.1 Contracting organisations' capacities

When it comes to construction, the contracting organisations are needed to be sharpening their existing capacities as well as drive for the new capacities. The organizational capacity development is undertaken by the contracting organization through its own decisions which relates to the several elements of it. Because they are dealing with large number of transactions, there is a need to create an efficient and effective system in the organisation.

However it's hard to find a concrete framework for contracting organisation's capacity development towards its sustainable goals as the capacities differ from one organisation to another and it will vary with organisation's vision and the mission.

### 1.2 Sustainable enterprise development

Sustainability is a systematic concept, relating to the continuity of economic, social, institutional and environmental aspects of human society [4]. It seeks to create conditions where social and environmental benefits which can simultaneously help to drive the business forwards. Danny [5] have identified capacity building as one of the most significant factor when the contracting organisations moving towards the sustainable goals.

Capacity building in organization is one of the most fundamental management activities that realise the vision where the organization wants to be in the short and long term future. Therefore any performance management system will need to have a strategy as the main input to build the organizational capacity, so that any result coming out of the system could be used to evaluate the extent to which the organization has met its capacity in terms of management, people, resources, partnership, financial, marketing, risk, knowledge, facilities etc. Since sustainability is the most significant concept which greatly influence on the quality of human life, the organization should always decide on behalf of the sustainable values and establish their vision and mission.

## 2. Research Methodology

This research was focused to introduce a framework for capacity building in contracting organizations towards its sustainable goals. It basically explores the current organizational capacity, key areas to be improved, existing development programmes, and future avenues of new capacities. The survey was limited to M1 and M2 grade contracting organizations that are operating in Colombo metropolitan region. Data was gathered from twenty five contracting organizations (25) to develop the framework.

The framework analyses how the organization can performs successfully to achieve the sustainable goals through capacity building. It comprises of two main processes. The identical driving factors and the way they are able to achieve the organisation's sustainability. IDEF0 method was used to model the functions of the contracting organizations, which creates a graphical model of what controls the function, which performs it, what resources are used in carrying it out, what it produces, and what relationships it has with other functions and at the last to visualize and present the framework.

## 3. Data Analysis

The derived data through the questionnaire survey was analysed using the five point numerical rating scale, where 1 represented 'low important' and 5 stood for 'significant'. It was found that identical areas for capacity building in contracting

organisations as management, financial, resources, marketing, information systems, research and development, documentation, quality assurance and other external factors like environment sustainability. The level of significant is more than 70% in all the aforesaid areas.

## 4. The Framework

The framework starts with leadership as the main driving factor for change and the improvement of the organisation. Leadership should focus on customer, people and other stakeholders while focusing on sustainability in terms of social, economical and environmental, which in turn should guide the development of strategic plans. The strategic plans are further detailed into functional and programmatic capacity building plans such as financial management, human resource management, resource management, facilities management, partnership and supplier management, organizational knowledge management, information system management, risk management and research and development. Those are incorporated to the process for establish the sustainable construction and the sustainable organisation. Once when it is implemented the project plans and the organizational processes, improved project results. Improved project results will affect customer, people and other stakeholders' satisfaction on the organizational level, which would finally reap organizational business results and carry the organization towards sustainable development. Organizational culture and information analysis were identified as the controlling factors of contracting organisation towards its journey to sustainability. The framework facilitates the capacity development through joint venturing, handle a proper network of contracts, producing a qualitative products as well as the customer satisfaction in contracting organisations.

## 5. Conclusion

The developed framework is tested in its adoptability and the acceptability among six selected contracting organisations. Out of six, five organisations (83%) accepted the framework and they commented it is in par with their organisational vision and mission. Therefore it can be concluded the developed framework on capacity building direct the contracting organisation towards its sustainable goals.

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# Lifelong learning as a tool for updating technical knowledge

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*Employers are looking for proficient and skilful workers. The personal demands of the workers have to be balanced with the economic demands for training and education. Many employers have chosen to adopt a policy of emphasizing education and training that lasts throughout workers lives. We agree that life-long learning is important given the context of today's rapidly developing technology and business practices in a globalize economy. Our goal is to determine how we can organize workforce education, and make knowledge more approachable to women and people who live far from universities. We will also consider ways to help those who need to improve their technical knowledge late in their careers, and also to help those who have entered the workforce without higher education.*

**Keywords:** Education, research, lifelong learning, training, adults, women, family

## 1. Background

"Adult learner" defined by the European Parliament, means a learner participating in adult education [1]. Life-long learning refers to persons aged 25 to 64 who stated that they received education or training. [2].

EU Commission to the Council – Adult learning published on October 2006 paper with the title,"It is never late to learn". They wrote about lifelong learning and how important lifelong study is for economic competitiveness, demographic change, poverty and social exclusion [3].

### 1.1 New countries in EU – position and work condition

The EU numbers 27 countries [4]. In 2004 the European Union accepted ten countries (Cyprus, Malta, Slovakia, Slovenia, Poland, Hungary, the Czech Republic, Latvia, Lithuania, and Estonia), Romania and Bulgaria joined in 2007. All new EU countries had been in a new position. Ten countries, excluding Cyprus and Malta, come from a socialist system. For further progress they need a good education and the possibility to acquire new knowledge. Technical knowledge and high technical profession experts are wanted because this kind of people are lacking. Why? In fact, technical knowledge is not as popular as other knowledge like law or economy. All around the world the situation is similar and in the last few years many governments strive to make these fields of knowledge more popular.

### 1.2 Courses in University

Most universities in the EU offer fixed programs, which proofed by government before they are implemented. Undergraduate program last 180 ECTS (1 ECTS is to Bologna Declaration about 25-30 hours which included lectures, personal work [5]). Most of programs are designated for a population that does not have work and family obligations.

### 1.3 Why are high degrees not good for adult learner

Across the EU the work week averages 35 to 42 hours. A lot of people spend more then one hour per day commuting. If we add that together it amounts to 11 hours per day. Average required time to sleep is six to nine hours per day [6]. For family, hobbies and personal activities this theoretically leaves six hours per day free and women often have difficulty juggling their professional and family lives.

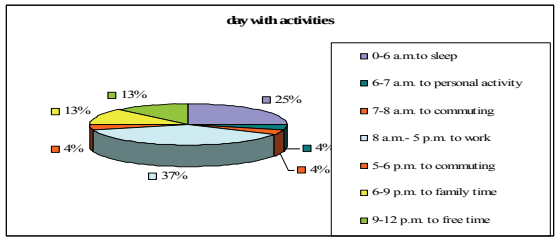


*Figure 5: activities in on day*

## 2. New solutions

If we look around universities we can see universities offering short and summer courses in technical fields. They also offer distance learning or e-learning programs. The other form of distance education, often called hybrid, supplements traditional classroom instruction with online resources. New computer technology made virtual worlds called »Second Life« [8] that are beginning to change

higher education. But in spite of this, in the next 5-10 years, distance learning and e-learning will be a good option for adult learners.

### 2.1 Fees and financial situation in Europe

For a good education you often need a lot of money. The fees are not low. In the 27 European countries we have 268 regions [10]. We have big differences between the highest and lowest regions ranged (Table 1).

*Table 3: A data of GDP expressed in terms of PPS in % - the five higher and five lowest regions over Europe*

| Region (Country) | PPS (%) | Region (Country) | PPS (%) |
|---|---|---|---|
| Inner London (UK) | **303** | Sud - Muntenia (RO) | 28 |
| Luxembourg (LU) | 251 | Severen tsentralen (BG) | 26 |
| Bruxelles-Cap. (BE) | 248 | Yuzhen tsentralen (BG) | 26 |
| Hamburg (DE) | 195 | Severozapaden (BG) | 26 |
| Wien (AT) | 180 | Nord - Est (RO) | **24** |

In fact, for many people from countries with low PPS (purchasing power standards) areas in Europe, studies in other countries with good faculty or good programs, is too expensive and unattainable.

### 2.2 Creating the condition for successful education for adult learner

The percentage of adult students, who want to study, is increasing. One education model, suitable for adult learners in EU, Learning Through Work, is found on University of Derby web site [14]. Learning Through Work is a way of getting a university qualification without having to leave the workplace. It's a form of work based learning. It's based on the simple premise that people don't always need to attend college or university to learn, because learning is part and parcel of everyday working life, and promotes continuing professional development.

## 3. Conclusions

Responsibility for life-long learning and good technical knowledge is not just that of an individual. It is also the responsibility of the EU Commission, government, universities and employers. Life-long learning, like open learning and long distance education featuring pre-recorded lectures, e-learning (tutorial hours and practical modules that can be performed over a block week, with flexible schedules, or an individual program) are much better for the adult student then standard and fixed programs that the government proofed ten years ago.

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# The Importance of the Construction Sector: Measuring its Value

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*An essential issue in consideration of the state of the construction sector and its relationship with the macroeconomy is measurement of the activity of the sector. To fully appreciate the economic value of the construction sector, a distinction needs to be made between the value of the sector in the economy and the value to the economy. A narrowly-defined construction industry contributes around 5-6 % of Gross Domestic Product (GDP) in many developed countries, whereas, on a wider definition, the contribution may be roughly twice this size [1],[2]. On the basis that the entire built environment falls into the field of activity of construction, however, the value to the economy may even be considered to be as high as 20% of GDP. The latter figure is based on the 'framework system approach' to analysing the construction sector. The rationale behind this approach and its use in understanding the construction sector's role in sustainable development are developed and explained. Data on Sri Lanka are presented to consider the validity of the approach in the context of a developing economy.*

**Keywords:** Construction sector, Macroeconomy, Evaluation.

## 1. Background

Construction activity represents a significant share of the economies of most countries in terms of its contribution to GDP and total employment and it is also an important market for materials and products produced by other sectors of the economy. The Pearce Report in the UK considered construction both in its narrow sense (on-site construction activity) with its contribution to GDP at around 5% and in a broader definition (including quarrying of construction raw materials, manufacture of building materials, sales of construction products and various associated professional services) making a contribution of about 10% of GDP.

To consider construction activity to be merely the act of building is to take too narrow an interest. The productive issue to be solved by construction is more wide-ranging and represents a considerable economic and social challenge. It is a question of producing and managing the living and working environment of the whole population. The entire built environment, as distinct from the natural environment, falls into the field of activity of construction. The traditional perception of the contribution of the construction industry to the economy is based on the methodologies employed for the definition and measurement of construction activity according to international standards. Construction activity has changed in response to new demands over recent decades and an evaluation is made of a new approach, to focus on construction activity to meet the changing needs of the economy and society. The role of built assets in the development of a nation needs to be considered and it may be that broader measures of the economic value of the built environment are needed in order to allow an assessment of the contribution of the built environment to quality of life and to enable the value of the construction industry to be properly understood. This basic definition of the construction industry does not include other value-adding construction activities such as:

*Upstream* - manufacturing, mining and quarrying, architectural and technical consultancy, business services.

*Parallel* - architectural and technical consultancy.

*Downstream* - real estate activities.

## 2. A new approach

The case for a new approach to the valuation of construction activity has come from two other areas. Firstly, the 'International Council for Research and Innovation in Building and Construction' (CIB) *Revaluing Construction* agenda focuses on improving the value of the final construction output and requires that the totality of activities involved in the production of the built environment is reviewed. Secondly, Carassus [3] proposes a framework system approach for understanding the construction sector. The rationale for this approach is based on the view that the role of the construction sector should be viewed in a wider context than that of the narrowly-defined ISIC definition of the industry.

## 3. Measuring the contribution

Research undertaken at the University of Salford, as part of the CIB Revaluing Construction agenda has produced an assessment of the contribution of the construction sector to GDP, based on the wider linkages of the sector using analysis of UK Input-Output tables. This more detailed break down of how the construction industry contributes to the economy also has the advantage of showing which areas have most importance (value added importance rather than actual importance within the chain) to the economy. This analysis can be applied to other developed countries and Figure 1 shows the estimated size of the construction sector for twenty European countries, when the same type of metric is applied.

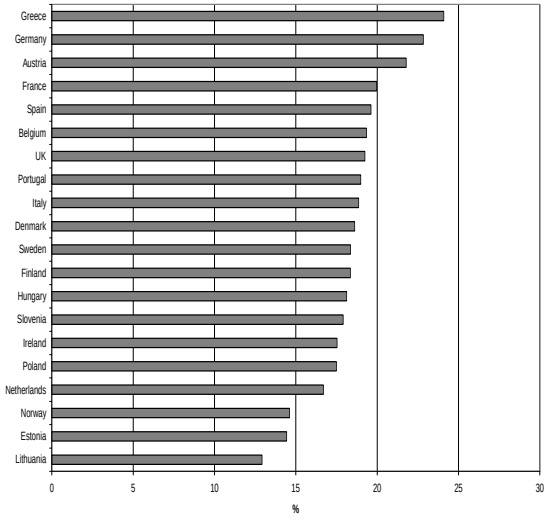


*Figure 1: Size of the construction sector as % of GVA*

Using a similar approach in the context of a developing country (such as Sri Lanka), an activity level for the sector can be determined (Table 1).

*Table 1: % share of GDP by origin at constant prices of construction sector activities in Sri Lanka*

| **Divisions** | **%** |
|---|---|
| Construction [Division 6] | 6.4 |
| Parts of:<br>Mining [Division 3.2]<br>Manufacturing:<br>(Rubber and plastics) [Division 4.2.3]<br>(Fabricated metal products, machinery and equipment) [Division 4.2.5]<br>Banking, insurance and real estate [Division 10]<br>Ownership of dwellings [Division 11] | 10.4 |
| **Total** | **16.8** |

## 4. Re-evaluation

This paper attempts to put forward a case for a re-evaluation of the construction sector in order to deliver a step change in quality of output and thus develop a sustainable built environment. At the core of the discussion is the issue of the nature of a sustainable built environment

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# Capacity building: A framework for the built environment education

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*Capacity building is a continuous process which delivers better services by developing and strengthening the skills, instincts, abilities, processes and resources that organisations and communities need to survive, adapt, and thrive in a fast-changing world. There is a considerable demand for built environment education with the rapid growth of humans and their pattern of thinking. Therefore the importance of built environment education has been recognised as a present day requirement. To meet these challenges, it is essential to improve the existing capacities or introduce new ones to built environment education. This research focused on developing a framework to explore capacity building in built environment education and test its validity within the Sri Lankan context. A comprehensive literature survey, structured questionnaire survey and structured interviews were carried out to achieve the research goal. A high level of acceptance was found for the proposed framework among local professionals with proven experience in built environment education.*

**Keywords**: Capacity building, Built environment education, Institutional framework

## 1. Background

There is a growing concern for the safety and security of civil infrastructure in relation to natural and man-made disasters. Due to the high demand for the built environment, it is important to enhance the capacities of built environment education. But improving the existing capacities and introducing new ones are significant in both the built environment and higher education system. Therefore this research tries to develop a framework for built environment education and create a path for capacity building in built environment education that then leads to a sustainable environment.

### 1.1 Capacity building

Capacity Building (CB) is not a new concept and has been used in a number of fields to improve human resources and organisational structures. Researchers, policy makers and other leaders in different industries have used the concept of CB to evaluate and assess the potential, ability or capability of a group of people, team, company or even society to attain self-proposed goals [1]. The CB approaches vary and change depending on the organisations and their visions and missions. The concept has evolved from a standard approach to a systematic and individualised method of analysing a system's needs [1]. It is important to adopt the concept to any system but it is critical to conduct an evaluation of the system before implementing and setting goals that may then prove unrealistic within its current capacity. The evaluation of a systems capacity to perform certain skills or reach specific goals is also important to determine what works and what changes are needed [2].

### 1.2 Built environment education and capacities

Carter [3] states the role of a higher education sector related to Built Environment (BE) as a promoter of BE degrees, to: develop skills related to the industry needs, develop a long term aspiration for a career in the construction industry, foster "enthusiasm" in BE. The International Union of Architects [4] identified architecture and other facets of the material culture as focal points of BE education. In general, the means and ends and the conditions and consequences of human interventions in the natural environment comprise the subject matter of BE education. The BE education prides itself in its design of ladders, nets and bridges to allow students to progress from one qualification to another, to provide some safeguards for students where they do not perform to an adequate level and to allow its qualifications to be recognised by other subject disciplines [5].

There is growing concern for the safety and security of civil infrastructure in relation to natural and man-made disasters. Safeguarding the future requires the expertise of professionals involved in the design, planning and construction of the built environment. This is particularly important to ensure that safeguards have the long-term vision to not only protect this generation, but future generations also [6]. Therefore the necessity has been recognised to enhance the BE education in its local context as well as in the international context.

## 2. Research methodology

A Questionnaire Survey [QS] focused on close ended questions by asking about the significant level of capacities from BE professionals. The derived level of significance of the QS was confirmed through structured Interview Surveys [IS] among professionals practicing in the construction industry and academic institutions.

# 3. A framework

At present there are many capacity development programmes underway in various sectors including higher education. There are individual frameworks to guide capacity building and built environment education. But no one framework addresses both concepts together. Therefore this research focused on developing a framework for CB in BE education.

## 3.1 Development of the framework

The framework encompasses three domains. These are: the capacities of higher education, the process and the capacities relating to built environment education. Each domain involves different issues and mechanisms. The domain includes the concepts of BE as an educational object; capacities in both institutional and programme level. Through mapping the ideas generated through the QS and the IS the institutional capacities were categorised to two arenas as core and supportive. Teaching, learning and research are identified as core capacities. Management and governance, infrastructure and finance were considered as supportive. The programme level capacities play vital roles in the framework. By exploring the available capacities of higher educational institutions the programme level capacities were embedded into the model.

## 3.2 Features of the framework

It is noteworthy that the new framework has been equipped with several user-friendly features than would the results obtained through the application of one concept without knowing the other. Introducing this framework will create a path to capacity building in built environment education. Implementing capacity building in regular intervals will give a good output to the institution. This framework is based on built environment education and focuses only on undergraduate courses. So this framework will give a clear picture of built environment education capacities. The proposed framework covers all the capacities and gives a clear idea about built environment education capacities. Achieving the sustainable built environment or, maximum or optimum use of resources can be achieved through the capacity building process.

# 4. Conclusions

Higher education institutions have been confronted with far-reaching demands and challenges. Safeguarding the future requires the expertise of professionals involved in the design, planning and construction of the built environment. But improving the existing capacities, introducing new ones is significant in both the built environment and higher education system. To deploy capacity building in BE education it is significant to develop a framework for BE education. This study aimed, by means of a thorough literature survey, at exploring the perceptions, challenges, capacities of BE education. Research then focused on identifying the link between capacities involved in BE education and concluded with a framework for its development and validation. The developed framework was tested in its validity through expert opinions and subsequently modified based on feedback. The practical validity of the completed framework needs to be tested in a built environment education institute. It is already accepted by the experts who have proven experience in BE academia. Therefore it can be concluded that the proposed framework could be sharpened through practical application. When an institute does this it is advisable to identify its capacities. The institute applying this framework should clearly define their organisational goals, objectives, vision and missions and benchmarks. This framework will give a clear path for capacity developments in built environment education institutes, thus it will lead to sustainable built environment education.

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# Small and Medium Size Contractors in Swaziland: Current Challenges

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*In Swaziland the construction sector is not only a significant source of direct employment but also a sector which contributes, through its wide range of projects and operations. The Swazi economy is unable to deliver employment for a growing number of would-be workers. Structural unemployment and poverty are persistent and growing problems in contemporary Swaziland. Small businesses have been advocated as an important means of generating employment in which Swaziland is not an exception. The paper will first outline the arguments that have been put forward for the development of small contractors in the construction industry in sub-Saharan Africa. The paper will then describe the problems and successes that have been experienced in Swaziland in relation to small contractor development programme. The paper will conclude with recommendations for the future which will enhance the success of small contractors in Swaziland*

**Keywords:** Contractor, Construction, Development, Employment, Programme, Small Businesses, Swaziland.

## 1. Introduction

In Swaziland and other countries there seem a general consensus that small enterprises are the mainstay of economic growth and prosperity. Small contractors can be powerful instruments of generating job opportunities; small contractors can perform small projects at different and remote geographical locations that might be unattractive to big firms or too costly using the big firms; low overheads enable small contractors to work at more competitive prices; large number of functional small and medium scale black contractors can help to decentralise the construction industry dominated by established large contractors; the relatively low skills and resources required at this scale can easily lower the entry point for the small and medium size owners to begin to participate in the industry; and a large number of functional Swazi owned contractors can develop a platform for growth and redistribution of wealth in Swaziland. At a time when the public sector and big business are shedding jobs, small businesses are maintaining real employment growth. The small contractor development programme falls under the Ministry of Public Works and Transport. The main mandate of the ministry is to ensure the provision and maintenance of a sustainable public infrastructure, an efficient and effective seamless transport system and network, regulation for a vibrant construction and transport industry, management of public service accommodation and the provision of meteorological services. In carrying out its mission, the Ministry is committed to upholding safety and environmental standards for socio-economic development by making the best use of the country's available resources. The following are the responsibilities of the ministry: construction and maintenance of Government buildings; construction and maintenance of public roads; administration of the Road and Outspan Act; planning and Regulation of Road Transport Services; Government Transport Administration; administration of the Road Traffic Act; administration of the Road Safety Act; Road Transportation Act; Government Housing; Royal Swazi National Airways Corporation; Civil Aviation; Meteorological Services; Regulation of Air Transport Services; and Regulation of Rail Transportation Services

## 2. Emerging Contractors in South Africa

In South Africa, the contractors enter the market at the lower end and in the general building contracting category, making the sector extremely competitive and unsustainable[1] and the emerging contractor policies intended for black economic empowerment (BEE) are being used as job creation opportunities, which contributes to the over crowding of the emerging market. It is common for black businesses to be based on technical skills which are based on technical skills, which are used to satisfy needs of the community. However, technical competence is no guarantee of business success. Operational (e.g. scheduling and ordering) and business (e.g. planning, financial control and budgeting) skills are vital to the success of any enterprise. It is precisely these skills which are often lacking in the black business and it is thus imperative that these are developed if the industry is to expand to accommodate the meaningful black presence that is necessary for economic growth.

Small enterprises contribute positively to the economics of the country and to the survival of large numbers of people. However, the success of small enterprise is impaired by the common weakness from which many enterprises suffer. South Africa is faced with a large challenge of developing infrastructure in the communities which were previously disadvantaged, and also upgrading the existing infrastructure to cope with the high demand. This category of contractors is the preferred vehicle of delivery of infrastructure to communities [2].

## 3. Problems Facing Small and Medium Size Contractors in Swaziland

The problems facing small contractors are not unique to Swaziland. The vast majority of construction firms are small enterprises that rely on outsourcing personnel as required. This has severely affected skills training and the retention of expertise in the industry as construction workers become highly mobile, walking in and out of the industry, depending on performance in other sectors of the economy. The impact can be seen in the rigid adherence to management techniques and construction practices handed down from colonial times which, as a result of inadequate skills and capacity. Delays with interim and final payments, as well as onerous contract conditions faced by construction firms, can also impose huge constraints on the industry. Many construction firms have suffered financial ruin and bankruptcy because of delays in payment, which are common with government contracts. Contemporary research that was conducted in 2007 by the authors revealed the

current reasons for the failure of small and medium size contractors in Swaziland. 87 owners of the small and medium size contractors were interviewed. 68% of the contractors are less than four years; 20% are between 5 and 9 years; and 12 % had operated for more than 10 years. There was no contractor that had operated more than 15 years. 63% of the respondents believe that the four major banks in Swaziland have proper systems in place to support small and medium size contractors once they have secured work. On the other hand 37% of the respondents do not believe that the four major banks in Swaziland have proper systems in place to support small and medium size contractors. 33.4% of the respondents think that the current environment within the construction industry in Swaziland is favourable for small and medium size contractors to be successful. On the other hand 66.6% of the respondents believe that the construction industry environment is not favourable for the success of the small and medium size contractors. From the research conducted it can be concluded that the relative lack of success among the small and medium size contractors in Swaziland is a results of the following problems which must be addressed in order for the contractors to be successful: A lack of resources for either large or complex construction work; An inability to provide securities, raise insurance and obtain professional indemnity; The contracts were inevitably packaged in such a way as to exclude small contractors; Inadequacy in technical and managerial skills required in project implementation.; Lack of continuity in relation to type, scale and location of work; An inadequate approach and insufficient knowledge, time and experience required for the whole process of finding work, once found, insufficient understanding of the contract documentation and the preparation and submission of tenders; Slow and non-payment by government after completing a government project.

## 4. Lessons and Recommendations

The planning processes in Singapore and Malaysia are comprehensive, detailed and act as a guide for different Ministries to set quantitative and qualitative targets for delivery institutions. The planning process involves extensive consultations and input by a broad range of stakeholders, which is then co-ordinated and submitted to cabinet and finally parliament as the Industrial Master Plan. These plans tend to unite society around a common purpose and vision. Integral to economic planning in Singapore and Malaysia is targeted financial assistance for broad based, industry based and sector based schemes with focused assistance programmes e.g. machinery, factory premises, raw materials, training programmes, industrial linkages, technology and research and development. The interest rates for the contractor programmes are generally lower than bank loans. The overall plan identifies certain industries and sectors as crucial to the economic development of the country. Holistic support programmes including financial incentives are introduced for identified sectors and industries. None financial support programmes cover a focused and wide range of issues including targeted training, quality circles, research, mentoring, design and product development, skills development, Local Enterprise Upgrading Centre, infrastructure development, export development, technology development and technical assistance. These support programmes are closely linked to the financial packages e.g. the buying of machinery requires, optimal training in the use of such equipment. Support programmes are not seen in isolation to the broader strategy and guides entrepreneurs in fulfilling the targets set. The programmes are able to rapidly shift focus and resources. The Singapore Local Enterprise Upgrading Centre acts as a first stop for SMMEs giving assistance in technical consultancy and financing. It co-ordinates government programmes administered by a range of institutions. The first stop centre avoids bureaucracy for the entrepreneur and increases delivery efficiency. Government procurement is clearly an important mechanism in redistributing resources and opportunities in society. In Malaysia the government has actively used procurement as a means to empower, skill and redirect resources to the Bumiputeras.

## 5. Conclusion

The small and medium size contractors in Swaziland is relatively underdeveloped, mainly constrained by limited access and high cost of capital and weak support programmes from government. There is also lack of skills. The most important deciding factors in the development of small contractors in Swaziland are to address the issue of access to finance, shortage of skills and adequate support from government must be a priority. Survival, growth and expansion of the small business sector are essential for economic growth and job creation in Swaziland. Small businesses represent over 95% of the total number of business organizations in the United States of America [7]. Thompson [8] points out that small businesses employ six out of every ten people and have been responsible for more than half of all the innovations developed during the 20$^{th}$ century. Haswell & Holmes [9] they attribute small business failures to the following: managerial inadequacy, incompetence, inefficiency and inexperience in running a business venture.

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# SECTION VI

## DISASTER MITIGATION

# Gender mainstreaming in disaster reduction: why and how?

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*Disaster reduction policies and measures, which ensure decrease of vulnerabilities, need to be formed and implemented to achieve a sustainable and consistent plan of disaster management. Since women are more vulnerable in disasters, their needs and concerns should be widely integrated into disaster risk reduction plans and procedures from both perspectives of women as beneficiaries and decision makers. Gender mainstreaming is considered an important element in disaster reduction policy making to integrate a gender equality perspective in all policies at all levels. This paper reviews literature on disaster reduction and gender mainstreaming to emphasise why gender mainstreaming has become a necessity in disaster reduction attempts and to highlight the ways in which it can be achieved.*

**Keywords:** Disaster reduction, Gender mainstreaming, Women

## 1. Background

### 1.1 Introduction

Since disasters cause large-scale damage to human life, their livelihoods, economic and social infrastructure and environment [2],[5] and these damages had shown a significant increase in the last one and a half decades [5], the world is in serious need of a sustained and comprehensive disaster reduction strategy. In achieving this, needs and concerns of all social groups such as poor, rich, men, women, young, old, indigenous or non-indigenous must be necessarily integrated into the disaster reduction policies and measures because the level of vulnerability depends on these social aspects [2].

The main aims of this paper are to highlight the importance of gender mainstreaming in disaster reduction policy making and to discuss the ways of mainstreaming gender. Accordingly, this paper reviews academic literature, papers and reports produced by the United Nations International Strategy for Disaster Reduction (UN/ISDR) and various other institutions on disasters, disaster reduction trends and practices, gender mainstreaming, its importance and the suggested ways of integrating gender mainstreaming to the disaster reduction policies and measures.

### 1.2 The way disasters are seen

Disasters are defined and interpreted in different ways by scholars and institutions. Shaluf et al. [5] indicates none of the definitions of disasters are universally accepted yet. The way that the disasters are defined varies according to the discipline in which they have been defined. However, almost all the definitions elaborate a disaster as an event which disturbs the social structure or the environment, causes a significant loss and needs external assistance in recovery. McEntire [4] puts forward a different perspective of disasters by indicating that disasters as the disruptive outcome or human-induced triggering agents when they interact with and are exacerbated by vulnerabilities from diverse but overlapping environments.

Disasters are often divided into two main categories as natural and man made according to their cause [5]. Initially disasters were seen as hazard agents but subsequently the disasters irrespective of whether they are natural or man made were believed to emerge as a combination of a triggering agent/hazard and vulnerabilities [4]. UN/ISDR [3] defines vulnerability as the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

## 3. An overview of disaster reduction

Building a culture of prevention through reducing disaster risk is important to avoid or limit disasters. Apropos, disaster reduction incorporates taking measures in advance, addressing risk reduction, involving environmental protection, social equity and economic growth, the three cornerstones of sustainable development, to ensure that development efforts do not increase the vulnerability to hazards [2]. The United Nations International strategy for Disaster Reduction (UN/ISDR) is considered to be a pioneer in disaster reduction movement in the international context. ISDR aims at building disaster resilient communities with four main objectives for disaster reduction.

## 4. Gender mainstreaming and disaster reduction

“Disasters affect women and men differently because of the distinct roles they occupy and the different responsibilities given to them in life and because of the differences in their capacities, needs and vulnerabilities” [1] (p.51). It is believed that women are more vulnerable in disasters because of the social values. On the other hand, in current practice of disaster reduction women are seen as helpless victims and their capacities, knowledge and skills in each stage of the disaster cycle are not recognised specially in the leadership, management and decision making positions [1]. Gender mainstreaming can be used to

bring equality into disaster management through considering the specific needs and interests of vulnerable women before, during and after disasters. Gender mainstreaming in disaster reduction refers to promoting awareness about gender equity and equality, to help reduce the impact of disasters and to incorporate gender analysis in disaster management, risk reduction and sustainable development to decrease vulnerability [2].

## 5. Conclusions

Gender mainstreaming in disaster reduction allows women to decrease their vulnerability through identifying their specific needs in a disaster at the disaster management planning stage. Women are empowered by gender mainstreaming to reach equality in decision making roles in disaster reduction and to utilise their skills in planning and implementation of policies and measures. After identifying the existing roles of men and women through gender analysis, gender mainstreaming helps to achieve equality in disaster reduction by giving a comprehensive understanding of the possible effects of policies and measures developed for disaster reduction on gender roles. However, since disaster reduction and development have a close inter-relationship, gender mainstreaming in disaster reduction is a parallel and inter-linked process to mainstreaming disaster reduction into sustainable development policies.

## 6. The way forward

As this paper discussed, gender mainstreaming in disaster reduction facilitates non-traditional ideas and parties to participate in disaster reduction and sustainable development planning while empowering women to develop their leadership qualities and other special skills in the decision making process. Therefore, the study which was the basis for this paper aims to continue researching in the future on,

- establishing a relationship among disaster reduction, construction and gender
- demonstrating the importance of gender in the context of disaster reduction construction
- understanding the need of mainstreaming women in construction in the disaster reduction and
- identifying the ways of mainstreaming women in construction in the disaster reduction decision making process.

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# A Bayesian-based Decision Support Tool for assessing and managing rock fall disasters

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*Many Civil Defence Systems have developed the knowledge and the experience to understand in "real time" the actual situation of the disaster context. Nevertheless, due to the complexity of the situation and the amount of information to process, specific decision support tools are needed that allow the decision maker to provide prompt responses and effective coordination of all the actors of the Civil Defence System. The paper describes a decision support tool, based on Bayesian Belief Network (BBN), for rescue and recovery operations during a rock fall disaster.*

**Keywords:** Disaster management, Rockfall, Bayesian Network, Decision Support System, Civil Defence

## 1. Background

Landslides are one of the greatest natural hazards, causing considerable damage and claiming a large number of fatalities in several areas of the world. The analysis and assessment of landslide risk is a complex task, due to: 1) the specific characteristics and hydrogeological properties of the area under assessment (landslide susceptibility), 2) the interactions between the natural environment, the built environment and the social environment, 3) the organization and management of rescue operations. What is clear, however, is the importance of an accurate knowledge of hydrological phenomena to be able to prepare efficient forecasting and planning intervention. (Figure 1).

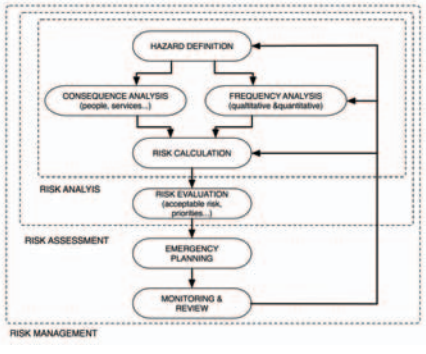


*Figure 6: A model of landslide Risk Management*

### 1.1 Rockfall: description of the phenomenon

Rock fall represents one of the highest risks in mountain area. A recent bibliographical study [1] outlines that rock fall is one of the most dangerous phenomenon for people safety. A rock fall consists in blocks fall due to slope traction or shear joints and the phenomenon can be divided in different steps, that are detachment, free falling, impact, bouncing, and sliding. Historical data shows that such events are really common in Lombardy [2]. As previously mentioned, detachment is due to a critical combination of intrinsic factors [3], described in the proposed model by means of a Bayesian Network (BBN) that represents the complex causal chain of the phenomenon [4].

## 2. The Hydrogeological Network

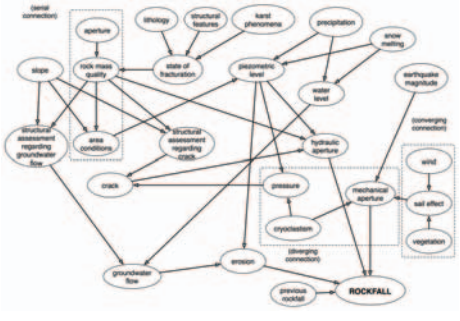


*Figure 7: Overall of hydrogeological BBN*

The construction of a Bayesian Network [5] is made up of two fundamental steps: 1) the definition of the variables and of the links between variables, 2) the quantification of the links in terms of conditional probabilities. The inductive process, followed in the topological definition of the network, uses the logic of identifying the phenomena capable of influencing the chosen target variable "rock fall": a set of relevant factors and observable phenomena exists whose correlation with the rock fall is proven by literature. Following on from these considerations the experts have defined the variables as well as the links, obtaining the hydrogeological network shown in Figure 2.

## 3. The Hydrogeological Network and Emergency Management

The BBN is now capable of returning the probability of a generic rock fall in the reference geographical area, via the conditional probability of the target variable "Rockfall", and based on the conditions defined by the prior variables. In addition we can improve the knowledge space of the hydrogeological phenomenon each time it is possible to gather direct observations of the variables [6] to partially replace experts' estimations. The joint exploitation of on-site inspections or monitoring and the proposed BBN allows to organize appropriate countermeasures (evacuation, structural reinforcement etc.) [7]. The present version of the BBN does not incorporate any decision model for selecting suitable measures for risk mitigation or emergency management, nevertheless and updated estimate of rock fall probability is an important factor for the decision makers.

## 4. Case study: The Varenna rock fall

On the 13th of November 2004, at around 17:30, 15.000 $m^3$ of rock broke loose from the slopes of the Foppe mountain at an altitude of 600 m above sea level, and tumbled down the slope below, reaching the village of Fiumelatte, in the commune of Varenna, completely destroying two residential properties and damaging a further 5. A summary of the geological characteristics is provided, highlighting main factors that affect the rock fall probability, such as: the morphology and the several discontinuities in the rock, due to erosion, cryoclastism and pressure induced by run-off water. All these causes which are intrinsic to the area, coupled with the freeze-thaw cycles and the steep incline of the mountainside, facilitate the manifestation of the landslide phenomenon. The BBN is capable of incorporating the above-mentioned observations thanks to the definition of the states of the corresponding variables.

## 5. Results

With the predisposing conditions quantified above and with the addition of the values corresponding to the environmental conditions (triggering factors), the BBN returns a very high value for the probability of rock fall (P (Rock fall) = 95,15%). In particular the contribution of the environmental conditions observed is about 30%. The simulation run using the BBN therefore proves to be consistent with the true evolution of the phenomenon as described on the basis of the data available for the Varenna rock fall.

## 6. Conclusions

The results obtained following the simulations, although still in the preliminary stages, have allowed the following objectives to be met: 1) to obtain an initial validation of the model and 2) to provide the first set of information which can be used to support the decision making process in the early stages of emergency. Finally, what is more interesting from an operational point of view, the BBN model of a rock fall demonstrated a good sensitivity with respect to the type and amount of available information. Further steps of the research project will be focused on the development of a fully integrated system for monitoring and and decision making.

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# Reversibility and sustainability as instruments in emergency interventions

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*The general objective is finding the ways to define a design for an emergency housing form, temporary and reversible, able to create positive trends of comebacks and recycle, in the range of the opportunities proposed by the marketplace.*

**Keywords:** Disaster mitigation, Temporary, Sustainable, Process

## 1. Introduction

The general objective of the research is the analysis of the concept of "reversibility" in the building sector, and its applicability to the contemporary constructive activity in terms of project quality and environmental sustainability[1]. The specific objective of this work is the elaboration of a system of tools to manage the" temporary" intervention, in which with the term "management" is intended as the definition of Guide Lines for planning a transitory and reversing housing form; among several typologies of use of the housing forms, there is the emergency shelter for the short and medium period (3 months - 1 year).

## 2. Provisional or reversible?

The variable factors are becoming the guide to the choice for the project solutions introducing the concept of temporariness, known not as “time for doing”, but as “time for using”; in fact, the “transitory” adjective, as that “temporary”, is able to be used in both situations, in which the physical consistence of the architectural object, or its conditions of use, is the one being limited in time (variability of the destination of use and utility). In the first case, the architectural research has made its own the managerial aspect of the “maintenance”, by the introduction and development of a tool as the “plan of maintenance”, and the analysis about the performance of the materials. In the second case, the problem has been dealt through provisional structures, whose realization, just like all the connected activities before and after the construction, is characterized by the attribute of precariousness (stands, awnings, containers, etc.). This negative mean of the ephemeral character of some buildings is a relatively recent acquisition of the western culture; instead, we can find some impressive examples about temporary buildings travelling in space and time: they all have in common the same concern for the dismantling phase of the architectural object, and so they show the common need to ``Go Back``. A need that moves the attention from the object to the corresponding process. The definition of a reversible process for the realization of every kind of architecture, and in particular, for the residential buildings, that shifts from the concept of adaptability of the systems (where the mentioned systems have to be intended as the organism with all its components, and the lower systems including components and implants), needs a revision of the structural requirements and conventional rules, according to the logic introduced by the *transitoriness*.

## 3. Hypothesis Planning

Planning in terms of reversibility and, in particular, in the emergency shelter sector, is taking act of the reducted duration time of the architectural object, when the time limit doesn't coincide with the deterioration of its parts, but with the lack of applications, and so of its destination use. The actual situation in the field of the temporary architecture sees a use of “closed systems”, undiversified as regards the typology of the request, that usually needs complex and expensive interventions of readaptability, prejudicing its re-use. The analysis of the temporary system markets has made obvious some visible problems, as:

*a .Invariability of the structural requirements; b. Reducted performance in terms of environmental quality; c. Elevated management costs for the process, (matters in supplying, need of storage areas, paralysis of the productive factors for a long term); d. Reducted levels of structural requirement maintainance; e. Using unsatisfactions.*

The suitable answer for the above - said queries has to necessarily be an answer in which the system has to be the result of the correct function of the process accomplishment. For this reason a project hypothesis for a transitory and reversible housing module, is transversal to the research path, because it was elaborated in order to respond to the implemented structural requirements and, at the same time, not concluded in itself, since, it is just to say implemented, through the application of elaborated management tools (CoDec, CoAd).

## 4. COGEST–CODEC–COAD CODES’ application sphere

The reading and the analysis of the relative data connected to an extremely complex situation, nailed by the hypothesis of the process model, require the definition of tools referred to information management (codes), calibrated according to the objectives of every phase of the process (fig.1). The information about the construction of the process model is characterized by differentiated analysis levels, functional to the defined objectives:

*a. The individualization of the characteristics data and their transmission to the "actors" of the process; b. The knowledge about the peculiar characteristics of the context; c. The rational management of input and output flows; d. The correspondence between the performance of the individualized solutions and the requirements expressed by users.*

The verification of the tools proposed for the management of a transitory and reversible intervention in case of emergency, consists of the application of an elaborated documentation taken from a current research, performed through the simulation of an event, including the different typologies of the emergency[2]. For this purpose, it is necessary to build a reference "scenery", representing the virtual context of the proper actions of intervention. The construction of such scenery needs a collection of some categories of informations, able to point in an univocal way the features of the matter, to inform the project.

## 5. Operation of the tool [3]

Typology of implementation of the environmental performances according to the climatic context: 1)The system is based on one "invariant structure" expounds the structural function and also the "varying structure", that constitutes the active covering of the building with the function of mediation with the external environment. This last one is defined and individualized in the beginning of the individualization of the climatic context and of the strategies related to the corresponding implementation. 2)Individualization of the covering partitions involved in the implementation: for an individualization of a climatic scenery which corresponds to the individualization of the covering partitions, that participate in the improvement of the environmental performances of the confined space.

Individualization of the products for the house building corresponding to the strategies of implementation individualized: the present phase occurs with the support of a informatics tool, defined a Virtual Store.

*The tool is constituted by two date-bases: 1)user / are constituted by file cards containing characteristics of the proposal and the corresponding codes for the strategies of implementation applications. 2)production / is constituted by file cards containing the characteristics of the production and labelled with a corresponding code to the typology of implementation which they correspond to.*

*Selection of the offer (resources for the house building). The choice of the system or the ideal component to acquit to the typology of implementation depends on some voices contained in the file cards: 1)index of reversibility / the informatics tool sends to the file cards of implementation, which to parity of code of implementation, introduces the value of a higher reversibility. Such a value is esteemed through the compilation of some parameters which correspond to a judgment of value. 2)availability / number of available units in a period of determined time. 3)cost / unitary price.*

## 6. References

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[2]Interval of individuated time for the definition of the intervention sphere (medium – long period) answers to the need to cover an evident gap in the sector of the shelter interventions for post – disaster, nearly always, created as an immediate answer for emergencies in which the housing standards offer some compatibilities with a performance limited in time (72 hours – 3 months).

[3]The methodological tool at the base of the present proposal is the result of the phd Thesis in Technology of Architecture: Grasso, M. R. (2005). "The reversibility as a tool for the management of the resources for the transitory architectural project: a proposal of implementation of drafts dealing with the project for the valuation of the intervention reversibility level", University of Reggio Calabria.

# Raising Preparedness by Risk Analysis of Post-disaster Homelessness and Improvement of Emergency Shelters

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*A central element of disaster response is the provision of adequate emergency shelters for those who have become homeless by a disaster. In order raise the preparedness for the disaster case and thereby improve the disaster response it is necessary to first of all analyse the risk of post-disaster homelessness and secondly to develop adequate shelters. Therefore, a risk analysis was undertaken investigating the distribution and the reasons for post-disaster homelessness. Furthermore, as a concrete improvement of the available emergency shelters different options of an insulated floor for tents in cold climate regions were developed.*

**Keywords:** Preparedness, Risk analysis, Emergency shelter, Reconstruction, Disaster management

## 1. Background

Due to natural disasters every year hundreds of thousands of residential buildings are destroyed leaving their inhabitants for a certain period of time homeless and in need of both intermediate shelters (such as emergency and temporary shelters) and long term housing reconstruction. Especially in cold climate regions it is important to provide quickly adequate emergency shelters in order to prevent post-disaster illnesses or even death from the cold. However, the Pakistan earthquake in 2005 with its 3.1 million homeless showed once more that appropriate tents for cold climate regions are not available. With no other emergency shelter option than tents feasible the earthquake underlined again the necessity to develop winterised tents.

## 2. Risk Analysis of Post-disaster Homelessness

For the undertaken risk analysis the data on post-disaster homelessness of the database EM-DAT was used [1]. It was shown that the distribution of homelessness over disaster types varies largely with the largest number of homeless generated by floods (672 homeless per year per mio. inhabitants), followed by windstorms (266) and earthquakes (71). Analysing the reasons for the observed homelessness it was found out that for earthquakes the number of homeless increases with higher Richter scale magnitude while, considering the human development index (HDI), the highest homelessness is registered for medium human development (Figure 1). This can be explained by an increase in vulnerability in the transition from low to medium human development e.g. by rural exodus and the formation of large urban slums while for high human development the vulnerability decreases e.g. due to larger financial means for preventive measures. Finally, assigning to each country a risk class depending on its Mercalli scale zoning and combining this with the human development status a risk index for earthquakes was formulated [2].

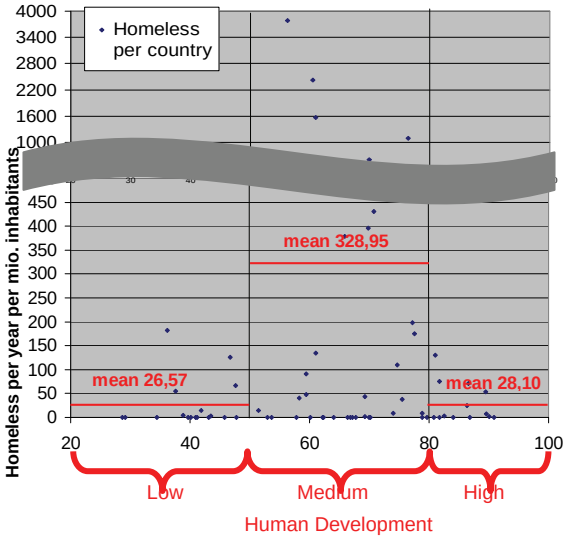


*Figure 1: Homelessness by earthquakes depending on Human Development Index*

Analysing the post-disaster shelter situation the dependency between socio-economic boundary conditions, vulnerability and shelter need could be identified. Initially the socio-economic conditions such as building quality and site location influence the structural vulnerability of the individual's home e.g. poor people settling on endangered land. In this way the socio-economic

conditions affect the total number of homeless which corresponds with the above demonstrated relation between human development status and the number of homeless due to earthquakes. Furthermore, the socio-economic conditions contribute to human vulnerability which influences the availability of emergency shelter options as well as the duration in temporary housing until reconstruction is finished. From past disasters it could be shown how with increasing human vulnerability the emergency shelter options change from renting a hotel room over mass accommodation in schools towards tents. This signifies that the availability of emergency shelter options is not arbitrarily but depends on the socio-economic context. At the same time this means that adequate shelter can only be provided if it is designed in correspondence with the given context.

## 3. Winterisation of Emergency Shelter Tents

Due to the observed lack of sufficient winterisation of emergency shelter tents the UNHCR defined the development of cold climate tents as a pressing task. Within this task the provision of an insulated tent floor is of major importance as it not only restricts the overall heat loss from the tent but reduces the heat loss of the occupants while they are sitting or sleeping on the ground [3]. Especially during the night the heat loss from the body is critical as less heat is produced and hence freezing is more likely. Therefore, different options for the floor insulation have been investigated using insulation materials from the building industry like EPS as well as locally available materials such as straw. Beside the conformity with the specific requirements from the use as emergency shelter material e.g. low cost, ease of transport the thermal properties of the solutions were evaluated using calculation methods from the building codes.

In Table 1 the heat loss of an uninsulated tent floor consisting of two layers of plastic sheeting is compared with two insulated options. The solid system is formed by 2 cm of rigid Styropor or Styrodur lying between two plastic sheetings. For the second option a 2 cm air layer is constructed by a rectangular grid of supporting beams and a top tile both of HDPP. The thermal properties of the air layer are additionally improved by an IR reflecting coating on the underside of the top tiles. Table 1 shows for a ground temperature of -10 °C how the heat loss during sleeping can be reduced from 157 W to 59 W by the installation of a stove and the provision of an insulated floor. The achieved 59 W are well below the heat produced by the body during sleeping (85 W) so that the occupants do not freeze. Similarly the overall heat loss for an internal tent temperature of 20 °C can be reduced drastically. This is important for the heating up of the tent as the heat produced by a standard stove is restricted to 5–7 kW. Furthermore, the thermal comfort which depends largely on the radiation of the surrounding surfaces is raised by a significant increase in the inner surface temperature of the floor ($T_{Si}$).

| *Type* | **Basic winterisation** | **Solid system** | **Air layer system** |
|---|---|---|---|
| *Standard* | 2 tarpaulins, 3 blankets p.p. | | |
| *Additions* | | 2cm EPS / XPS, stove | 2cm air layer, stove |
| $R_{tot}$ | 0.21 $m^2K/W$ | 0.78 $m^2K/W$ | 0.80 $m^2K/W$ |
| $Q_{sleeping}$ | 157 W | 59 W | 59 W |
| $Q_{floor}$ | 2273 W (heated) | 613 W | 603 W |
| $T_{si}$ | -4.1 °C (heated) | 13.5 °C | 13.6 °C |

*Table 8: Thermal properties of different options for tent floor*

## 4. Conclusion

Much work has been undertaken to identify the risk of death or monetary damage due to natural disasters. However, the significance of shelter for a fast recovery of the affected and the large financial expense for both temporary shelter and reconstruction necessitate as well an analysis of the risk of post-disaster homelessness. The undertaken risk analysis shows how a risk index can be developed using the endangerment and the human development status as indicators.

With respect to a concrete improvement of the disaster response the presented options for an insulated tent floor demonstrate that an enhancement of the thermal properties of emergency shelter tents is possible. This will not only raise the immediate post-disaster living conditions of the affected but as well enhance the overall sheltering process. With adequate emergency shelters to hand and a thereby raised preparedness for the disaster case, more time for good reconstruction becomes available and potentially temporary shelters become abundant leaving additional money for a better reconstruction. However, still a lot of effort will be needed until the completion of a fully winterised tent.

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# Investigating SME resilience and their adaptive capacities to extreme weather events: A literature review and synthesis

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*In the UK, extreme weather events (EWEs) such as floods, heat waves and storms are increasing in frequency and severity. As part of Engineering and Physical Sciences Research Council (EPSRC) funded projects we investigate how Small and medium-scale Enterprises (SMEs), prepare themselves for the effects of EWEs. SMEs constitute a substantial proportion of the community that is affected as a result of these events. They need to prepare themselves for the effects of EWEs in a way that minimises disruption to them and allows them to return to near normal working conditions as soon as possible after an event. Very few studies have examined how SMEs respond to EWEs. Their individual and collective attitudes influence the activities that SMEs perform towards preparation of disaster preparedness plans and post disaster recovery measures. The paper argues that this continuous process of engaging SMEs will develop their adaptive capacities and enhance their coping measures in facing up to the risk of extreme weather events. The paper provides a literature review and a synthesis and a methodological vehicle to guide this research.*

**Keywords**: SME, extreme weather event, coping skills, adaptive capacity, built environment

## 1. Introduction and main focus

South Asia Disaster Report (2006) states that 2004 – 05 period was the 'most appalling' period in the history of South Asia. In the UK, extreme weather events (EWEs) such as floods, heat waves and storms are increasing in frequency and severity. The ability of local communities to cope with the immediate impact and recover from the aftermath of a disaster is critical to the continued well-being of the community that is affected. Small and medium-scale Enterprises (SMEs) constitute a substantial proportion of the community that is affected as a result of these events. They need to prepare themselves for the effects of EWEs in a way that minimises disruption to them and allows them to return to near normal working conditions as soon as possible after an event. Most of the natural disasters affect many organisations and are difficult to predict or prevent. SMEs in particular are often affected directly and indirectly from the very same disasters faced by large companies. As part of UK's Engineering and Physical Science Research Council (EPSRC) ideas factory project titled "community resilience to extreme weather events through improved local decision making", we investigate the role of SME's within a community in response to extreme weather events in the UK. The three year research project commences in February 2008.

The paper details an initial literature review on unique characteristics of SMEs, their general behaviours and decision making. These will inform the investigation of the various coping mechanisms and the importance of SME resilience and disaster risk management (DRM) plans. The literature review and synthesis of the paper will serve as the foundation for this research.

## 2. Literature review and synthesis

According to Robbins et al (2000) SMEs are important to the economic vitality of cities, states and the countries due to their significant number and employees. However, they tend to display vulnerability in facing up to various conditions prevailing in a country's economy resulting in business failure. Ability of SMEs to turnaround their companies is constrained due to their limited access to financial resources and capital (Kirchoff, 1994). Historically, it has been recognised that the SME sector poses various challenges for implementing policies, transfer of good practice and various Government agendas. For instance, studies conducted by researchers at University of Salford (see Sexton et al, 2006) identified that strategic horizons and organisational capabilities of SMEs did not allow sufficient 'organisational slack' to conduct activities outside their main business activities.

Bosher et al (2007) suggests various forms of disaster risk mitigation measures. Some of the non-structural measures address the development of coping mechanisms and consist of various behavioural changes that the companies can make. Governments, SME associations, supply chain companies should work with the SMEs to facilitate behavioural changes so that SMEs could develop their coping measures and decision making skills. One of the techniques that can be combined with SME engagement in coping with EWEs is to visually model various EWE scenarios to understand SME behaviour, their adaptive capacities, coping skills and the overall resilience (see paper for other methods).

The above discussion indicates that simply raising awareness of the problems with the SMEs will not result in behavioural changes. Although large companies will be to a certain extent be receptive to various Government policy making and regulations towards DRMs and improving their adaptive capacities, SMEs perceive such strategies as too remotely connected and misaligned with their business objectives. Therefore, a possible way of making effective changes to SME work practices and behaviour, might be to effectively engage them through a formalized way that is sympathetic to their specific working conditions and needs.

## 3. Problem identification and research focus

Writers in the field have proposed various models and frameworks to improve the adaptive capacities of SMEs by concentrating on identification of risks and opportunities coupled with strategy development and implementation. However, the effectiveness of these models and frameworks in practice and how the SMEs' individual and collective attitudes influence their activities have not received adequate attention. This research focuses on this broad area of understanding the SME decision making processes, their coping strategies and their adaptive capacities in facing up to various extreme weather events.

## 4. Methodology

The research considers a broad array of approaches to investigate, the current scoping mechanisms and adaptive capacities of SMEs and finding solutions. Engaging SMEs via participatory approaches is the overall guiding methodology for this research. As a first step, a UK wide cross-sectoral survey will be conducted to identify the current coping mechanisms and adaptive capacities of SMEs. Then participatory action research is conducted with a target sample of fewer SMEs (about 50) focusing on the coping measures and solutions. The solutions will also be disseminated towards a wider body of SMEs through various networks and supply chain partners. A re-survey is then undertaken of the same initial sample of SMEs to identify any improvements achieved during the course of the research.

## 5. Conclusions

SME sector is renowned for suffering the most in times of crises such as extreme weather events and prepared the least for such events. The paper provided a literature review and a synthesis on the current coping measures and the various potential methodologies and models for improving adaptive capacities of SMEs in facing up to EWEs. It proposes a high level abstraction of the core principles of SME engagement through various participatory techniques associated with appropriate capacity and capability building techniques that will enable the various stakeholders such as SME networks, supply chain partners and policy makers to create a new application to suit the appropriate context of the transferee SMEs.

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# Children as Actors in Disaster Management - Insights from a South Asia Regional Research Study

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*Disasters around the world disrupted the lives of millions of people, especially children pushing many of them in to prostitution, armed conflict, drug trafficking and other dangerous occupations leading to violation of their rights. At the same time, approaches to disaster management continue to be largely technology centered, top down and isolated from human development processes. This paper is focused on disasters that took place during 2004-2005 in the South Asia region. The findings of the research show that community revitalization is a neglected element in disaster recovery. Children were treated as passive beneficiaries and their rights were not recognized by the duty bearers.*

**Key words**: Child Rights, Disaster Management, Legislation, Policy, South Asia

## 1. Background

### 1.1 Approaches to Disaster Management

Historically, approaches to disaster management were *technology-centred, top-down* and isolated from the development process. They relied heavily on outside 'experts'. The growing evidence that the top down approaches to disaster management resulted in inequitable, unsustainable and inappropriate results. However, over the past two decades, increasing emphasis has been placed on *community-based approaches,* and on the other, *pre-emptive approaches* that focus on the root causes of vulnerability rather than isolated disaster events. Many development practitioners now support *Community Based Disaster Management* (CBDM) and *Community Managed Disaster Risk Reduction* (CMDRR) approaches.

### 1.2 Children Rights and Natural Disasters

The UNCRC convention of 1989 draws attention to four sets of rights namely: the right to survival; the right to protection; the right to participation; and the right to development [1]. The UNCRC sets principal standards for the well-being and development of children. It is based on the premise of the child as a subject and bearer of his/her own rights. A *child rights-based approach* to disaster management challenges the existing top down models and promotes a new culture of respect towards young people. The approach is based on the belief that the humanitarian imperative comes first and that people affected by conflict and calamity have right to protection and assistance [2]. Many researchers highlighted that the knowledge base on children and disasters is so thin that studies related to children in this context are needed across the entire mitigation, preparedness, and response and recovery spectrum [3]. The findings of several studies suggest 'disaster interventions rarely consider children holistically as the UNCRC indicates they should [4]. There is a serious need to find a place for children and youths on the disaster research agenda.

## 2. Insights from Country Case Studies

The floods and landslides of Nepal in 2004 have affected the lives of approximately 360,243 persons of 62,357 families in 25 districts of the Nepal. The government and many of the NGO activities were focused only on disaster relief.

On January 26, 2001 a massive earthquake struck western state of Gujarat, India. *Child based emergency response* programs were implemented by some NGOs and INGOs. A Child Help Line was established and the telephone based service was supplemented by a set of trained volunteers.

The Earthquake disaster of 2005 in Pakistan focused on bringing normalcy back into children's lives affected by the earthquake and to mobilize families and e community support to help children.

December 26, 2004 triggered a series of lethal tsunamis that spread throughout the Indian Ocean, killing large number of people. In India, the government provided immediate relief support very quickly. The government's support were mainly focusing to food and non-food items, clearing of debris, setting up temporary shelters and providing assistance to the families who lost their family members. In Sri Lanka, the government and NGOs have been involved in relief, rehabilitation and preparedness program for the Tsunami affected population.

## 3. Conclusions

The field evidence suggests that, rescue, relief and rehabilitation are the major approaches taken to respond to the disaster affected communities.

The rescue- relief-rehabilitation model of interventions resulted in treating children as passive beneficiaries and not as actors. These models fail to pay attention to the special needs and rights of the children.

Policies related to natural disaster preparedness, relief and response are adult focus and there is much less consideration of children's needs and rights. Hence, children who are most vulnerable in disasters are always left behind and suffer a lot.

Only few examples available where children rights concepts were taken in the policy making. To cite, Sri Lanka banned adoption of child orphaned by Tsunami, which is a firm step to protect children from sexual exploitation and trafficking. From Pakistan case it was clear that the local communities if mobilised are the best judges of protection needs of children and vulnerable families.

The paper concludes with an argument that there is an urgent need for increased focus on the child centred preparedness and risk reduction policies and co ordination between the governments, donors and NGO in the region.

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# Tsunami Disaster Risk Reduction- Practical Guidelines for the Indonesian Context

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*Much of the practical advice and certainly the theoretical position of those trained in disaster management fall short of what is encountered in Indonesia. Based on the development of tsunami guidelines for Aceh this paper outlines the particular differences that make Indonesia a special case. The proximity of tsunami generation and consequent lack of warning time, a large coastal population, large areas of flat coastal land and the lack of escape options particularly for those returning to previously tsunami hit areas puts Indonesia unfortunately outside much of the experience of neighbouring countries such as Sri Lanka and India. And consequently, there is the need for specific guidance for the Indonesian context. This paper documents the basis for the tsunami disaster risk reduction measures that were developed to provide some rational grounding on which to plan an evacuation from village rebuilding projects located back in tsunami affected areas of Aceh.*

Keywords: Disaster risk reduction, tsunami, guidelines, planning

## 1. Background

There is a lack of design guidance on exactly how one physically builds disaster risk reduction into communities. And this was the situation that faced many NGO's in terms of developing meaning village plans as required by BRR in Aceh , Indonesia as part of their post disaster reconstruction work following the Asian Tsunami of 2004 [1]. In response, engineers, architects and planners on the ground developed their own rational approaches for this design one of which is now outlined in this paper. The standard approach consisted of marking exit routes on to a masterplan of the village under study that would have been sufficient given adequate warning. However, the Indonesian reality of between 10-20 minutes of warning time meant that exit (or evacuation) distances were in reality severely limited and consequently design teams had to determine a suitable design approach. And hence the topic of this paper.

This approach was developed based on the following 4 pieces of research:

A tsunami report by Wilkinson [2]

Interviews of survivors of the tsunami

A desktop review of past lessons learnt based around work by the US Geographical Service [3]

The development of practical guidelines based on speeds of people observed in fire situations and video footage of the actual disaster.

And in particular, the work by Wilkinson.

## 2. The Wilkinson Report

Wilkinson studied the tsunami context in Aceh and confirmed the following:

- Early warning was not an option for the Indonesian situation
- The Asian Tsunami was not a rare event but had a return period of 1:100 years and thus was the design event that any subsequent engineering response should be based.
- Not with standing the above the probability of another 10 metre tsunami in the next 30-40 years was 3 times that of this 100 year event.

This was not understood and therefore not incorporated into most programs in Indonesia.

## 3. Interviews of Survivors

Given such a background, how did anyone survive? Earlier research work by Potangaroa had created a database of 404 eye witness accounts of survivors of the Asian Tsunami in Aceh using a questionnaire developed at the Cambridge University Centre for Risk in the Built Environment [4]. These interviews were later analysed in collaboration with Cambridge University [5] and given that there were (at least they were perceived to be at the start of this process) critical villages in the city of Banda Aceh (the Provincial capital) those respondents from Banda Aceh (91 in all) were analysed separately to find the following:

1) What was their sense of the earthquake?

2) What was their immediate response to the earthquake?

3) When were they first aware of the tsunami and what warning did they have?

4) Where did they go in response to the tsunami? And how did they go?

5) Was their first choice exit route available?

The results from this are summarised in the paper and the general response was that everyone experienced the severe shaking of the earthquake and afterwards ran outside, half were warned by others with many having no warning till the tsunami arrived at which point there were a variety of responses with most finding their preferred evacuation route blocked.

## 4. Lessons for Surviving a Tsunami: Desktop review.

Other countries are (like Indonesia) subjected to tsunami. And the aim of the desk review was to ascertain what survival strategies worked in other countries and what should/ could be used in Indonesia. Much of this work in other countries had been gathered by the US Geological Service. The lessons are tabulated below with the lesson learnt in italics and its relevance to Aceh reviewed.

Thus, while many of the lessons learnt in other tsunami affected countries did apply in Aceh there were several that did not. These were the lack of warning and the decision to evacuate horizontally rather than vertically.

## 5. The Design Details

The work so far set the basis of the design process in Aceh but the process had to assume the following:

- People individually knew where to go (the horizon and vertical evacuation plan)
- Families collectively knew where to go ( if they were not at home at the time of the tsunami)
- And safe havens (either hill tops or designated buildings) besides being identified were open and accessible.

Consequently, there was also a significant community and socialisation component required to make such a plan effective. And from this a 10 point design process was developed.

## 6. Conclusion

The development of the above design process when applied to the actual situation worked well except for situations where people could not evacuate the area and instead had to seek refuge in buildings (and adopt a vertical evacuation rather than a horizontal evacuation). In this situation it became clear that floor area was critical and that despite all the previous efforts many would not be saved. Thus, there was no conclusion.

## 7. References

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# Integrated Monitoring and Assessment of Rockfall

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*This paper will present a new methodology for the assessment and monitoring of rockfalls through an integrated multi-disciplinary approach. Current solutions include classical surveying instruments (e.g. total stations, GPS) integrated to sensors for monitoring local deformations (e.g. strain-gauges, deformometers), which are used to achieve information about a limited number of critical points of a rock slope, complemented by geological inspection and qualitative analysis. The innovation of this approach is firstly based on the use of some new sensors which allow to increase the achievable information: terrestrial remote sensors – laser scanner and ground-based interferometric SAR – would allow the measurement of deformations of whole surfaces instead of single points, ground penetrating radar the exploration of rock sub-surface, digital photogrammetry the automatic measurement of crack deformations, seismic and acoustic sensors the detection of vibrations and sounds which could be pre-signal of a rockfall. The second stage of the research involves the integration of different techniques to exploit the full achievable data. This means either the integrated use of sensors and the development of expert systems to integrate different measurements and to make decisions. All activities will be carried out through the setup of some test fields in the Alpine area, where all investigation techniques will be tested.*

**Keywords:** Engineering Geology, Natural Hazards, Rockfall, Georadar, Ground-Based InSAR, Seismic Sensors, Terrestrial Laser Scanning

## 1. Introduction

The investigation of potentially unstable mountain slopes is today a primary need to increase natural and anthropic risk prevention and forecasting. Among the many natural hazards in mountainous regions, rockfalls are frequently occurring processes characterized by their suddenness and difficulty of prediction.

The state-of-the-art on analysis, prevention, and monitoring of rockfalls accounts for several studies which for the most concern only a limited aspect of the whole problem. Solutions applied for deep-seated landslides cannot be easily extended to rock face investigations, due to the presence of vertical and sub-vertical slopes. Here the main role is currently played by classical surveying and monitoring instruments with results complemented by geological inspection and qualitative analysis, as well as meteorological observations. In case of permanent monitoring systems, some measurements per hour could be taken, while in case the instrument needs to be periodically repositioned the frequency might become weekly or monthly. Moreover, traditional monitoring techniques are based on the definition of a safety threshold for every measurement. When this is not more respected, an alarm will be activated and emergency procedures will be called for. On the other hand, this approach seldom exploits data integration.

The complexity of rockfall assessment and monitoring requires not only to focus on specific issues, but to establish a close cooperation between experts skilled in several research fields. Up today the cooperation has been generally limited to geologists and geotechnical engineers, with very few openings to expertises in measurements and data acquisition systems. Thus it's possible to state that a multi-disciplinary approach represents the real new frontier of this research field.

In 2005 the Politecnico di Milano (Italy) university started an internal project (PROMETEO) focusing on 6 different frontier research fields on the theme of hazard management and public protection (see www.polimi.it/prometeo). The basic aim was to establish some multi-disciplinary investigation teams collecting different resources working inside the university. Here we limit to deal with one of the sub-projects (GPE – "Management of the first emergency"), where the problem of rockfall is concerned, among others. One of the specific tasks of this project is to establish the safety conditions for intervention of the emergency teams, based on the evaluation of the so-called residual risk. In case of a landslide or a rockfall, this means the capability of understanding in a quick time and possibly with limited resources, if the happened process is not completely ended and might occur again. This issue becomes even more complex when dealing with rockfalls, subject that has only been partially investigated up today. This goal generated the need for a wider investigation about rockfall in GPE, based on a multi-disciplinary approach, termed as IMARF ("Integrated Monitoring and Assessment of RockFall").

Mainly, on-going research activities under GPE are organized in two main sections: (i) testing and development of new technologies, sensors, and data processing techniques for rock face monitoring; (ii) establishing a methodology to apply different investigation and monitoring instruments and method by an integrated approach.

## 2. Adopted monitoring techniques

In recent years new instruments and techniques for deformation monitoring based on ground remote sensors have appeared (Terrestrial Laser Scanning and Ground-Based Interferometric SAR), whose application to rockfall monitoring represent a current challenge. On the other hand, the development of Ground Penetrating Radar and related data analysis methods offer some powerful tools to investigate about sub-surfaces. This could be successfully exploited to detect discontinuities under a rock face, and then to locate areas of possible mass detachments. Similarly, digital photogrammetry is expected to allow monitoring of cracks on the surface of a rock face. Eventually, distributed sensors (microseismic or acoustic) could allow to sense small sounds or vibrations which might be a signal of rockfall. New techniques need to be widely tested on sites really

interested by rockfalls, in order to evaluate their potential and operational effectivenes. On the other hand, these are expected to be integrated among them as well as to traditional monitoring systems.

## 3. Analysis and integration of multi-source data

The integration of different data is the core of IMARF project and concerns two different levels: (i) the use of multisource data during the data processing stage, in order to improve the quality of achievable information; (ii) the integration of final results that are obtained from every monitoring system, in order to recognize and to predict cases when the risk of rockfall is too high and decisions must be made (e.g. evacuation of population). Typically, monitoring sensors work through the definition of thresholds: when a signal or a measurement goes out the safety field, an alarm is activated. This concept still holds for integrated monitoring as well, even though the setup of suitable values for every threshold is an open problem. However, the added-value derived from the IMARF approach is not only limited to the availability of several systems sensible to different phaenomenological aspects which might address to possible rockfalls (deformations, sounds, etc.), because these also accounts for correlations between different signals. This extension would allow to detect high risk situations which might occur also in case every of the single sensors' alarm thresholds is still satisfied. Strategy will involve pre-alarm thresholds which could be activated by different monitoring systems, each of them triggering a specific emergengy procedure. These might consists in analysing data acquired by other systems to look for correlations, or to start new investigations by adopting techniques for remote deformation measurement (GB-InSAR and/or TLS) or GPR measurement. The integrated analysis of all collected data after a pre-alarm status will give a final risk evaluation based on the estimation of the possible total volume of detached rock mass. At this stage an external alarm procedure involving Civil Protection forces will be called for.

## 4. On-the-field testing

The IMARF's approach requires to experiment different innovative technologies to the aim of assessing and monitoring the stability of a rock face. Moreover, also already known monitoring and investigation instruments need to be tested in this context, in order to optimize, improve and possibly standardize their use. The testing stage will involve test-sites of different size and complexity, which will be dedicated to experiments concerning specific sensors only, or to the whole integrated monitoring system. In this case, tests will be not limited to assess performances and capabilities of each technique, but will extend to the full IMARF procedure. Currently some initial test-fields have been selected in the Lecco mountain area. In a second stage, three different rock faces which have been recently affected by rockfalls or which are likely to be will be equipped by an integrated monitoring system.

## 5. Conclusions and future activities

As a first follow up of the research, we expect the assessment of innovative technologies requiring either a metrological analysis and further investigations to grant effectiveness in the envisaged application. The second main objective of the research is to develop risk-based operational guidelines for emergency management and rescue under specific site conditions. This activity will be based on innovative modeling and analysis approaches, such as: definition of a quantitative method for the evaluation of the contribution of the new monitoring systems to the effectiveness of emergency management plans and, in general, to improve the safety of population; development of a decision support system for real-time emergency management, specifically to assess the stability of a given site, integrating experts' judgements and observed data.

# SECTION VII

## LEGAL SCHOLARSHIP AND RESEARCH WITHIN THE BUILT ENVIRONMENT DISCIPLINE

# The rule in Hadley v Baxendale (1854) and its place in the standard form of contract[1]

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*The English standard forms of building and construction makes provision for the financial consequences of delay in carrying out the works. Since the usual remedy for non-performance at common law is damages, these provisions are in law secondary obligations. This means that the parties are in fact fixing the consequences of delay beforehand. In interpreting these provisions the courts have used the common law case of Hadley v Baxendale to decide what these do. This paper analyses the common law approach to damage and, specific clauses in a number of contracts and explains their practical application.*

**Keywords:** Risks, damages, secondary obligations, delay, liquidated damages, direct and indirect loss.

## 1. Introduction

The risk of delay and its financial consequences arises in all construction contracts. In *Phillips HK Ltd v AG of HK* [1], the court commented that parties should know with reasonable certainty, their liability under the contract. Construction contracts make provision for the payment of Liquidated Damages, the payment of loss and or expense and the limitation of liability for breach of contract. Provisions are also made for termination of the contractor's employment. This paper analyses these contractual provisions and their relationship with the common law.

## 2. The rule in Hadley v Baxendale

Underpinning the right to damages at common law is the rule in *Hadley v Baxendale* [2]. There are two limbs to the rule. Damages arise either (a) directly from the breach of contract or (b) are a consequence of the breach. In the case of (b) liability depends on whether the parties had prior knowledge of the consequence of their breach. This is called the rules of remoteness of damage. At the time of making the contract, the parties are free to make provisions which exclude such consequences.

### 2.1 Remoteness of damage

The date for assessing what the parties knew of the consequences of a breach of contract is the date of the contract: see *Jackson v Royal Bank of Scotland* [3]. The importance of the date is that it is at that date that it is possible for the parties to exclude liability under the contract.

### 2.2 Application to Construction Contracts

The application of the rule is shown by *Balfour Beatty Construction v Scottish Power* [4]. The House of Lords decided that the power company was not responsible for effect of the failure of their fuses during construction. This was because under the second limb of *Hadley v Baxendale* they did not have the required knowledge that water-tight construction needed a continuous pour of concrete.

Once the rule in *Hadley v Baxendale* has been satisfied, the loss has to be quantified. The cases demonstrate that this is no easy matter: see for example *Birse Construction Ltd v Eastern Telegraph* [5], where nominal damages of £2 were awarded on a contract worth £23m.

## 3. Contractual provisions

The avoid the difficulty and uncertainty of proving damages at common law, construction contracts provide expressly for what is to happen in certain circumstances. The apportionment of financial risks include the provision of Liquidated Damages for delay, the use of exclusion or limiting clauses, and making provision for loss and/or expense to be paid in certain defined circumstances. Consequential losses are also excluded. Termination clauses too, fall in this category for they contain provisions that are much wider than the position at common law. Again, what has to be borne in mind is that by doing so, the parties are in effect allocating risk between themselves.

[1] My thanks to Andre De Wet ( Quantity Surveyor and Project Manager for Transnet South Africa) for the genesis of this paper

# 4. Secondary Obligations

Secondary obligations arise where there is a breach of contract. Parties decide beforehand what is to happen in the event of a breach and what losses are excluded. Contracts analysed are the JCT 05 [6], NEC 3 [7] and PFI 4 [8].

## 4.1 Liquidated Damages ('LD')

The advantages of fixing beforehand the damages payable on the event of delay is that it avoids the common law. Worked out beforehand they consist of the direct loss that will be caused by a delay. As such it falls into the first limb of *Hadley v Baxendale*. As an estimate it need not be right. There has to be a wide discrepancy between the sum fixed and the actual damages to be a penalty.

## 4.2 Relationship between LD and extensions of time ('eot')

An eot clause retains the right to LD., 'relevant events' in JCT05: clause 2.29. These are matters that entitle the contactor to claim extra time to complete the work. It does not entitle the contractor to extra money in compensation; this is a matter for clause 4.29. The NEC3 treats these together in clause 60 called 'compensation events'. Clause 61 requires the contractor to give notice of compensation events. Where the project manager accepts that's such an event has occurred, the project manager may instruct the contractor under clause 62 to provide a quotation for extra time and compensation. The PFI 4 allows for Supervening events in clause 5. There are in clause 5.2.1: (a) Compensation events which are at the Authority's risk and the contractor receive compensation (b) Relief events which carry no compensation. Clause 5.1.3 provides that Compensation events entitle the contractor to more money and extra time and relief events only extra time to complete.

## 4.3 Direct loss and/expense and its meaning

The JCT 05 in clause 4.23 allows the contractor to claim loss and /or expense. The meaning of the phrase has been interpreted by the courts to mean the same as damages at common law. In other words, the costs claimed by the contractor must fall into the first limb of the rule in *Hadley v Baxendale*.

## 4.4 Consequential losses

Both The JCT 05 and the NEC 3 excluded liability for Consequential losses. Both contracts provide for the sums payable to be limited by the contract to fixed sums. The interpretation of the words 'consequential loss' by the courts has been that the phrase deals with losses that fall within the second limb of the rule in *Hadley v Baxendale*.

# 5. Termination clauses

Such clauses entitle either party to bring the contractor's employment to an end. As such they are much wider than the common law rules for repudiating a contract. They provide also the provide a mechanism for assessing the financial consequences of termination. Hence they avoid the rule in *Hadley v Baxendale* altogether.

# 6. Conclusion

The primary interpretation of contractual clauses dealing with delay and its consequences have been made in the earlier cases on the JCT form of contract. It is therefore be concluded that in interpreting expressions such as compensating events or relief events, the courts are likely to look at the interpration of similar provisions in other contracts.

As a matter of analyses it can be concluded that construction contracts allocate secondary obligations which arise when there is failure to carry out primary obligations. In doing so, contractual parties avoid the difficulty of proving damages at common law. Where the courts have to decide what these clauses mean, they in fact, return to the common law to decide. The question of how the parties have allocated risk then depends on whether the loss falls into the two limbs of *Hadley v Baxendale*. This is the very thing that secondary obligations are meant to avoid.

# 7. References

[1] Phillips HK Ltd v. AG of HK (1993) 61 BLR

[2] Hadley v. Baxendale [1854] All ER 461

[3] Jackson v Royal Bank of Scotland [2005] UKHL 3, 1 WLR 377

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[5] Birse Construction Ltd v Eastern Telegraph Co Ltd [2005] EWHC 2512

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[7] The Engineering and Construction contract NEC3 Thomas Telford Ltd and the ICE

[8] Standardisation of PFI Contracts Version 4 (PFI) April 2007 HM Treasury

# Judicial Mediation Statements in the Technology and Construction Court: Appropriate Cases for Mediation

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*CPR encourages mediation in 'appropriate' cases by giving judges the power to penalise an unreasonable refusal to mediate. [1] Halsey (2004) gave guidelines on 'appropriateness criteria' but the list is not conclusive leaving uncertainty as to when a refusal will attract a cost sanction. [2] P4 v Unite (2006) exemplifies the likely approach the TCC will take to an unreasonable refusal to mediate. [3] This paper examines the Halsey guidelines and reviews cases in the TCC to elicit how the court is developing mediation appropriateness criteria.*

**Keywords:** Mediation, ADR, Technology and Construction Court (TCC), Civil Procedure Rules (CPR)

## 1. Background

CPR has given judges control of the running of a dispute through case management. Judges have a duty to facilitate settlement which might be through facilitating mediation in appropriate cases. Stronger encouragement is given by the application of a cost sanction for unreasonable behaviour in litigation, which can be a refusal to mediate and at the judge's discretion this can be at a higher indemnity rate.

### 1.1 CPR in the TCC

The TCC is governed by the Construction and Engineering Court Protocol. [4] Parties are required to meet 28 days after the respondents receive the claim and at this meeting consider whether some form of ADR or mediation is more suitable than litigation. At the first case management meeting the parties have to address the court on the suitability of ADR. It is therefore essential that construction parties understand which cases the TCC regard as appropriate and when a party will be sanctioned for refusing to mediate.

## 2. Appropriate criteria for mediation

Evidence from studies in mediation use suggest the type of case and the relationship of the parties are unlikely to create barriers to settlement but a number of significant determinants may lead to failure to settle, which centre on the skills and quality of mediators; the mediation rules; the uncompromising attitudes of the parties or the financial size in dispute. [5] CPR is underpinned by the principle of directing 'appropriate' cases to ADR. There are important considerations that construction parties need to evaluate when considering dispute resolution strategy. First, what criteria of construction case make mediation a suitable alternative to litigation, and second, what conditions do the courts regard as appropriate for rejecting an offer to mediate in order to avoid a cost penalty. This paper analyses cases to elicit court opinion on 'appropriate mediation criteria' and the existence, if any, of specific conditions where a refusal may be deemed acceptable or unacceptable.

## 3. Appropriate criteria in the TCC

The Court of Appeal first sanctioned a successful party for unreasonably refusing mediation in Dunnett [6] but did not specify guidelines, which Halsey then provided. The decision is founded on the belief that mediation is suitable for many disputes. Six circumstances were identified for consideration when determining the reasonableness of a refusal: (1) Nature of the Case; (2) Merits of the case; (3) Other settlement methods; (4) Costs; (4) Delay and (6) Prospect of success. [2]

The court has the discretion to award costs on an indemnity basis if the party's conduct is unreasonable to high degree. [7] However, costs at the higher rate are unlikely to be awarded in the TCC solely for refusing mediation [8][9] or if the parties are preparing for trial on the judge's orders [8] or if they agreed to use ADR but failed to decide the form. [8] Indemnity costs were awarded in Tonkin & Anor. v UK Insurance Ltd (2) [2006] when the claimant refused 'two sensible offers of mediation', their case was 'weak'; they were wrong on 'almost every issue' and their conduct was 'unreasonable and at times reprehensible', particularly their attack on the bone fides of the defendant's expert witness. Further disputes involving 'architectural detail' were deemed particularly suitable. [9]

The Halsey guidelines were considered by the TCC in P4 Ltd v. Unite Integrated Solutions PLC [2006]. P4 claimed Unite had notice of a Retention of Title clause in goods worth £70,000 but had gone on to install a significant number. P4 failed to better the amount awarded by the court, therefore the court had to order the claimant to pay the costs of the defendant unless unjust to do so. Unite were found to have unreasonably refused P4's invitation to mediate for the following reasons: [3]

***Nature:*** The case was suitable for mediation because it involved small sums compared to the cost of litigation and there were a number of 'uncertain factual and legal issues'. [3 at 45]

***Merits:*** Unite's claim of a 'watertight case' was rejected as it only became stronger later during proceedings and mediation might have assisted by providing evidence on fittings which could have narrowed the dispute.

***Other methods:*** Exchange of offers and information were not held to be evidence of other settlement methods. Offers to settle might be relevant but is only as an 'aspect' of the prospect of success.

***Costs:*** The cost of mediation would not have outweighed the amount in dispute because Unite failed to consider the court costs and time spent litigating.

***Delay:*** Mediation would not have delayed the action but Unite were unreasonable in stating that P4 had not considered the process when they had, which indicated Unite were not seriously considering ADR when they should have done so.

***Prospect of success:*** The starting point for considering the prospect of success is that the majority of cases are suitable for mediation. Unite relied on Halsey's judgment that where the other party is intransigent there may be little prospect of success. The court observed Halsey had suggested mediation success '*may not only* depend on the willingness of the parties to compromise', implying mediation can be successful even under these conditions. Mediation had not only a reasonable prospect but a 'good prospect' of success in this case. P4 were not intransigent and the court believed there was a good possibility they would have compromised if they had the opportunity to meet face to face or with a mediator. The court placed emphasis on the existence of a long commercial relationship, which P4 had been seeking to develop because this would have given mediation a good prospect of success. [3 at 45] Finally, P4's conduct was not found to be 'out of the norm'. [3 at 51]

Construction cases are likely to be deemed appropriate when they involve disputed facts or legal issues because mediation might allow the parties to gain a better understanding of the dispute and help bring about settlement, or allow the parties to narrow the issues. Settlement is undoubtedly the optimum outcome but an understanding by the TCC that other advantages can be gained is a factor parties are advised to take into consideration when reviewing dispute resolution strategy. Research indicates other benefits can accrue with mediation such as clarifying or narrowing issues, assessing strengths and weaknesses or reality checking, all of which might stimulate later settlement or help prepare for trial with the added bonus of reducing costs. [10][11] Tactical benefits such as 'feeling the financial muscle' of the other side or 'testing' evidence have been identified as incentives for mediating but some lawyers adopt a more cynical use by employing 'tactical games' and being 'less open and more manipulative with the mediator'. [20 at 213] The parties are entitled to adopt any position they like in mediation and the court will not look behind the reasons for non-settlement as this compromises the confidentiality of the process. [2 at 14] It would be unfortunate if the TCC, in its efforts to encourage mediation, play into the hands of less scrupulous parties.

## 4. Conclusion

Mediation offers numerous benefits to disputing parties and many TCC judges, with personal experience and expertise in construction disputes believe it should be discussed and used by the parties. [2] A failure to do so may be sanctioned by the court, although it is unlikely to be at the indemnity level unless there is other evidence the parties conduct is unreasonable to a high degree. Construction parties should take into account that the court continues to emphasis the ability of mediation to deal with intractable parties and the importance of continuing commercial relationships despite evidence suggesting uncompromising attitudes are often a key factor for non-settlement and mediations rarely achieve creative outcomes enabling parties to continue their ongoing relationship. Although Halsey witnessed a retreat from the contention that nearly every case will acquiesce to the mediation process and the skills of experienced mediators, the personal experiences and perceptions of judges continue to drive appropriateness criteria in the TCC, which could in the long term work negatively against its true potential. The more construction parties experience mediation, or less experienced mediators, failing to work its 'magic' with intractable parties or not producing creative outcomes, the less confidence there is likely to be in the process.

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# Developing a conceptual framework of catastrophic withdrawal behaviour in construction dispute

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*The voluminous reported studies on dispute management have engendered a need for sustainable improvement in negotiating skills because of its decisive effect on the success or otherwise of construction dispute negotiation (CDN). Earlier studies identified that performance of negotiators dictate and influence the outcomes of negotiation. Thus, the prospect of negotiation is doomed if negotiators lose the interest to continue. This phenomenon is described as withdrawal. Withdrawal has been found to be influenced by a vast array of cognitive factors. Ignoring or undermining these cognitive obstacles to negotiation can be fatal as these can be the major hurdles against successful outcomes. This study aims to contribute to the study of CDN by analysing withdrawal phenomenon under a 3-variable catastrophe framework.*

**Keywords:** construction dispute negotiation, withdrawal management

## 1. Background

There is wide range of conflict resolution methods available. Among these, negotiation is the most informal, thus, allows the disputants to take control of the resolution process. Furthermore, it offers high degree of confidentiality and is well recognized as a time- and cost-effective method. An effective negotiation involves heavy information exchange as well as meticulous trade off of values and interests. As such, it is imperative to keep the negotiators at the negotiation table. In other words, once negotiators withdraw, the disputes would likely have to be dealt with by other means like arbitration and litigation. The possibility of future dealings and relationship among the contracting parties would very likely be tarnished. Therefore, negotiators should display their perseverance and patience to engineer a successful negotiation. In this study, withdrawal is defined as situations when negotiators decide not to continue with the negotiation [1]. Withdrawal behaviors are therefore those happenings that would lead to withdrawal if not controlled.

## 2. Characterizing withdrawal behavior by catastrophe theory

Negotiation breakdown occurs when one of the negotiating parties withdraws. It is resulted from psychological struggles experienced during the course of negotiation [2]. Resolution becomes impossible once withdrawal happens. When withdrawal tendency is high, the associated feeling of uneasiness and insecurity would ultimately cause collapse. Retreating and leaving the dispute unresolved is thus simply a suboptimal outcome. Negotiation often involves mixed-motive interactions in which disputants face particular cognitive dissonances. Indeed, research has revealed that once withdrawal happens, it can affect the way people think and act, as well as repetitive withdrawal behaviors. Bluedorn [3] described withdrawal as a reduction in the socio-psychological attraction to or interest in organization. Herzberg et al. [4] further suggested that ultimate withdrawal is predisposed by a series of dysfunctional behaviors progressing from declining performance, frequent lateness, and absenteeism to withdrawal.

Negotiators are often regarded as rational utility maximizers. As such, these models typically suggest that negotiations would end in resolution at the point that utilities of each party are enhanced. However, negotiators often fail to reach an agreement even when there are mutually acceptable solutions within the positive contract zones. Hence, withdrawal does not sit comfortably with the rational models that predict negotiators would pursue their goals and maximize joint profit. This proposition suggests that there exists a threshold of level beyond which withdrawal will suddenly occur. When human behaviors exhibit a continuous change displaying a discontinuous lapse, these classical phenomena can be described by Catastrophe Theory (CT). In this study, withdrawal in construction dispute negotiation (CDN) is taken as the behavior whereby a negotiator loses the interest to continue with the negotiation. It is further suggested that such change is dynamically associated with the underlying factors of disputes and can be characterized by a catastrophic discontinuous lapse.

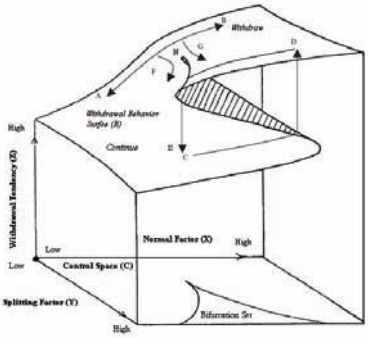


*Figure 1 A 3-variable cusp CDN withdrawal framework (Modified from Zeeman [5])*

## 3. Models development

The simplest cusp catastrophe model is adopted. It includes one dependent behavioral variable – withdrawal tendency (represented by Z-axis) and two independent control variables – splitting and normal variables (represented by X- and Y-axes) as shown in Figure 1. In a professional negotiation context, the withdrawal behaviour axis may run as shown in Figure 2.

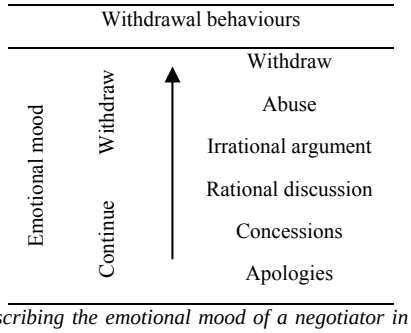


*Figure 2 The behaviour axis model describing the emotional mood of a negotiator in a negotiation (Modified from Zeeman [5])*

Three forces in CDN are identified as co-existing and in dichotomy, these forces fit nicely with the requirements of the 3-variable cusp catastrophe model. Therefore, the application of CT to analyze the relationship between withdrawal behavior and its drives in dichotomy is considered probable. These forces are identified as pragmatism, intelligence and interdependence [6]. To sum up, the measurement frameworks of the three conflict frames are adopted into the control factor models as represented in Figure 3.

## 4. Concluding Remarks

Most construction disputes are firstly negotiated for a resolution. A negotiation can be considered doomed if a negotiator withdraws from the process. Conflicts then have to be resorted to lengthy and costly legal actions. In this study, withdrawal is defined as situations where negotiators lose the interest to continue with the negotiation. This study suggests the use of cusp model to describe the dynamics of withdrawal behaviour. This conceptual framework is subject to empirical testing currently being conducted by the authors to confirm the appropriateness of employing the three dimensions of negotiation frames – pragmatism, intelligence and interdependence as control and splitting factors. Six such frameworks are proposed through different combinations of these frames. Testing of these models shall provide invaluable understanding of CDN.

| Level | Control factor model | | |
|---|---|---|---|
| | Pragmatism | Intelligence | Interdependence |
| High | Force | Problem-solving | Collaborating |
| | Withdraw | | Avoiding |
| | Compromising | Compromising | Compromising |
| | Confront | Concession | Accommodating |
| Low | Smooth | Threatening | Competing |

*Figure 3 Control factor models for the three negotiation dimensions*

## 5. Acknowledgement

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# Legal research in the built environment: a methodological framework

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*The methodological basis of legal research has traditionally not been explained by its practitioners and this has led to misunderstandings between researchers in interdisciplinary fields, including the built environment. The paper therefore develops a methodological framework as a mechanism for communicating the implicit, often subconscious, methodologies employed by legal scholars to other researchers within the built environment. It distinguishes legal research from scientific research and defines it as a normative process which is undertaken within the humanities research tradition. The approaches adopted by researchers are explained primarily in terms of deductive, analogical and inductive reasoning although it is noted that the term "methodology" is more suited to research in the sciences than in the humanities.*

**Keywords:** Disciplines, Epistemology, Jurisprudence, Knowledge, Law, Methodology, Research, Theory.

## 1. Introduction

Legal research is a comparatively recent phenomenon within the built environment research community. Its academic methods have traditionally been regarded with suspicion by other built environment researchers who have struggled to recognise its outputs as credible research contributions. In particular, legal researchers have arguably been insufficiently reflective as to the methodologies employed in their work and, as a consequence, have found difficulty in explaining these to researchers from other disciplines.

The underlying reasons for this phenomenon are to be found in the traditional approach to legal education which conditions students to "think like a lawyer" without providing any theoretical grounding in the methods actually being employed. As a consequence legal researchers have always struggled to define their work in terms that their academic peers in other disciplines can understand.

The present paper therefore reflects on the techniques actually employed by legal researchers at a subconscious level and attempts to make these explicit. It presents these in the form of a methodological framework for possible adoption by the built environment legal community as a mechanism for more effectively describing its work to researchers in other disciplines within the field.

## 2. Epistemological aspects

Before considering the methodologies employed by legal researchers (or legal scholars, as they are more usually described) it is first necessary to understand the epistemological nature of the process being undertaken by them, and to appreciate how this differs from other research in the built environment.

At an epistemological level it differs from the questions asked by empirical investigators in most other areas of built environment research. Scientific research, in both the natural and social sciences, relies on the collection of empirical data, either as a basis for its theories, or as a means of testing them. In either case, therefore, the validity of the research findings is determined by a process of empirical investigation. In contrast, the validity of doctrinal research findings is unaffected by the empirical world.

Legal rules are *normative* in character as they dictate how individuals *ought* to behave [1]. They make no attempt either to explain, predict, or even to understand human behaviour. Their sole function is to prescribe it. In short, doctrinal research is not therefore research *about* law at all. In asking "what is the law?" it takes an internal, participant-orientated epistemological approach to its object of study [2] and, for this reason, is sometimes described as research *in* law [3].

## 3. Methodological framework

### 3.1 Deductive reasoning

The starting point is to recognise that there is no fundamental distinction between the process of academic doctrinal analysis and the legal analysis undertaken by practising lawyers or judges. In either case, the initial process of applying a rule of law to a factual situation can be understood as an exercise in deductive logic. In a legal context, the familiar syllogism, comprising major premise, minor premise and conclusion, takes the following form:

Major premise – identifies a general rule of law which requires a specified legal outcome when particular facts are present in a situation.

Minor premise – describes a particular factual situation.

Conclusion – states whether the rule in the major premise therefore applies to the facts in the minor premise, and whether the specified legal outcome therefore takes effect.

### 3.2 Dealing with hard cases

This, of course, is an idealised account of the process of legal reasoning. In reality, in almost all cases, the deductive model will fail, without further analysis, to produce a definitive answer to the question of what the law is in a given situation.

Legal rules, of necessity, have to be expressed in general terms and therefore capable of interpretation in more then one sense. There will, therefore, often be an element of doubt as to whether a rule applies to a particular factual situation.

Although Hart [2] concluded that judges exercise discretion in these so-called "hard cases", their decisions are actually based on recognised patterns of reasoning employed within the legal community which are used to supplement the deductive model described above.

### 3.3 Analogical reasoning

The most widely used technique is undoubtedly the process of analogical reasoning. In contrast to deductive reasoning, which entails reasoning from a general rule to a specific case, analogy involves a process of reasoning from one specific case to another specific case. In those many situations where it is unclear whether a particular factual situation falls within the ambit of a rule, it can often be helpful to examine apparently similar cases which have previously come before the courts. Most readers will be familiar with this process in the context of the operation of the common law doctrine of precedent.

### 3.4 Inductive reasoning

A third technique involves the use of inductive reasoning which can be described as the reasoning from specific cases to a general rule. This can be of particular assistance when a particular factual situation does not appear to be addressed directly by a legal rule at all and it therefore becomes necessary to "fill the gap" in the law. In the case of legal reasoning this involves the recognition of a new general rule which emerges from a number of earlier authorities which are then regarded simply as particular instances of the new rule.

### 3.5 Policy judgments

Nevertheless, there is now a widespread recognition that, in some cases, the law cannot be determined with certainty from an analysis of the rules alone and the law is then said to be indeterminate [4].

The challenge for the legal scholar (or practising lawyer) trying to predict the likely outcome of future cases is to understand the nature of the policy considerations that are likely to influence the judiciary.

## 4. Conclusion

This paper began by highlighting the failure of the legal research community to adequately explain itself to its peers in other disciplines and in this sense it can hardly complain if those peers then judge it by standards other than its own. Communication between disciplines is one of the great challenges to achieving genuine interdisciplinary and that challenge is never greater then when trying to bridge the gulf between the humanities and the sciences.

Nevertheless, it is surely incumbent on all of us within the built environment research community to do precisely that. This involves developing at least an awareness of practices within the field's various disciplines. But it also involves a willingness to reflect upon our own previously unquestioned assumptions about the practices in our own discipline, and to articulate these for the benefit of others within the field. It is hoped that the methodological framework presented in this paper might provide a vehicle for communicating the nature of legal research to other built environment researchers, and thereby assist the process of communication within the wider discipline.

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# An analysis of dispute resolution literature in construction management journals

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*Dispute resolution has become an established part of construction management discipline, both with respect to the academic research undertaken and to its wide application in practice. This paper analyses the recent literature on construction dispute resolution as published in the mainstream construction management journals, aiming to identify those aspects of dispute resolution that have been studied by the researchers and chosen for publication. Peer reviewed articles published in the selected mainstream construction management journals are analysed and classified in terms of research stream, level of analysis, sector, definitions of dispute, sources of information, contribution of the articles and backgrounds of the authors within a meta-classification framework proposed. Based on the findings, the paper presents research trends, neglected areas and future research suggestions for the discipline.*

**Keywords:** Dispute resolution, Construction management, Meta-Analysis, Research Trends

## 1. Introduction

Academic journals are platforms where communication of research findings and scholarly debate take place. In the academic world, communication is central to the promotion of knowledge and while there are many forms of communication channels, the most permanent and durable are the published literature, especially refereed academic journals [1]. Within all fields of study, it is needed to know the ways in which an academic discipline develops, the main dimensions of the subject matter and the ways relevant research methods and tools are used. These studies are called meta-analyses and concern, in general, the characteristics of the articles and the nature of the authors in many dimensions within a framework. This paper sets out to reflect upon the most recent research in the field of dispute resolution in construction and gives an overview of what aspects of it have been studied in the articles published in five main stream refereed construction management journals in the last decade. With this study on the recent research in the field, a more holistic view of the subject area can be obtained to identify trends and knowledge gaps. This integration of the recent research is expected to contribute to generating new agendas for future research and to the debate on the development of the field.

## 2. Method

A wide variety of sources are available on dispute resolution in construction. To ensure the academic standard of the literature analysed in this study, only peer reviewed articles were decided to be included. For this purpose a core of international refereed journals that had a construction and project management perspective were designated and the keyword "dispute" was searched for amongst the title and the keywords sections of the articles in the selected journals. In order to obtain the most recent research in the field, the study was limited to a ten year period (1997-2006) of publication.

### 2.1 The Framework

Betts and Lansley [1] suggest that the meta-models are important for the analysis and classification of a discipline, inter-relating different areas of study and identifying emerging or neglected themes. The rationale for the use of meta-models arises out of a theoretical understanding that the main determinants of the nature of construction management research come from the multi-disciplinary background of its knowledge bases, the multiple stages through which construction projects move in their life-cycle, the many organisational levels within the industry, the professional differentiation that exists between parts of the sector and the distinctions within different types of research process.

The framework proposed in this study, which the articles were analysed against, has three dimensions and each dimension has several factors. "Content" dimension includes four factors; research stream, level of analysis, sector and definitions of dispute. "Style" dimension includes two factors; sources of information and contribution of the article. The last dimension is the "author" and includes two factors; author background and author's country.

## 3. Analysis and Results

The results show the analysis of forty-two journal articles obtained from the search done in the mainstream construction management journals against the framework proposed.

### 3.1 Content

The first factor analysed in content dimension is research stream, which is the most diversified factor analysed in this study. In the meta-classification framework proposed, the attributes for this factor are defined as analysis of a dispute resolution method, method selection models, factors affecting dispute resolution, causes of disputes, dispute resolution approaches, Alternative Dispute Resolution (ADR) and policy making. Nearly half of construction dispute resolution research is most closely related to

analysis of a dispute resolution method. ADR in general and dispute resolution approaches, each in six of the articles, are the following most frequent research streams. The rest of the attributes of research stream attracted limited attention.

The attributes of the second factor, levels of analysis were determined as global industry, national industry, profession group, organisation, project and professionals. At least one journal article was identified at each level of analysis in this review and national level has received the most attention.

In terms of sector, there is a lack of specific focus on public and private sectors. With the exception of a few authors, most do not make reference to their research concerning the sectors although the contexts are markedly different for dispute resolution in public and private construction sectors.

As for the last factor in the content dimension, articles were analysed for definitions of dispute. Although all journals analysed contained the word dispute in the title of the article or as an article keyword, only two of the articles actually define dispute.

### 3.2 Style

In the style dimension of the meta-classification framework, the articles were firstly analysed for their sources of information. The attributes were designated as empirical data, reviews and case studies for this factor. More than half of the articles used empirical data as their source of information. A variety of research techniques were used to collect data that include surveys, interviews and historical analysis. Case studies were classified as a separate attribute and six of the articles were determined as case studies. Fourteen articles, on the other hand were classified as review-based articles.

A further research aspect of the articles analysed was the contribution of the articles to the field. There were twenty articles offering general insights most of which were reviews, whereas thirteen articles offered statistical results arising from the empirical data used. One remarkable result is that there were only seven model building contributions and only two system building contributions among the articles analysed.

### 3.3 Author

The last dimension of the meta-classification model proposed is the author background. One of the most striking results reached in the analysis of the dispute resolution in construction literature is the publication dominance of academic authors. There are only four articles without any academic authorship and only six articles that include collaboration in authorship between academic and non-academic authors.

The forty-two articles analysed involved sixty-one different authors from only eight different countries. This analysis shows that the research on dispute resolution in the construction industry is still undertaken by the authors from a very limited number of countries. Of the forty-two papers, only two papers involved the collaboration of authors from different countries. This is another remarkable result showing that international collaboration is also limited.

## 4. Conclusion

Remarkable findings have been reached regarding some of the factors. The identified shortcomings include the lack of specific focus on public and private sectors, the failure of most of the articles to define dispute, the lack of articles contributing to model building in the discipline, the limited practitioner and government employee authorship and the limited collaboration between academic and non-academic authors resulting in the publication dominance of academic authors. Future research directions are suggested in the study in order to address the identified shortcomings and improve the knowledge base in dispute resolution in construction field.

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# Critical Factors for Insurance Premium Computation in Construction

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*Workers' compensation insurance is imperative for construction projects to safeguard the interests of workers and contractors. The commitment of insurers under this insurance is extremely broad. They must therefore accomplish rigorous risk and market assessments to decide optimal premiums. General insurers in Singapore have been experiencing detrimental loss-ratios in this business due to the lack of a proper framework that encompasses all the critical variables. The purpose of this study is to identify and explore the critical variables for premium-rating of construction workers' compensation insurance. An extensive literature review helped identify 17 variables that may influence premium rates. An interview questionnaire survey and subsequently a statistical analysis of the survey data were carried out to identify the critical variables. Eight variables were found significant for insurers for premium-rating including: wage roll, project hazards, project safety, contractor's claims history, insurer's overhead costs, insurer's corporate objectives, competition, and investment income from underwritten premiums. The findings of this study can be used by insurance companies in their risk assessment and premium-rating exercises.*

**Keywords:** Occupational injuries, Construction safety, Workers' compensation insurance, Premium, Singapore

## 1. Introduction

Construction is one of the most dangerous and risky occupations. Insurance is a keystone to eliminate most of the financial threats in construction business [3]. Bunni [1] identified five types of insurance that are available for contractors for different risk nature: contractors' all risk insurance, general liability insurance, worker's compensation insurance, motor insurance , and marine transport insurance. Out of these five classes of insurance, the significance of the WCI in construction is overwhelming because the construction industry is well-known for poor safety performance globally. In Singapore, the construction industry accounted for 29% of the total number of industrial workers but accounted for 40% of worksite accidents [2]. Providing adequate WCI covers is therefore mandatory by the law of Singapore for employers to engage workers under a contract of service. It is enforced to safeguard the interests of occupational injury victims and to ease their employers' financial burden of compensating. On the other hand, insurance companies who issue the WCI for construction projects are forced to assume abundant financial risks. This implies that the construction WCI is a critical class of insurance in the whole portfolio of any insurer's business. Hence, the utilisation of an effective premium-rating technique is essential for insurers to perform rigorous risk assessments for construction WCI.

In the Singapore insurance industry, WCI premiums are traditionally computed by applying a rate on the wage roll of construction projects. There has been a collective agreement among general insurers that the preferable WCI premium rate for construction projects is 1% of the wage roll. This is an ill-structured method and it brings about riskier projects that are being covered by insurers at lower premiums, which ultimately result in adverse loss ratios. The industry statistics for year 2006 of the General Insurance Association of Singapore reinforced that the WCI business has sustained poor underwriting results over the years. This is mainly due to unrealistic pricing, under declaration of wages by some companies as well as aggravated and fraudulent injury claims by some foreign workers [4]. Hence, there is an intense need for developing a new methodology for WCI premium-rating of construction projects. The prime task towards developing a new model is to identify the critical variables that influence WCI premiums for construction projects. Hence, the aim of this paper is to explore and critically analyse the variables pertinent to WCI premium-rating.

## 2. Premium-rating variables for construction WCI

From the literature review above, 17 variables pertinent to WCI premium-rating of construction projects were identified and classified into four categories as follows:

- Project factor – includes wage roll, project duration, project hazard level, and the effectiveness of the safety management system on site.
- Contractor factor – contains contractor's claims history, placement of multiple policies by the contractor, expectation of potential business from the contractor, co-operation by the contractor, and contractor's size.
- Insurer factor – encompasses corporate objectives of the insurer, investment income from underwritten premiums, overhead costs of insurance, amount of outstanding claims to the insurer, profit/loss experience in WCI business, and reinsurance cost.
- Market factor – consists of competition, and volume of business in the market.

## 3. Research method

A questionnaire was designed with the objective of determining the most significant variables. The questions in the questionnaire assessed the significance of the 17 variables for deriving the optimal premium rate on a 10-point Likert scale,

whereby 1= "Low important" and 10= "High important". The field survey was conducted during November and December 2005 in the Singapore insurance industry, which encompasses a population of 23 general insurers. Subsequently an interview questionnaire survey was conducted to collect data. All the 23 companies were covered in the survey. A statistical analysis of survey data was accomplished to identify the most important variables for WCI premium-rating. Descriptive statistics were computed for each category of variables. The 17 variables were then re-organised into 3 groups namely, important variables, less important variables and unimportant variables, based on their mean importance ratings. Unimportant variables have mean importance ratings < 4.00, important variables possess mean importance ratings > 7.00, and the rest are less important variables.

## 4. Conclusion

Seventeen variables pertinent to WCI premium-rating for construction projects were identified in a literature review. An interview questionnaire survey was conducted in the Singapore general insurance industry to identify the most significant variables that fit in the Pareto's 80/20 rule. Statistical analyses results of the survey data indicate that eight variables are important for WCI premium-rating: (1) wage roll, (2) project hazard level, (3) effectiveness of the safety management system on site, (4) contractor's claims history, (5) overhead costs of insurance, (6) competition, (7) corporate objectives of the insurer, and (8) investment income from underwritten premiums. The finding may be utilised by insurance companies in Singapore to re-engineer their premium-rating approach. The study may be extended to develop a premium-rating model for workers' compensation insurance incorporating these significant variables.

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# Contracting in good faith – giving the parties what they want

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*The duty of good faith is an integral part of the newer forms of construction contract in the United Kingdom. This paper begins by examining the duty of good faith as an express obligation contained in the newer standard forms of construction contracts available in the United Kingdom. The development of good faith provisions and their re-emergence in modern construction contracts is discussed as well as a comparison with other jurisdictions. The seeming hostility of the English judiciary is examined and signs of a change in attitude encouraged. The benefits that might arise from "concretising" the duty of good faith are described and further developments in this area encouraged in what could be a new and exciting departure for the common law.*

**Keywords:** Contracts, Partnering arrangements, Good faith, Construction contracts, Contractual innovation

## 1. Background

Partnering promotes a co-operative approach to contract management with a view to improving performance and reducing disputes. The relationship between a contractor and a client in a partnering contract contains firm elements of trust and reliance. In so far as partnering is delivered through the medium of contracts, those contracts more often than not contain an obligation that the parties act in good faith to facilitate delivery of those aims.

Partnering contracts pose a problem for contract advisors containing as they do "hard" and "soft" obligations. Whilst all conditions of contract are equal, some, to misquote George Orwell, are more equal than others. Clients can be advised and terms drafted stipulating hard obligations such as payment and quality standards. But what of the soft obligations – and in particular the duty of good faith – what are we to make of them? As one leading commentator put it:*"We in England find it difficult to adopt a general concept of good faith…we do not know quite what it means*."[1]

The resulting situation is that "soft" obligations are often overlooked and not given any particular importance. This sentiment was picked up by a report expressing the consensus of construction lawyers as being that duties of good faith are not likely to be newly recognised in law by reason of their introduction into partnering contracts. [2]

This consensus of opinion invites the question whether this is what the users of construction contracts want. Parties having taken the trouble of entering into a partnering contract may feel disappointed to learn that their voluntarily assumed mutual obligations are not enforceable. This paper seeks to open a discussion around this point and recommends the "concretising" of the duty of good faith by judiciary and/or parliament to deliver what the parties have chosen for themselves.

## 2. The Newer Contract Forms

By far and away the most popular forms of contract are those which make no mention of partnering obligations [3]. The dominance of the JCT lump sum and design and build forms remains intact. However, the growing trend is to use contracts which move away from formal legal "black letter" contracts to contracts fulfilling a different role which includes seeing the contract as a management tool and a stimulus for collaboration. The challenge for these newer contract forms is to capture this new role whilst providing sufficient contractual certainty in the event that disputes arise.

The link between contracts, partnering and good faith was initially made by organisations such as Associated General Contractors of America making statements such as: *"Partnering is recognition that every contract includes an implied covenant of good faith."* [4]

These connections are relatively straightforward in the United States, a legal system that recognises the duty of good faith in contracting. The principles of partnering are congruent with the doctrine; trust, open communication, shared objectives and keeping disputes to a minimum. Making the connections in the English context is more challenging given the absence of the general duty of good faith. In its absence it is the partnering contracts themselves which fill the gap.

In the thirteen years since the Latham Report partnering contracts have become significantly more sophisticated in terms of the wording of partnering obligations and the conduct expected. The duty to act in good faith is a common thread.

There are variations on the exact imposition of the duty to act in good faith in partnering contracts. A distinction can be drawn between those which are intended to regulate the parties' behaviour through the contractual terms and conditions (binding) and those which place a non-contractual partnering framework over the top of another contract (non-binding). The latter have been described as seeking to influence rather than mandate certain behaviour.

The parties to the JCT Non-Binding Partnering Charter agree to "act in good faith; in an open and trusting manner, in a co-operative way in a way to avoid disputes by adopting a no blame culture". The binding multi-party PPC 2000 requires that the parties "agree to work together and individually in the spirit of trust, fairness and mutual co-operation". The NEC x12 Partnering Option calls the parties "partners", and requires that partnering team members shall "work together to achieve each other's objectives."

The latest contract to enter the fray is the JCT Be Collaborative Constructing Excellence Form. The contract goes further than the other partnering contracts in introducing an over-riding principle which includes a duty of good faith and stipulates that this principle takes precedence over all other terms.

This contract completes the transition of good faith-type provisions from being somewhere on the under-card of contractual terms to being the main event. A significant proportion of the standard forms of contracts now available to the construction industry expressly impose an increasingly onerous duty on the parties to act in good faith. This paper will briefly review the history of the duty of good faith before examining the reasons why the consensus of rejection of the legal significance of this development exists.

## 3. Conclusion

Good faith has been described as "repugnant to the adversarial position of the parties". The duty is surely not so repugnant to an industry currently characterised and actively pursuing an agenda not of adversarial relations but of collaboration.

The industry would benefit from some clear messages from the judiciary as to the enforceability of their collaborative arrangements. The positive stance taken in the Birse v St David case is encouraging in terms of direction but further concretising of the exact meaning of such obligations on the particular facts of any case would be helpful. Re-ordering the structure of construction contracts by introducing the sound theoretical basis presented by the duty of good faith is an achievable and laudable aim. The expression of this underlying principle with its uncluttered simplicity may serve to bring clarity to the dense contractual conditions for which the industry is renowned.

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# The optimization of regulations that guarantee housing quality

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*All countries have sets of public building regulations to guarantee a minimum technical quality of buildings. To assure that the regulations are met enforcement regulations like permit procedures are laid down in laws.. In the Netherlands there is an ongoing debate about the minimization of the administrative burden caused by regulations at one hand, and the improvement of the enforcement at the other hand. Also in other countries like England and Germany discussions are going on about the building regulations. Part of the discussion is the form the regulations take. This paper presents some societal developments and examples that influence the way one can look to the role of the government in safeguarding a minimum quality of houses. This is illustrated with examples of the systems of building regulations and building control of various European countries based on the outcome of ongoing international comparative research.*

**Keywords:** Building regulations, Europe, Technical requirements Deregulation, Privatization.

## 1. Background

The OTB Research Institute for Housing, Urban and Mobility Studies undertakes comparative studies of systems of building regulations since the mid nineteen-nineteen's [1] [2]. Our studies generate much insight that contributes to the ongoing policy debate about the urge for deregulation on the one hand and on the other hand a rising sense of necessity of a proper functioning system of building regulations and building control. Recently the Dutch government has launched a project in which it wants to fundamentally reconsider the system of regulations. There is a strong feeling in Dutch politics that the whole system is too complex, too detailed and goes far beyond what should be the core of government responsibility. It seems that the vision on the role of the government is clear yet. The government is responsible for the system and the private parties are responsible for the quality of building. In this paper we take this dilemma as a starting point. We use the characteristics of the current system with its pro's and con's in combination with examples of other countries and some societal developments to create some basic elements for a terms of reference for a future system of building regulations.

## 2. Reasons and goals for building regulations and building control

The Dutch Building Decree has the following mayor goals: safety, health, practicability, energy saving and environmental protection. This last goal however has not yet resulted in concrete regulations  In Sheridan et all [2] we compared the starting points (goals) and the subjects that were covered by the building regulations in eight European countries. The conclusion was that there are many similarities in de European countries in the mayor goals and subjects that are covered. However the formulations and the level of detail vary quite a lot..

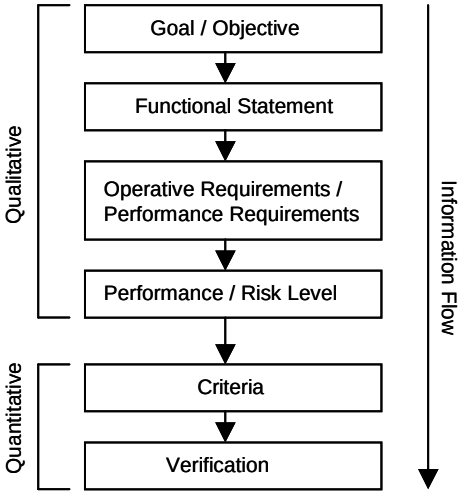
In 2007 the Building Decree existed 15 years. During a conference many representatives of Building Decree discussed about the pro's and con's of the current regulations. One quite clear conclusion could be drawn from the debate: no one wants to eliminate more requirements from the Building Decree. Even developers, builders and home owners are in favour of a good functioning national system of building regulations. When elements are removed from the regulations at national level there is a 'danger' that pseudo regulations are going to be developed at local levels or that some quality topics have to be defined at project basis. Public building regulations in fact serve a series of goals of which the guarantee basic qualities for its users is only one.

## 3. Systems of formulation of technical building regulations

The formulation of technical requirements has been discussed for many years. The CIB Taskgroup 37 'Performance based building regulatory systems' developed a model to analyse and describe the various systems of performance based requirements. The concept of the 'Performance System Model (PSM)' was formalized. In2004

We have used this model to analyse the formulation of requirements in different countries. Some countries, including the Netherlands, have consciously attempted to follow such a model.

*Fig 2 Performance system model CIB-TG 37*




## 4. The organization of building control

Our studies show that administrative procedures in Europe vary widely. Although building permit procedures are determined at the national level, developments indicate a trend towards convergence across the Europe member states. This trend is best described as 'procedural (or administrative) deregulation'. Within these countries, the category of construction works that require building permits is diminishing. Authorities are trying to improve both the effectiveness and the efficiency of their procedures through such initiatives as making a procedural distinction between simple and regular procedures. Actions being taken to streamline regular procedures even further include introducing online facilities for acquiring information and applying for permits, allowing exceptions for certain frequent construction works (i.e., Type Approval) and dividing the regular procedure into phases.

The future of building control (and especially the way it is best organized and executed) are high on the agenda in many European countries. In almost all cases deregulation and privatisation are important themes. The way one can look at solutions however differs. We give an impression of the actual situation (and discussions that take place) in the Netherlands, England & Wales and Germany.

## 5. Discussion

Building regulations are an essential tool in planning and building processes. One may not expect that the primary processes of design and construction will lead to buildings that meet the defined requirements without strict quality assurance procedures. Therefore building permit procedures based on procedures of plan checking and site inspections are essential elements of the building regulatory systems. Time and again initiatives are started in the European countries to reduce the administrative burden and to improve the actual enforcement of the regulations. This can be worked out at several levels: the scope of the regulations, the system of formulation of the regulations and the system of enforcement. The expectation is that the scope of public regulations will not become narrower. The growing importance of environmental issues and reduction of energy use in buildings will lead to more regulations. Also, we believe that the existence of technical requirements is not the main reason of administrative burden. More can be gained by an easy use of the regulations in the building practice and an effective and efficient quality control process. The move towards more privatisation seems to be a sensible move. But do not consider it as a panacea for (serious) failures and weaknesses of current building control systems. Look at the German experiences. We think the Dutch and (especially) English are good 'process examples' to try to develop a sound future building control system. Current problems and barriers are addressed without the exclusion of possible solutions beforehand. Developments and solutions found in one country can inspire other countries in their strife for a better building regulatory system. However solutions for one country can not be automatically implemented in another country. Tailor-made solutions for certain problems/barriers still are needed.

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# Minimizing construction disputes: the relationship between risk allocation and behavioural attitudes

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*The continuing incidence of costly disputes in the construction industry has led to a common interest of researchers in different countries to identify the generic aspects of conflicts, claims, disputes and their resolution. This paper undertakes a comprehensive review of literature in the field of construction disputes and identifies the relationship between procurement selection (with the inherent risk allocation) and the behavioural attitudes of key stakeholders as critical factors in the incidence of disputes. It conceptualises the research area and identifies a proposal for further research based on case studies of construction projects in Lebanon which have encountered disputes and claims.*

**Keywords:** Disputes, conflict, claims, risk, behavioural attitudes

## 1. Construction disputes

### 1.1 Disputes and conflict

Unlike other types of industries where the development and manufacture of product can be standardised and tested before being purchased, the nature of projects in the construction industry is extremely diverse. Every project is unique. Even where identical buildings are under construction, the site conditions in each will differ and introduce new challenges. Moreover, it is a multi-party process where numerous specialist parties are involved due to the diversity of skills required and thus maintaining teamwork atmosphere and controlling potential conflicts is important. Also, the construction projects normally span for a long period between the decision to invest and the completion of works. This leads to instability of supply and demand and high sensitivity to economic fluctuation. Maintaining a cooperative environment becomes a difficult task because conflicts are inherent in construction projects. Where conflicts result in adversarial stances and mistrust, they have a detrimental effect on project performance. Eliminating conflicts appears to be a daunting objective and so efforts have been directed towards reducing their magnitude and/or keeping them under control.

### 1.2 Causes of disputes

Kumaraswamy [1] attempts to understand disputes by identifying common root causes and proximate causes, and confirms the need to isolate the real root causes of avoidable claims and disputes. Fenn [2,3] conducted exhaustive international surveys of previous research into causes of disputes and. However, it has been suggested by that the direct comparison of results is "neither possible nor useful, because of the diverse industry cultures and differing methodologies and terminologies used in data collection, analysis and outcome presentations" Kumaraswamy [4]. Nevertheless, factors do tend to fall into broadly three categories: external factors; contracts; and project teams. This is confirmed by the Dispute Prevention and Resolution Task Force of CII where the factors were described as project uncertainty, process problems including imperfect contracts and people issues. Mitropoulos and Howell [5] move beyond individual factors and study the effect of interaction of technical, contractual and behavioural factors on the development of disputes as proposed in a dispute development model. These authors again identify three basic factors that directly affect disputes: project uncertainty, contractual problems and opportunistic behaviour.

## 2. Uncertainty, contracts and behaviour

### 2.1 Project uncertainty

Construction projects are sensitive to an extremely large matrix of hazards and risks due to some of the inherent characteristics of construction projects. As with disputes, many attempts have been made in the literature to identify and categorise risks. It is suggested that if risks surface in a project, and are not treated correctly, a dispute will result. Much of the literature asserts that the risk should be transferred to the party that has the competence and expertise for best assessing, managing, controlling and minimizing it. Risk allocation may be achieved through any one or a combination of risk retention, risk transfer, risk reduction and risk avoidance.

### 2.2 Contractual issues

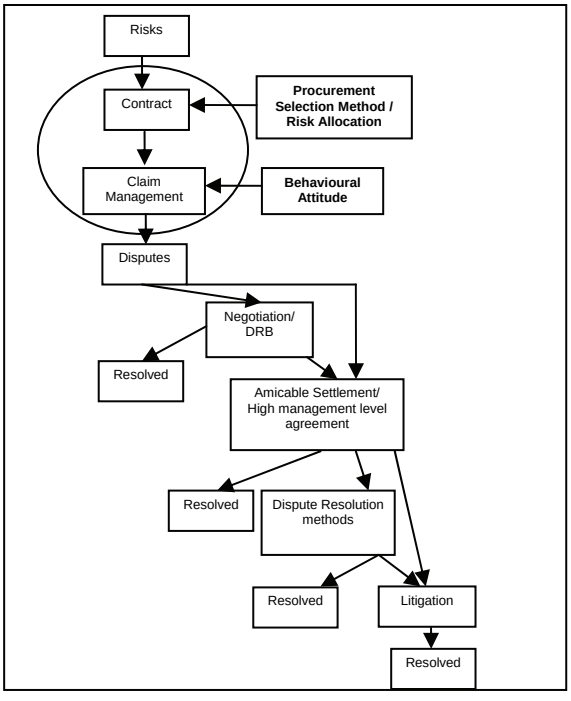
Choosing the appropriate procurement method is a vital preventive method which if not carried out effectively might increase the probability of dispute occurrence. Consequently many models have been devised for procurement selection: discriminate analysis approaches; multivariate analysis; decision support systems; knowledge-based systems; rating systems; procurement path decision charts; multi-attribute and analytical hierarchical processes; objective-subjective procurement method; and the multicriteria / multiscreening models.

### 2.3 Behaviour

The main causes of inter-organizational conflicts are identified as: conflict due to task interdependency, conflict due to differentiation, conflict due to differing values, interests and objectives, conflict due to communication obstacle, conflict due to tension, and conflict due to personality traits. The resulting conflict leads to stereotyping and attitudes of low friendliness, low trust, and low respect which in turn has an adverse impact on performance. In studying the dispute predictors: people, project and process criteria as likely sources of emanating disputes, the results showed that the people criteria had the most effect followed by the process criteria.

## 3. Research area conceptualisation

The literature clearly reflects the interrelationship between different factors. A study of disputes has led to the study of risks, conflicts, claims, procurement methods, and dispute resolution methods. A conceptual flowchart (below) indicating the trajectory of disputes from inception to resolution informs the development of three research questions. What is the impact of risk allocation in contributing to the incidence of disputes on construction projects? Can effective project management / contract administration help mitigate claims and minimize construction disputes? How does the behavioural attitude of the parties involved in projects affect dispute avoidance, management and/or escalation?




The long term aims of this research are therefore to examine the frequency and causes of disputes in the specific context of the Lebanese construction industry and to identify possible relationships within and between the risk allocation strategies adopted during the procurement of the construction works and the behavioural attitude of the parties. Once these relationships are understood, a theoretical framework will be developed to help prepare advisory risk and behaviour recommendations for construction projects.

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# SECTION VIII

## SUSTAINABILITY

# Adapting NSW Health Facilities to Climate Change – A Risk Management Approach

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*With incontrovertible evidence that anthropogenic climate change is occurring worldwide, the need to safeguard critical community infrastructure in the face of increasing incidences of extreme weather events must be addressed. This paper will report on the outcomes of a risk management workshop conducted early in 2007 for the NSW Health Environmental Health Branch that considered possible risks to human health and impacts on healthcare infrastructure likely to be associated with these types of events in NSW, Australia. The findings from this study are generalisable to other communities and indicate a range of available controls to address and manage the identified risks and opportunities generated by climate change for critical healthcare infrastructure.*

**Keywords:** Climate change, healthcare infrastructure, risk management, asset management

## 1. Background

This study was undertaken at the request of the NSW Health Environmental Health Branch as part of the *Human Health Impacts of Climate Change Adaptation Project* funded by the NSW Greenhouse Office, NSW, Australia. The NSW Greenhouse Office project was designed to provide research evidence and develop policies and programs that will enable NSW government service providers to adapt to the potential impacts of climate change.

This paper reports a preliminary investigation of the adaptive capacity of NSW Health infrastructure to increasing incidences of extreme weather events likely to be generated climate change. It considered both mitigation and adaptation approaches, with the primary focus is on adaptation strategies required to safeguard essential healthcare infrastructure so as to protect the current and future health status of the NSW population.

The *parameters* of the study were deliberately restricted to focus on the facility-related impacts of heatwaves (and bushfires), floods, storm surges, and tsunamis. The overall *objective* was to identify a range of potential adaptation strategies for NSW healthcare facilities in coping with extreme weather events, to develop an Action Plan that summarises identified key risks and opportunities, and a strategy in dealing with each of these. In doing so, it also determined where further research and investigation are required [8].

## 2. Method

The risk management approach towards adaptation strategies adopted by this study was developed in accordance with recommendations made by the UNFCCC [2], the Australian Greenhouse Office [3], CSIRO [4], UK CIP [5] and other authorities. The study commenced with the identification of ten key stakeholders who were subsequently invited to a Risk and Opportunity Management (ROMS), which principles have been published in [34]: NSW Health Asset and Contract Services; Ambulance/emergency Services; Private - designers and/or contractors; Government – NSW Dept of Commerce (Govt architect); NSW Health Statewide Services Branch; NSW Health Environmental Health Branch; NSW Area Health Services (clinicians/public health officers)– NSCCAHS; NSW Greenhouse Office; Aged Care Services Assoc (ACSA).

## 3. Results

These key participants identified the following key factors in adapting health facilities to extreme weather events.

### 3.1 Risks to the Healthcare System due to Climate Change Extreme Weather events – Impacts on Human Health and Health Facilities

The change in weather patterns and increased variability and extremes suggests that patterns of disease will alter both within NSW and Australia generally. Healthcare infrastructure may come under pressure as a result of those seeking refuge from extreme events and increased demands by those suffering injury or ill health. However, it was beyond the scope of the study to undertake specific or detailed investigations into this. The work is either being undertaken by others and/or demands the skills of public health specialists and epidemiologists.

### 3.2 Possible Infrastructure Responses

The workshop identified that a key barrier to moving forward with adapting to extreme weather events was the lack of understanding of the likely quantum and nature of the impacts of such events on health infrastructure. The quantification of the impacts of climate change and the resulting extreme weather events was considered key to reinforcing understanding of the immediacy and severity of problem. It also indicated that an evidence-based approach must underpin adaptation strategies designs, and the likely costs associated with these.

### 3.3 Adaptive Capacity – existing and required

The workshop identified the lack of certainty around how climate change will impact the Australian community, and that a sense of urgency was beginning to become apparent but was yet to be translated into policy and adaptation strategies. The workshop confirmed that changing attitudes towards adaptation and then "ensuring behavioural change" is an important factor in enhancing the "adaptive capacity" of health infrastructure to cope with extreme weather events.

### 3.4 Integration with current disaster management strategies and other community responses

One impediment emerged from the workshop was the current lack of focus on the issue of climate change adaptation strategies within NSW Health itself. Adequate responses to the issue require firstly acknowledgement of its existence, then a willingness to consider and to support development of appropriate responses, all requiring a heightened sense of urgency from those in NSW Health responsible for planning and funding the development of health facilities. Another barrier is the lack of integration of Capital Expenditure and Operational Expenditure budgets. Appropriate governance structures and high level coordination of efforts to overcome these difficulties were also perceived to be lacking in many instances.

### 3.5 Research Required

*Impacts of Climate Change extreme weather events on Health and Facilities:* The lack of research in this area discouraged any attempts for adaptation to extreme weather events. The use of Geographic Information Systems (GIS) mapping, Laser Radar (LIDAR) and other technologies to examine the impact on real locations are feasible techniques already being used. *Infrastructure Responses and Adaptive Capacity:* encourage a better understanding of the suitability and applicability of adaptive responses through evidence-based practice. These included the development of innovative strategies through multi disciplinary research that should include accurate forecasting of implementation costs. *Integration with Current Disaster Management Strategies and other Community Responses:* NSW Health should continue to work with existing disaster planning agencies to respond to the additional challenges. Suggestions made at the workshop included the need for applied research to be more prescriptive in its outcomes specifications and to include the prioritisation of efforts for the NSW Health Asset Management Planning policies and processes.

### 3.6 Communication of Research Findings

It will be important to communicate clearly and effectively any early assessment of gains from pursuing the adaptation route. This could be done through forums and respected research bodies, with adherence to a wider national research agenda. Demonstration projects showing the implementation of health infrastructural adaptation strategies and ongoing evaluation of these may be used to inspire the current clinical and asset management practices.

## 7. Conclusion

The study demonstrates the need for a systems approach to developing adaptive capacity in healthcare infrastructure to cope with climate change. This includes the requirement to determine not only the impact of increasing incidences of extreme weather events on the health of the community that may increase the demands of the customers for healthcare services, but also to consider how to prevent health facilities failing under the demands placed on the building fabric due to these same events. Working with existing systems appears to offer the greatest chance of success in achieving both these aims. For example, where possible, tapping into existing disaster management frameworks will ensure more effective community responses and greater pressure for the development of adaptive capacity for healthcare infrastructure. This approach will thus also be more responsive to the existing political, social, technological and institutional capacity, wherever the healthcare system may be located

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# Sustainability index for roof covering materials

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*Construction is the largest user of materials of any industry. Hence selecting environmentally preferable building materials is one way to reduce negative environmental impacts. The lack of scientific data available in Sri Lanka for roof covering material selection is seen as a problem. The purpose of this study is to derive a sustainability index for alternative roof covering materials that will assist design team members to take informed decisions. It was intended to take into consideration the environmental, economic and technical performance of the roof covering materials. Life Cycle Assessment (LCA) is adopted to assess the alternatives including the economic and technical performance. This study has been limited to Asbestos corrugated sheet, Calicut tiles, and Zn/Al sheets.*

**Keywords:** Embodied energy, Roof covering materials, Life cycle assessment

## 1. Background

All economic sectors, including the construction industry, now face an inescapable challenge posed by the term "sustainability". The construction industry is commonly considered as one of the largest industries in both developed and developing countries in terms of investment, employment and contribution to GDP. Consequently, the impact of the construction industry on the environment is also significant [4].

The term `sustainable construction' was originally proposed to describe the responsibility of the construction industry in attaining 'sustainability' [2].

### 1.1 Construction materials

The fact that construction materials are low-value should not surprise us; neither should it blind us to the importance of these materials. The sheer scale of consumption means that their use has a major impact on the environment and economists, engineers and environmentalists have all devoted much thought to ways of measuring this impact. A number of criteria or indices of impact have been devised, with the objective of furnishing numerical data, which can help decision making. Qualitative assessments are useful up to a point, but if real progress is to be made it necessary to quantify the impact of materials consumption [3].

### 1.2 Building materials and sustainability

The overall performance of the building is the most important consideration in achieving more sustainable construction. Building materials play an essential role in increasing their energy efficiency and contributing to economic prosperity. Traditionally, materials selection for the design and construction of facilities has been based on economic and technological considerations, given the desired life span of a facility and the programme of requirements and codes it must meet. In design environments where ecological, health, and ethical impacts are increasingly important, often the only way to choose from many different material alternatives is by relying upon on quantified professional judgement or past experience. The method should allow comparison not only of the technical performance and costs of materials, but also the immediate and long-term impacts their use has on the finite supply of natural resources and the ongoing needs for those resources by society. Together, these impacts comprise a measure of the sustainability of materials and should be given consideration during materials specification [1].

## 2. Sustainability of the materials

1.47 m2 of Asbestos sheets, 3.35 x 10 -3 Tons of Zinc alum sheets and 17 Calicut tiles have been used as the normalisation values for comparison except for functionality and life cycle cost.

*Table 4. Embodied energy values of roof covering materials*

| Roof covering material | Embodied Energy in MJ |
|---|---|
| Asbestos sheets | 134.90 |
| Zinc alum sheets | 1,448.43 |
| Calicut tiles | 549.57 |

*Table 5. Environmental impacts of roof covering materials*

| Roof covering material | Global environmental impact in CO2 Equivalents | Local environmental impact in CO2 Equivalents |
|---|---|---|
| Asbestos | 318.88 | 0.30 |
| Zinc alum | 142.81 | 0.15 |
| Calicut Tiles | 49,211.56 | 25.08 |

*Table 6. Reusability of roof covering materials*

| Roof covering material | Reusability |
|---|---|
| Asbestos sheets | 0.51 |
| Zinc alum sheets | 0.44 |
| Calicut tiles | 0.27 |

*Table 7. Life cycle costing of the roof covering materials*

| Roof covering material | Life cycle cost |
|---|---|
| Asbestos sheets | 654,440.00 |
| Zinc alum sheets | 2,803,186.00 |
| Calicut tiles | 1,040,520.00 |

*Table 8. Functionality ranking of the roof covering materials*

| Roof covering material | Functionality ranking |
|---|---|
| Asbestos sheets | 2 |
| Zinc alum sheets | 3 |
| Calicut tiles | 1 |

## 3. Conclusion

Based on the findings of this research, Asbestos sheets have the lowest embodied energy coefficient whereas calicut tiles have the highest. This is because calicut tiles uses fire wood extensively for production. Asbestos sheets are less energy consuming. However this increased energy consumption could be offset against the longer lifetime of calicut tiles.

As far as global impacts are concerned, Zn/Al sheets have the lowest impact where as asbestos and calicut tiles have higher impacts. The reason for the calicut tiles to have higher values for global impacts (e.g. global warming) is that it uses fire wood extensively which results in increased emission of $CO_2$. Calicut tiles have the highest effect on the local environment too, due to its lengthy transportation of large quantities and the immense use of firewood. Asbestos sheets have a high reusability index whereas the Zn/Al sheets have the second highest and calicut tiles the least. When comparing asbestos sheets and calicut tiles based on life cycle costing, asbestos sheets take the lower NPV value, because its frame cost is significantly less than that of calicut tiles, even though it has one replacement during the life of the building. For Zn/Al sheets the cost of the roof frame and roof plumbing are comparatively high and it has three replacements during the lifetime of the building. Hence Zn/Al takes the highest NPV over the other two roof covering materials. Calicut tiles have the highest thermal performance, reducing the cost of roof insulation whereas Asbestos and Zn/Al sheets have their thermal performance ranked second and third respectively.

The table below displays the sustainability indexes of the roof covering materials considered in this study. Asbestos sheets have the highest sustainability index.

*Table 9. Sustainability index of the roof covering materials*

| **Roof covering material** | **Sustainability index** |
|---|---|
| Asbestos sheets | **444.78** |
| Zinc alum sheets | **352.25** |
| Calicut tiles | **241.09** |

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# Towards process mapping the development of sustainable housing projects in the UK

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*The Consideration of sustainability alongside the financial impacts of the construction projects calls for the focus during the pre-construction stage of a life cycle of the project to shift towards the life cycle of the project. Using good quality materials from sustainable sources will increase the lifecycles of sustainable construction projects and reduce their negative impact on the climate. This research aims at developing an initial framework of the processes involved with sustainable socially owned housing projects which when further refined could help deliver better social housing projects. Interviews were conducted with construction professionals in the operating within the development processes of sustainable social housing projects. The emergent framework highlights the actual processes used on the ground to consider sustainable factors as well as the pre-construction cost evaluation of social housing projects. It examines the actual consideration of the project whole life cycle during the feasibility stage for this type of projects. This early consideration of sustainable issues in general and sustainable materials in particular helps to reduce the negative effects of the construction projects on the environment and prepare by the using of recyclable materials to avoid the awful impacts of unexpected disasters on the environment.*

**Keywords:** Process mapping, Climate, Social housing projects, Sustainability, Cost

## 1. Background

The building industry, directly or indirectly causing a considerable part of the annual environmental damage, can take up the responsibility to contribute to sustainable development by finding more environmentally benign ways of construction and building. The sustainability of a certain material based product is mainly dependent on the materials used for the product itself or during its lifetime. However, it is also very important to insure that selecting materials and equipment from sustainable sources, with the lowest in-use environmental impacts, with the lowest embodied environmental impacts, and with high-recycled content is one of the main pre-construction processes in the project development. Corgolewski [1] explained that taking into account the environmental impacts of selecting durable and well performing materials chosen for sustainable construction projects should be done over their full life cycle including manufacturing, construction, operation, maintenance, demolition and disposal. Looking more specifically at the housing industry, the environmental impacts of the long-life materials in a house are significant in ways that create quality, long lasting environments with minimum damage to the planet [2]. It then goes further by minimising the embodied impacts of the construction materials used to achieve the design of the sustainable housing projects. Barton [3] explained that the UK government has become interested in sustainable housing during the 1990s, along with other mainstream actors, such as private sector house builders. Low carbon sustainable housing projects are one of the attempts to solve the climate change problem. Climate change has been judged by the UK government to be an important domestic and international environmental issue [4].

## 2. Materials and Process mapping in construction projects

Riley *et al.* [5] explained that sustainable building projects require intense interdisciplinary collaboration, highly complex design analysis, and careful material and system selection, particularly in the early stages of the project delivery process. Social housing projects are a good example of the building projects in UK, but it is asserted that they suffer critical weaknesses in their delivery. There is a great need to investigate the current processes of developing sustainable social housing projects, identify the various phases of social housing projects with particular emphases on sustainable issues to capture the actual stages during project development. Research conducted by Shashar *et al.* [6] developed a generic process protocol for use in the construction industry. The process protocol identified the main phases of activity that need to be addressed in the delivery of a client's project but as yet its many sub-phases remain to be fully detailed. The generic process protocol considers the whole lifecycle of the construction project whilst integrating its participants under a common framework. Other current process maps in the UK are the OGC guides [7] and [8] which were provided in 2007 by the UK Government who underlined its commitment to sustainable development to achieve a better quality of life through the efficient use of resources. The first guide took the project procurement life cycle as its base and focused to deliver a sustainable solution which satisfies the social, economic and environmental aspects of sustainable development that should be addressed during the lifecycle. While the second guide helps the project team to identify the range of options and deliver the best value whole life solution. However, this guide highlighted the key areas of sustainability together with a series of questions and steps for action to help to choose the best solution for the project. It is very important to check that sustainable materials are considered in the current construction policy for housing projects to protect the environment.

## 3. The research contribution

The aim of this part of the research is to develop a process map as an essential tool for construction processes of sustainable social housing projects. Its aim is to check the reality of considering sustainable issues in general and sustainable materials in particular during the initial steps of developing the project budget. It aims also to evaluate the existing process maps and to identify when and how sustainable factors are taken into account in this type of projects. To achieve that, the research developed an integrated framework between the generic process protocol as an academic point of view of the process of developing the project and both of the OGC 2007 procurement and sustainable frameworks from the public funding projects point of view. Then this integrated framework was tested in the social housing projects of housing associations to check its validity. Comparing of the Generic Process Model and the OGC model and pointed out some of their inconsistencies. It was not possible to find enough integrating points between these two frameworks as they have different critical phases and different hard gates. In addition; there is no clear mention for sustainability in the generic process protocol. For that and as publicly funded social housing projects in the UK are supported by the government, in addition to the great emphasis on sustainable issues within the whole life cycle of the building from design to construction and operation in this guide, this research aimed to check the validation of the integration of both the OGC 2007 procurement and sustainable guides for social housing projects of Housing Associations in the UK. Interviews were made with the number of the key Housing Associations concerned with developing sustainable housing projects. The aim of the interviews was to adjust the integrated OGC framework to suit the actual planning and construction steps experienced by practitioners on the ground who were involved in sustainable housing projects in the UK. As a result of this analysis the work is able to highlight the exact stages and their timing involved in the consideration of sustainable materials in addition to other aspects of sustainability associated with the development of sustainable socially owned housing projects. The results of this research was a new grounded framework which can be used to set out a map of the processes involved in the development of sustainable housing projects in the UK.

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# Practicing energy efficient design for commercial buildings in Sri Lankan industry

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*The building industry is constantly expanding with consequences on energy expenditure. As in many other countries, the building industry in Sri Lanka is the most energy consuming industry. In recent years there has been much discussion regarding energy conservation techniques required to mitigate the demand side of the energy sector. Building design directly affects the energy performance of a building. The emphasis on energy conservation has therefore, begun at the design and control stage throughout the life cycle of the building project. Buildings, energy and the environment are issues that building professionals have to address in current day projects. This is partly due to increased public awareness of environmental issues related to building developments. Therefore, to achieve the energy efficiency goal, architects and building designers need to perform energy conscious designs in their relevant discipline. The purpose of this study was to find out to what extent energy conscious design has been considered by the designers, in the Sri Lankan context, and to recognise the areas to be developed to achieve energy efficient building in the industry. The research methodology adopted for this study was quantitative, within which questionnaires were used for the detailed survey. The pilot study was conducted by telephone interview. Through this research it was found that mandatory energy guidelines should be enforced on designers. In addition, the designers lack of knowledge on life cycle benefits; available technology; available energy efficient techniques; and non- usage of energy analysis tools are major hindrances to proceeding to energy efficient designs.*

**Keywords:** Analysis tools, Building energy code, Design team, Energy efficient design.

## 1. Background

In most of the countries, the building industry is most energy consuming industry and it is constantly expanding with consequences on energy expenditure. The past twenty years of research effort has produced a consensus understanding of the impacts of energy consumption and the approaches needed to reduce this impact by using energy efficiency and the deployment of renewable energy technologies. Therefore, to achieve the energy efficiency goal, architects and building designers need to design energy conscious designs in their relevant discipline. Hence this research was aimed a finding out to what extent energy conscious design has been applied by designers in today's buildings in Sri Lanka.

In Sri Lanka, the demand for electricity is rapidly increasing. In 2004, electricity demand growth rate varied between 7%-8%. The average electricity consumption per capita is 348Kwh/person for the same period and it has grown by 8% from previous years [2]. It was forecasted that electricity demand would quadruple in the next 15 years [1]. The main sectors of energy consumption in Sri Lanka are Industrial, Transport, Household and Commercial and others (e.g. religious organisations). According to the ECF [4] for 2003, the percentage of consumption of the Household and Commercial sector was 51.10% when compared with the other two sectors i.e. Industry and Transport which are respectively 24.41% and 24.80%. Among these, the rate of increase in energy demand in the commercial sector is the highest due to: the rapid development of the sector, changes in life styles, contemporary architectural practices and lack of suitable energy saving technologies and building management/automation systems. For these reasons, the present annual electricity consumption in commercial buildings, which is approximately 1000GWh, is expected to increase by 28% of the total electricity demand [3]. Now sustainable development has a global focus in present day industry. Buildings, energy and the environment are issues that the building professions have to address in current day projects. This is partly due to the increased public awareness of environmental issues related to building developments.

## 2. Sustainable design

Sustainable design is the thoughtful integration of architecture with electrical, mechanical and structural engineering. In addition to concern for the traditional aesthetics of massing, proportion, scale, texture, shadow, and light, the facility design team needs to be concerned with long term costs: environmental, economic, and human. The main objectives of sustainable design are to avoid resource depletion of energy, water, and raw materials; to prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and to create built environments that are livable, comfortable, safe, and productive.

## 3. Energy conscious design in Sri Lankan context

Progress towards sustainable development, is one of the major contributions provided through designing energy efficient buildings. Therefore practicing and developing energy conscious design encourages the production of more energy efficient buildings. This research aims to find practicing energy efficient designs in the building industry in Sri Lanka. Due to the broad scope of energy efficient design, this initial research focuses on identifying energy conscious design disciplines within architectural and services designers, of the building sector – focusing mainly on commercial building in the Sri Lankan industry.

## 4. Research methodology

The research methodology adopted for this study was quantitative. Initially the pilot study was conducted by telephone interview to establish the designer's views on energy efficient design and the usage of energy analysis design tools. A detailed survey was then conducted within which closed questionnaires were used. This included the fixed responses option as Likert scales. The structured questionnaire survey was conducted with thirty selected samples including the pilot study samples. Fifteen professionals were involved from Architectural Designs and Services Design, including electrical and air conditioning disciplines. Descriptive statistical measures, viz. the minimum, maximum, median and the quartiles were used in analysis. Further Mann-Whitney U test have been used to identify the significant differences between two independent groups of sample such as the architects and service engineers.

## 5. Conclusion

The awareness of energy efficiency design was very important in the present day design scenario. Most of the designers should consider it in this context not only because of the benefits to the clients but to society as well. As an initial measure, to reduce the demand side energy, was taken by introducing EEBC as voluntary guidelines to the Sri Lankan building industry in 2000. However until now it has not developed and the implementation of that code is very rare in present day industry. Most of the designers expressed a need for mandatory guidelines to construct more energy efficient buildings in the future. They further expressed that the present EEBC needs to be updated and revised as soon as possible, before it implemented as a mandatory guideline. Furthermore, clients have been very reluctant to go for energy conscious design. Most of clients have a misconception that construction cost were high for energy efficient construction, based only on the initial cost. However it was not real in the present scenario. When considering the long life of the building it was found that the energy efficient building was more economical than that of the traditional energy non-conscious buildings. In the industry, certain energy efficient design concepts are in practice such as solar gain control, efficient lighting, power factor correction etc. but techniques like passive design techniques were not as familiar among the designers. Moreover it was found that techniques to achieve energy efficient building, by using low embodied energy materials are not well known amongst designers. However, overall, most designers are not specifically concerned with energy efficient designs in their design discipline. Knowledge regarding energy analysis tools was also lacking amongst designers. Hence providing education and training and other measures to develop awareness for the need for energy conscious design will be needed much more in present day industry. In addition to the designers, the various stakeholder parties such as local officials, private and public clients and consumers also need to be made aware of the energy efficient aspects to save energy and provide vital economic and ecological benefits to a country like Sri Lanka.

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# Management plans and 'state of environment reports' prepared and implemented by local councils in NSW: problems and potential for biodiversity conservation

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*The Local Government Act 1993 (NSW) demands every local council in NSW to prepare, inter alia, an annual 'management plan' and 'state of the environment report'. This paper critically examines both mechanisms and the relationship between them. Discussion is underpinned by the context of biodiversity conservation at the local level. Whilst good environmental intentions lie behind the legislative requirements, their benefits are questionable. They are often recognised at the local level as little more than bothersome bureaucratic requirements. Although overdue legislative and policy change is forthcoming, concern is raised about a loss of emphasis on conserving the natural environment.*

**Keywords:** local government, environmental law, management plans, state of environment reports, biodiversity conservation, policy change.

## 1. Background

Local government in Australia experienced major change throughout the 1990s. One particular aspect is the legislative move away from prescriptive to broad powers. Councils no longer need to rely on any express or implied statutory hook on which to hang a particular activity. Instead, apart from their own regulatory roles, local authorities can engage in a wide range of actions provided they are lawful. This has led to significant functional expansion. A ready example is biodiversity conservation, exemplified by special law and policy and emergence of environmental officers on the municipal stage [1]. But municipal attention to biodiversity is scarcely universal. One reason is that councils are facing ongoing financial paucity. A Commonwealth Parliamentary report issued in 2003 warned local government against taking on new costly activities [2]. For some authorities, biodiversity conservation may easily fall into this situation.

The primary aim of this paper is to critically consider two compulsory mechanisms in the *Local Government Act 1993* (NSW) (LGA 1993) that encompass biodiversity, namely the 'management plan' and the 'state of environment report' (SoER). Whilst the focus is on NSW, many of the issues apply across Australia. One significant exception is that NSW is the only state where preparation of local SoERs is compulsory [3]. In contrast, management plans under various names apply across the country, but now extend far beyond the traditional municipal corporate plan. The narrative will also illustrate that whilst the statutory demands in NSW raise various problems, recent state government review of the system raises further questions.

## 2. Management Plans

Councils in NSW that embark on major new projects, including conservation works, must engage in the management plan process. As described by the NSW Department of Local Government (DLG), this is the 'central mechanism … by which councils allocate their resources and prioritise their activities' [4]. The plan must identify 'principal activities', wherein the LGA 1993 lays down a non-exhaustive list of matters that, if carried out, the management plan must address. It refers to traditional municipal functions in wide terms such as 'capital works projects' and 'services'. The list also makes specific reference to 'activities to properly manage, develop, protect, restore, enhance and conserve the environment in a manner that is consistent with and promotes the principles' of Ecologically Sustainable Development (ESD). These are known as 'environmental protection activities' (EPAs). A major weakness of the regime is that in the case of activities falling *outside* the EPA umbrella, the LGA 1993 does not expressly demand the factoring of any environmental concerns into the decision-making process. For instance, a council might decide to construct a new road through native woodland. As the activity comprises a 'capital works project', attention may relate to engineering issues alone.

There are other issues. First, whilst draft plans are placed on public exhibition, the level of community input is dubious. Second, the plans give opportunity for desired environmental objectives to permeate all council activities [5]. The problem is that many celebrated environmental projects often work in isolation, suggesting a need for closer internal interaction. Third, more awareness is needed on potential for cross-boundary cooperation, with both neighbouring councils and state agencies. Whilst relevant subsidiary legislation recognises this, it is narrow and hidden away.

## 3. State of Environment Reports

SoERs must be periodically prepared by the Federal, State and NSW councils. The LGA 1993 requires eight 'sectors' to be addressed, including biodiversity. In meeting that obligation, councils must tackle the relationship with management plans relating to the environment, which provides one of several direct statutory links between the two. But empirical research from interviews with local officers reveals a widespread belief that the SoER is merely a mandatory administrative hurdle rather than a potential strategic device [6].

Several further subtopics arise here. First, the legislation requires councils to consult with their communities, including 'environmental groups', and also involve people in 'monitoring changes to the environment'. Unfortunately, there is scant detail on how this is to occur. Second, no public comprehensive review of SoERs has been undertaken to test the extent to

which they influence council on-ground policy. Whilst there is widespread recognition of the fragile and limited extent of vegetation remnants, the emphasis appears to be on the need to gather more information rather than setting down concrete responses. In many cases, the detailed statutory rules appear to have been disregarded. Of course, there is scope for SoERs to *evolve*. But biodiversity will continue to diminish whilst we wait. Importantly, such commentary is not intended to overlook those councils that are head and shoulders above many others. Third, many environmental aspects, including biodiversity, transcend local borders. Prospects exist for regional collaboration via voluntary structures such as 'regional organisations of councils' and 'strategic alliances'. From an ecological viewpoint, SoERs prepared on a bioregional basis would make far more sense than many unconnected SoERs of varying quality.

The picture is again one of unfulfilled opportunity. Any success of the SoER as a conservation tool relies on a combination of commitment, sufficient resources and regional willingness. As far as politics are concerned, many councils will already have other priorities ingrained by tradition. More consideration needs to be given to specialised funding, improved environmental regional cooperation and better linkages between the two mechanisms.

## 4. Current Policy Change and Conclusion

At the time of writing, it is likely that the two mechanisms will be substantially changed, if not deleted. In late 2006, the DLG issued an 'Options Paper' [7]. Of the various alternatives put forward, it appears that the third option, which is receiving most government support, does not embrace continuation of either the management plan or SoER. Instead, at the top of the hierarchy is a 'Community Strategic Plan' (CSP), which is designed to serve the community rather than the council itself. The CSP will last for ten years, after which time scales will depend on individual council decisions. Below the CSP there is to be a 'delivery plan' for every four year electoral term, an annual operational plan and the annual report, which will influence the CSP. The failure to include an improved, well articulated and community-based structure for the SoER demands reconsideration. Further investigation into regional cooperation is also crucial. Councils devoted to maintaining the SoER concept may apply their own emphases. This would not only match the subsidiarity principle but may encourage regional scales. Retention of SoERs or similar devices will not be universal. But whilst the legislative and policy review by the DLG was well overdue, we do want to see the baby being thrown out with the bathwater.

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# The built environment in Southern Africa: The influence of diversity, culture and tourism on conservation

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*South Africa has a diverse and cultural society with a tradition of colonialism, cultural interaction, separatism and democracy. To conserve buildings influenced by South African history, a sympathetic approach to all its cultures is needed to ensure conservation, showing merit in diversity.To this end tourism in Southern Africa plays a major role in respect of sustainability of cultural and historic buildings. This paper will demonstrate how this was done in the past and how future conservation will play a major role in showing the cultural history of the Southern African heritage. The paper will be strongly supported by visual images of the South African built environment.*

**Keywords**: Diversity, tourism, cultural heritage, conservation, built environment

## 1. Background

South Africa has a tradition of colonialism, cultural interaction, separatism and democracy within a diverse and cultural society. To conserve buildings influenced by South African history, a sympathetic approach to all the cultures is needed, one that will ensure conservation showing merit in diversity.

Tourism in Southern Africa plays an important role in respect of sustainability of cultural and historic buildings.

Southern African conservation in the past and how future conservation will play a role in its cultural heritage is demonstrated in this paper.

## 2. Conclusion and recommendations

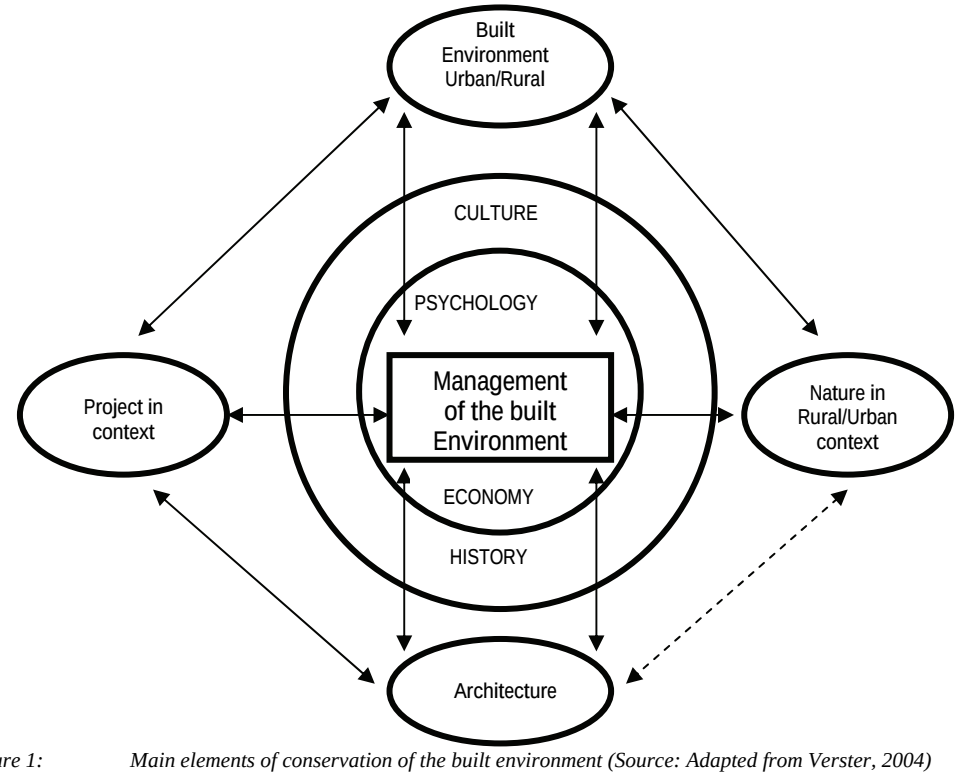


*Figure 1: Main elements of conservation of the built environment (Source: Adapted from Verster, 2004)*

This paper aims to show examples of the wonderful architectural heritage of South Africa as well as the variety of styles, history, materials used, culture and time periods. It also proposes that the protection of this heritage will enhance South Africa's image as a tourist destination.

Historical architecture is important for sustainability and should focus on value at these entities to attract tourism, especially the up-market industry. Research clearly shows the importance of tourism towards sustainability (refer to Graph 1). A country and its citizens must protect architecture to ensure the attraction of tourism for sustainability.

Figure 1 proposes a model of the main elements and links that should influence conservation of the built environment in the South African context, to ensure sympathy for the country's building heritage.

South Africa has an interesting heritage of building architecture, objects and structures that inherently depicts the people of the country, their culture, politics and inter-relationships. New, Africa-centred architecture that may delight visitors to the country has now begun to evolve.

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# A New Village in Sri Lanka: Learning Lessons There, Sharing Lessons Here

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*When the Indian Ocean tsunami hit Sri Lanka, it destroyed the 190-person village of Kalametiya. Eleven people were killed and every building was ruined. In March 2005, the authors helped to "catalyze" the reconstruction of the town under the direction of architect Madhura Prematilleke and with faculty colleague Nihal Perera and 21 students from the U.S. These efforts, along with those of many others, built one of the country's first post-tsunami permanent villages, known today as Minsiripura. This paper reflects on our shared experiences in Kalametiya and discusses how lessons learned there have influenced recent works completed by the authors and their students, including a construction in Halifax, Nova Scotia, Canada and deconstructions in Flint, Michigan, USA.*

**Keywords:** Kalametiya, CapAsia, Autoethnography, Local Knowledge, Bottom-up

## 1. Background

When the Indian Ocean tsunami hit Sri Lanka on December 26, 2004, more than 40,000 lives were lost and another 2.5 million were displaced. Among these large numbers of people directly impacted by this natural disaster was the 190-person village of Kalametiya. Eleven people were killed and every building was ruined. Four months later, in March 2005, two of the authors helped "catalyze" reconstruction of a new village. [1]

With this paper the authors reflect upon the lessons we learned in Sri Lanka and suggest how our experiences there influence the lessons we share with students and colleagues in North America. Autoethnography adds a critical dimension to the process of reflection. The intent is to alter the way an audience of dominant outsiders understands the subordinate group, and beyond that, to push back against the shove of domination. [2]

## 2. Prior Knowledge

Sri Lanka was a familiar place. Our faculty colleague, Nihal Perera, is a native Sri Lankan and the originator and director of CapAsia, a field study program that brings U.S. students to south Asia. [3] Wes is the co-director of CapAsia and visited Sri Lanka in 2001, 2002, and 2003. In 2003, Nihal and Wes collaborated with Madhura Prematilleke, Vijitha Basnayake, and Varuna de Silva and led sixty students in the design and construction of two pavilions on the University of Moratuwa campus.

## 3. CapAsia IV, 2005, Kalametiya

Following the tsunami, Madhura designed a plan and typical house for Kalametiya. He also encouraged us to help in any of four areas: 1) permanent house construction, 2) restoration of livelihoods, 3) cleaning up house debris, and 4) social engagement. After arriving, our group spent one day cleaning a lagoon, visiting the temporary village, and playing with children. Following the auspicious moment, we began to work. When we departed one week later, all the foundations were dug and one house had its granite foundation completed.

## 4. Lessons

### 4.1 Lesson 1: Waking Up

Our experiences on the ground "woke us up" to the tension that existed between our desire to get involved and locals who often "pushed back" at our plans. We had to wait for the auspicious moment. Persons who had lost a family or family member in the tsunami remained in a state of shock. Even as we "woke up" from our middle class nap, we found a multi-layered local "sleep."

### 4.2 Lesson 2: Not Knowing

We took cues from the locals and looked to them to provide leadership. We could help, but it was, in the end, their job site and in a very positive sense, their village. While we had some knowledge, still, we did not know.

### 4.3 Lesson 3: Living Now

We connected to the place and people. The ground in and on which the village was to be built was stubborn and did us no favors. The sun was hot and relentless. And the locals extended friendship. The place kept us in the "now" even as the locals'

engagements with us suggest their efforts to break the immediacy of our involvement. They "pushed back" with friendship and thanks.

### 4.4 Lesson 4: Defining Success

We didn't get to start the project when we wanted to, didn't accomplish our objective, and departed with just a small percentage of the work completed. And we left behind friends and a place we had grown close to and had been a part of, a place with which future contact would be difficult. It was, we came to understand, enough to help begin, enough to complete one house foundation, and more than enough to be very sad when we departed.

### 4.5 Lesson 5: Shifting Innovation

The architect Sheila Kennedy challenges the widespread belief that we, in the developed West, innovate and share our technology with those in developing economies and settings. She argues that a 1-2-3 (first world to third world) exchange fails because the innovation often cannot be adapted to the local culture. [3] Working alongside the masons and villagers, we learned practical and technical lessons related to technique and local intelligence. More importantly, we came to respect a 3-2-1 flow of knowledge.

## 5. Case Studies

### 5.1 Halifax, Nova Scotia, Canada

In the summer of 2006, Tim was invited to lead a 15-day FreeLAB studio at Dalhousie University. This work resulted in the "Light Sail Installation," of which Tim says: "In retrospect, listening, including, and enabling were central to the success of the project. Were these lessons I had learned while sweating alongside the local masons in the dusty red earth under the hot sun of Kalametiya? It's hard to define what one takes from such events, but in the end I've discovered perhaps that the true magic lies in letting go."

### 5.2 Flint, Michigan, USA

General Motors was founded in Flint one hundred years ago. In recent years, 60,000 GM jobs were lost, 60,000 people left the city, and thousands of abandoned houses have been torn down, with thousands more in need of demolition. Beginning in 2006, Wes consulted to the Genesee County Land Bank on their demolition processes, hoping to find ways to reduce the amount of house waste taken to local landfills. His "small" recommendations recognized the "push back" of too many abandoned houses, a well practiced teardown process, limited funding, scavengers and squatters, thousands of lost jobs, and more. Each, essentially, is part of a setting in which their combined "shove" overwhelms any others.

## 6. Conclusions: New Modes of Practice and Design

In this version of immersive learning, constructional projects are grounded in local and larger building cultures, immediate settings, and lived lives; these moments are conceived as learning venues for all. That said, basic questions arise. Who is the building educator? Who is the building student? Who is the building community? Absent "answers," even as some old and some new concerns for power and position swirl around us, our search for new modes of practice and design will continue.

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# Development of low-cost fly ash bricks

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*Due to growing environmental concerns and the need for cleaner production, the management of fly ash has become an important issue facing the power generation industry. For that reason, many researchers are actively working to find new and improved methods of combating the fly ash waste disposal problem, particularly by establishing its useful and economic utilisation. One such example that is gaining considerable interest in many parts of the world is the utilisation of fly ash in brick manufacturing. This paper examines the potential for using Class F fly ashes from Queensland as major constituents in the manufacture of common residential building bricks. Both fired, oven-dried and air-cured bricks were tested for their properties.*

**Keywords:** Construction material, Brick, Fly ash, Sodium silicate, Masonry

## 1. Background

Housing shortages in many developing countries have stimulated efforts to develop construction methods that use cheap and durable local materials. In this case, it is essential to choose technologies that use minimal resources because of the increasing shortage of energy and raw materials [1]. It is not surprising that with growing environmental awareness, there has been considerable interest in the use of fly ash in the brick manufacturing industries.

The use of fly ash in brick manufacturing is not new. Sloanaker [2] studied class F fly ashes from the USA. In India, Rai [3] was able to produce calcium silicate type bricks using fly ash, sand and lime mixtures, while in Australia, Kayali [4] patented a new process to produce bricks from 100% fly ash which has a compressive strength of more than 40 MPa using a kiln with a firing temperature of 1000°C - 1300°C. The possibility of developing non-fired (air-cured) fly ash bricks was studied in Israel [5].

This paper describes an experimental investigation into the use of fly ash in making pressed fly ash bricks by firing, oven-drying and air-curing.

## 2. Materials

In the current investigation, pressed bricks were made using fly ash and other materials such as sand, lime and sodium silicate of various proportions.

A dry processed "fine-grained" ash from Queensland, namely the Tarong fly ash, was chosen as the main constituent in this investigation. To improve the mix gradation and workability, two types of sand were used in this study, namely silica sand and common river sand. Liquid Sodium Silicate (LSS) Grade 42 ($SiO_2$ : $Na_2O$ = 3.22, total solids = 39.3%, pH = 11.2) was used as an additive. Commercial building lime (hydrated lime) was used to trigger the pozzolanic reaction of the class F fly ash..

## 3. Specimen preparation

Initially, three different combinations of fly ash and sand (i.e. primary raw materials) were used, namely, 50/50, 70/30 and 90/10. Liquid Sodium Silicate (5, 10, 15 and 20%) and hydrated lime (5%) contents were added to the mix with proportions calculated by multiplying the percentages in parenthesis by the total mass of primary raw materials.

It was found by trial and error that 150 grams of mix, moulded using pressure of around 10 MPa would produce a test brick of approximately 78 mm x 38 mm x 27±2mm; the ratio of these dimensions are similar to those of a common house building brick (225mm x 105mm x 75mm).

## 4. Testing and results

### 4.1 Fired bricks

To produce fired bricks, a high temperature oven was used. An initial study carried out to find the effect of firing temperature indicated that a firing temperature of 555°C was adequate.

The compressive strength results, as shown in Table 1, indicate that they increased rapidly with the amount of LSS up to approximately 15% by mass.

Compressive strengths greater than 20 MPa were easily achieved by all mixes containing silica sand and 15% LSS, and strengths >25 MPa could be achieved with the 90/10 fly ash/silica sand mixture incorporating 20% LSS. However, with the objective being to maximise fly ash utilisation and the fact that the 70/30 mixture of fly ash/common sand produced the most consistent results averaging around 25MPa with 15% LSS, it could be selected as the most viable mixture alternative.

The mixture of 70/30 fly ash/silica sand with 15% LSS produced consistent tensile strength averaging around 2.3 MPa. In general, compared to the tensile strength of common clay bricks, the tensile strength of the fly ash bricks was lower (2 to 3 MPa less).

The optimum blends of 70/30 fly ash/sand showed distinct differences in water absorption properties for the different sand types used. The bricks made with silica sand exhibited unacceptable water absorption as compared with those of the bricks made with common sand. The latter averaged approximately 13% water absorption, when 15% LSS was used, which can still be considered comparable to that of typical clay bricks.

### 4.2 Non-fired bricks

If air-cured bricks could perform adequately, it would certainly be the most economical option. In the present investigation, it was decided to prepare non-fired bricks with 70/30 fly ash/sand ratio. Only common sand was used with either 0 or 5% lime and with either 12% or 15% sodium silicate.

Curing in a sealed bag produced the worst performing bricks, especially when tested in moist conditions. Curing in open air for 28 days produced much better performance when testing was carried out after oven drying the bricks (at 105°C) to a constant mass. The best performance was achieved when green bricks were placed in an oven (105°C) for 24 hours before testing; the results is comparable to, if not better than, those of the fired bricks. In general, the addition of lime improved the brick's performance. It should be noted that whilst bricks cured in open-air have reasonably high dry compressive strength, the strength completely disappeared after 48-hours soaking.

## 5. Conclusions

The results of this investigation suggest that it is possible to produce lightweight bricks from fly ash at a firing temperature of around 550°C. In particular, with proper proportioning, these bricks can produce compressive strengths comparable to those of common clay bricks. Although their tensile strength is somewhat below the typical values of clay bricks, the absorption characteristics may be comparable to those of clay bricks.

*Table 1: Uniaxial Compressive Strength*

| | COMPRESSIVE STRENGTH, $\sigma_c$ (MPa) | |
|---|---|---|
| % LSS by mass | WITH SILICA SAND | WITH COMMON SAND |
| 50/50 FLY ASH/SAND | | |
| 5% | 8.57 | 9.37 |
| 10% | 7.55 | 15.41 |
| 15% | 23.49 | 30.82 |
| 20% | 12.29 | - |
| 70/30 FLY ASH/SAND | | |
| 5% | 8.25 | 8.11 |
| 10% | 11.40 | 11.72 |
| 15% | 26.98 | 25.91 |
| 20% | 24.31 | - |
| 90/10 FLY ASH/SAND | | |
| 5% | 10.01 | 7.56 |
| 10% | 16.66 | 12.72 |
| 15% | 24.29 | 24.10 |
| 20% | 27.81 | - |

The possibility of developing oven-dried fly ash bricks has also been explored and the results show that it is possible to simply dry green bricks at 105°C and yet obtain performance similar to that of the fired fly ash bricks. Translated into the conditions found in many developing countries, this could mean an affordable small/home industry with low energy requirements and minimal energy losses. More than that, the process is making use of waste material (fly ash) in large quantities and hence, is more environmentally acceptable.

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# Sustaining Cultural Heritage in South and SouthEast Asia: Integrating Buddhist philosophy systems theory and resilience thinking to support sustainable conservation approaches.

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*This paper proposes that any sustainable approach to the conservation in South and Southeast Asia must be based on the cultural and philosophical traditions that have underpinned the formation of the cultural heritage. Through a review of literature synergies between systems theory, resilience thinking, based on holism, and the philosophical traditions of the region, particularly Buddhism are established. Focusing on a case study of non-secular built heritage in Sri Lanka it is argued that systems theory provides the foundation for an alternative paradigm supporting an original approach to sustainable conservation and protection of cultural built heritage in South and Southeast Asia. Outcomes presented in this paper indicate such an approach highlights the uniqueness of cultural traditions, notions of spirituality, place-making and spatial relationships particularly of non-secular monuments. Sound preconditions for sustainable cultural heritage conservation outside the institutional protection provided by the World Heritage Convention and euro-centric approaches.*

**Keywords:** Sustainability, cultural heritage, Buddhist philosophy, systems theory, conservation theory, resilience thinking.

## 1. Background

This research postulates a new paradigm supported by a conceptual framework for conservation of non-secular monuments of South and Southeast Asia, based on the cultural and philosophical traditions of the region. This is represented by the philosophical foundations of Buddhism that has widespread acceptance throughout Asia and a number of key similarities with other philosophies in the region, predominately Hinduism. Buddhism forms the basis of the study for this reason; however it doesn't provide a coherent foundation for the development of a conceptual conservation framework. For this purpose a search for an appropriate sound methodology was undertaken. From the literature review, the work of Joanna Macy (1991), a Buddhist and systems theorist, provided the initial links between Buddhism and systems theory which has since been supported by a number of others (Chao and Midgley 2007, Khisty 2006, Capra 1996).

Macy (1991) establishes links between Buddhist philosophy and systems theory based on the synergies and similarities between the Buddhist universal law of causality and the cyclical process of cause and effect and can be related to the notion of feedback loops in cybernetics and systems theory (Macy 1991). In Buddhism the concept of the universal law of causality is central to the notion of *karma*. *Karma* is an important notion in the context of a cyclical view to life processes, that is birth-death-rebirth, as opposed to a linear view and is a common theme amongst the religions/philosophies of the sub-continent. Macy's (1991) other key links relate to holism, as she perceives Buddhism as providing a holistic view to life and empiricism. In Macy's view, the Buddha is essentially an empiricist as he developed a philosophy based on his experiences and observation of life and has avoided all metaphysical arguments. She supports these further similarities by detailing the empirical basis of systems theory and how systems theory relies primarily on empirical data as a means of dealing with problems (Macy 1991).

In the context of this research these issues are relevant predominately because they offer an organic, holistic, pluralistic ontology of aspects that may guide the conservation and preservation of non-secular built heritage in the South and Southeast Asian region. This would ensure that all aspects of the uniqueness of the monuments and indigenous beliefs are taken into account in a sustainable context.

## 2. The development of a systemic conceptual framework.

The essential principles of current global conservation practice are based on the test of authenticity, the significance of the monument, and the values that are contained within the monument. These principles have been formulated within the mechanistic worldview sustained by the rationalist and empiricist philosophical supported by a reductionist model. For example, the essence of these principles has sought to assess the monument by the "reduction" to a set of nine criteria. These criteria seek to analyse the monument in a rationalist framework, concerned with components seen in isolation rather than in a holistic sense. Concepts that define the monument or cultural built heritage (CBH) within very rationalist boundaries (Munjeri 2004) are in contradiction to Asian values and philosophies. Different values require very different conservation approaches. As the systemic approach has been linked to the cultural traditions and values of the east, any approach to conservation developed within this milieu would recognise the uniqueness of South and Southeast Asia. In this context the protection and conservation of the cultural built heritage would be seen as a system within the larger complex system of the cultural and philosophical systems of South and Southeast Asia. In this way it is necessary to view the whole larger system in which the CBH is a subsystem, and not reduce the system to its smaller components such as authenticity, significance or its various values and look at these in isolation. The subsystems encompass questions of spirituality, naturalistic sensibilities (Seung-Jin 2005) the cultural landscapes along with values, norms and societies (Munjeri 2004) that may form part of the larger system. These proposed subsystems are those that demonstrate the differences between Asian and Euro-centric conservations approaches.

## 3. The components of a framework based on systems theory.

There are a number of key principles of Buddhism; including impermanence, karma, dukkha, the eightfold path and the four noble truths (Macy 1991). As argued above, three principles of Buddhism that provide strong links with systems theory are universal interconnectedness, radical interdependence and mutual conditioning (Khisty 2006, Macy 1991). It has been argued that these principles provide the methodology for describing intra- and inter-systems relationships that would be the basis for determining what is important about the heritage, how is it important, and how it could be conserved. These are then three key relational qualities of heritage, chosen because they explain the complex multiple reciprocal relationships (Munjeri 2004) between heritage, communities, societies, tangible and intangible values that provide a basis for developing a theoretical framework for conservation in South and Southeast Asia. Table 1 provides the description of the elements of the framework while

| Key Relational Quality | Description |
|---|---|
| Interconnectedness | The quality where interconnections exist between one system and another. |
| Interdependence | The quality where one system is dependent upon another. |
| Mutual conditioning | The quality where one system conditions another, one system must have existed for the other to come to exist. |

*Table 1: The three key relational qualities of heritage systems within South and Southeast Asia (Source: The Author).*

## 4. Conclusion

Finally, from this discussion a conceptual framework was formulated that incorporated the philosophy of systems theory and principles of Buddhism. The framework has the key relational qualities, interconnectedness, interdependence and mutual conditioning that form the basis of the relationship between the heritage and the people who consume it. The interpretation of these key relational qualities is done with clarifying questions, which provide the opportunity to describe the key relationships that give the heritage its values and meanings, significant qualities in the context of how people view the heritage.

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# Educated trade-offs for sustainable resource development through stakeholder participation

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*The paper describes an on-going case study at Ma Oya river basin in Sri Lanka where the conflicting uses/issues of the natural resources in the river and its valley are identified through the consultation of key stakeholders. The study conducted in the entire down stream and immediate upstream of a proposed multi-purpose balancing reservoir at Yatimahana, included 145 Grama Niladhari divisions in 16 Divisional secretariats along both banks of the river. It assesses the natural resource uses; the present issues and future probable issues with regard to resource uses, stakeholder views and then discusses the probable social and environmental impacts of the proposed reservoir. The results obtained in the study are direct inputs for a five-step framework developed for educated trade-offs. The term 'educated trade-off' means that stakeholders are able to engage in technically, economically and environmentally (including socially) informed (educated) decision-making between the critical resource uses (trade-offs) in a river valley*

**Keywords:** educated trade-offs, stakeholder consultation, river basin development, natural resources

## 1. Background

In the recent times there is widespread recognition of the need for greater stakeholder consultation in water and other natural resources development projects. It is the premise of this study that in such involvements stakeholders should be able to engage in educated trade-offs between the values of the different resource uses/issues in a river valley or otherwise the consultations will be emotional. The main hindrance for educated decision-making by the stakeholders is lack of methods of educating the stakeholders on the technical, economical and environmental (including social) impacts of the decisions taken by one group of stakeholders on the choices of another group.

Thoradeniya and Ranasighe [1] proposed a 5-step framework on 'Educated Trade-offs' as a tool, which facilitates trade-offs between different resource uses by educating the stakeholders on the combined (economic and environmental) economic value of each resource use.

The objective of this paper is to present as a case the results from an on-going study at Ma Oya river basin of Sri Lanka, where the proposed framework is being applied. The present study identifies the resource uses and stakeholders, assesses the stakeholder views, and then discusses the probable social and environmental impacts of the proposed reservoir and valuing such impacts.

## 2. Ma Oya Basin

Ma Oya river commences in the central hilly regions of Sri Lanka and drains a catchment area of 1528 $km^2$ along its total length of 130 km [2]. The river flows are mainly used for supplying drinking water to 17 major population centres. The next major use is as a pollutant carrier (absorber) from a number of cities, private poor dwellings located on riverbanks and from a number of industries located in the river valley. Thus the two major uses are conflicting with each other and results in critical water stressed situation during the low flow periods both due to inadequate quantity and poor quality [3].

## 3. Development Proposal – Balancing Reservoir

The National Water Supply and Drainage Board (NWSDB), a key stakeholder of the river basin has proposed a multi-purpose balancing reservoir in the upper catchment at Yatimahana as the best option in an attempt to mitigate the expected severe water shortages in the near future [3].

The reservoir is expected to store the excess flows of the river during rainy seasons and then to release the required flows, under control, during the dry weather periods. Nevertheless, it is speculated that the implementation of the balancing reservoir may have adverse impacts on the other water use sectors. For example, production losses in the agriculture sector, poor water quality due to increased pollutant concentrations leading to limiting the human consumptions and the growth of industries in the river valley.

## 4. Identification of Stakeholders and Natural Resource Uses

This is the first step of the 'educated trade-off' framework. A six-step approach was designed to obtain necessary data from a representative sample (427) of stakeholders [4] from river estuary to Aranayake (a location upstream of the proposed reservoir).

The resource uses at each smallest administrative unit (Grama Niladhari Division-GND) were identified through the survey. The present critical uses, as well as uses, which are expected to become critical in future, were identified.

The major use sectors of the natural resources of the river and its valley identified are bathing/washing, sand mining, drinking water through dug-wells, agriculture through ground water, rearing animals and waste disposal sectors.

## 5. Technical Requirements and Economic Value of Project

The project report estimates the lower bounds of the technical requirement of the river flow for four use sectors, which is the second step of the 'educated trade-off' framework.

Estimating the economic value of the technical requirements of the natural resource uses is the third step of the framework. The economic benefits of the project are due to power generation, water sales, crop production, etc. The economic costs of the project are due to capital costs, and recurrent costs. The estimated economic internal rate of return (EIRR) for the base case is 15.2%. [3]

## 6. Environmental Value

Estimating the environmental value of the critical bound of the technical requirements of natural resource uses is the fourth step of the framework.

The consultations revealed that in most locations sand mining is continued at least as an illegal activity resulting in increasing depths of riverbed. The regulated reservoir releases coupled with the lowered riverbed will result in longer periods of low water levels and the three indirect water user sectors (dug-wells, non-irrigated agriculture and environment), which depend on ground water, will be severely impacted. Primary and secondary environmental valuation methods [5] will be utilized to estimate the economic values of the above environmental impacts. The final step of the framework combines the economic and environmental values to estimate the net value of the resource use in economic terms which will be used to educate the stakeholders.

## 7. Conclusion

This case study focused on identifying the different natural resource user sectors and the stakeholders, which varies spatially. The six-step approach adopted for this purpose proved to be efficient in achieving the set objectives.

The research results clearly indicated the spatial variation of resource user sectors and the pertaining issues. Five resource use sectors, which were identified as threatened or as facing conflict situation at most number of GND locations are a) drinking water due to the drying up of dug wells, b) lands on the river banks due to severe erosion c) sand mining due to inefficient regulatory framework d) bathing and washing sector due to the high risk posed by deep pits beneath water level and pollution and e) environment.

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# SECTION IX

## FACILITIES MANAGEMENT

# Briefing as a process of cultural knowledge exchange in a hospital partnering project from a Facilities Management perspective

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*Outsourced Facilities Management (FM) has been noted to be problematic in terms of understanding clients' needs, especially in the hospital sector. This paper argues that an understanding of hospital's needs inevitably requires an understanding of the hospital's organisational culture, where the 'value' for FM rests. Using a hospital partnering project as a case study, it investigates the process of learning about culture, an approach which has traditionally been treated as a black box. Nonaka's [1] theory on knowledge creation provides a framework for the study, with an emphasis on the socialisation process whereby individuals exchange their cultural knowledge through face-to-face experiences during briefing. Sackmann's [2] categorisation of knowledge proves useful in detecting such exchange. It was found that a lengthy, deep, and thorough discussion on specific topics triggered the sharing of cultural knowledge. "Creative chaos" in the form of problems, disagreements, and conflicts should be encouraged and managed as it facilitates the sharing of cultural knowledge. Finally, cultural knowledge exchange was found to be an extremely subjective process, whereby the briefing participants competed against one another to impose their version of knowledge.*

**Keywords:** Cultural learning, Facilities Management, hospitals briefing, partnering, knowledge exchange

## 1. Background

Outsourced Facilities Management has been noted to be problematic in terms of understanding clients' needs [3, 4]. Cultural, systems, and operational differences between Facilities Management and hospital teams can mean that clients' needs are not effectively and accurately captured, causing a mismatch between the design and the intended use of the building [5]. In hospitals, the impacts of such mismatches can be enormous, including higher maintenance and operational costs, poor value for money, and even higher death rates [6, 7]. The challenge involved in understanding the hospital's needs and in designing appropriate facility strategies ultimately points to the importance of understanding the hospital's organisational culture. Culture is represented by its members' mindsets, basic assumptions, or beliefs [8, 9]. Previous research into the briefing process has almost exclusively ignored the need to *learn* the culture, treating the process of *cultural learning* as a separate variable rather than as necessarily embedded in the efforts to understand client's needs. The new perspective presented here demands that the process of briefing is treated as an organic and cyclical process of *cultural learning*, where Facilities Managers and client representatives gradually converge upon a shared meaning of each other's cultures over time. This study also points to briefing as a context for cultural learning.

## 2. Method

The knowledge creation theory developed by Nonaka [1] is best suited for conceptualising cultural learning. In particular, the socialisation process depicts the briefing meetings whereby individuals exchange the cultural knowledge through face-to-face experiences. In measuring the exchange of cultural knowledge, Sackmann's [2] categorisation of knowledge proves useful: **Dictionary** knowledge refers to the labels used to describe or name things or events or the *'what'* question; **Directory** knowledge refers to commonly held practices or the *'how'* question; **Recipe** knowledge refers to knowledge in the form of prescription, repair, and improvement strategies, which includes recommendations of certain actions or the *'what-should-be'* question; **Axiomatic** knowledge refers to reasons for causation, and explanations of the final causes perceived as underlying a particular event, which is about the *'why'* question. This study uses an Australian partnering project of a major redevelopment within an existing hospital precinct, whereby the managing contractor was engaged prior to the design stage rather than later in the process as in the traditional procurement.

## 3. Results

It was necessary to separate the case study into two sub-cases, as they involved different sets of briefing meetings. There were a total of *nine* meetings for Case Study 1 and *six* meetings for Case Study 2. This difference was due to the differing nature of the facility planning process for each sub-case. In both case studies all meetings were attended by representatives of the following subgroups: clinicians, planners, contractors, and consultants.

### 3.1 Contexts of cultural knowledge sharing

Case Study 1 the topic of space fit-outs seemed to dominate the briefing discussions, followed by discussions on space allocation and layout. This was due to the nature of the department involved, as their operation relied on the equipment and technological advancement of the facility. In Case Study 2 the topic on space layout seemed to dominate the briefing meetings where room relationships and placements were important for the effectiveness of its operations. In both cases, knowledge sharing occurred within the contexts of discussion on facilities requirements in terms of space allocation, space layouts and space fit-outs.

### 3.2 Types of cultural knowledge shared

The sharing of **directory knowledge** was encouraged by discussions on background information regarding the project requirements, and through a process of problem solving on facility-related issues. **Dictionary knowledge** was less frequently shared than directory knowledge, which was communicated with much reference to the briefs and was not fully verbalised. While this type of knowledge could be communicated through texts, it formed the basis for the sharing of other types of knowledge through uncertainties, disagreements, or conflicts. **Recipe knowledge** was the next most frequently shared, reflecting that the groups were learning about the project requirements and its problems, thus making recommendations about space allocation, layout and fit-outs. **Axiomatic knowledge** was the least shared among the subgroups, and seemed to emerge mostly during a lengthy and deep discussion on certain topics and during the sharing of other types of knowledge. It was noted that the average sharing of recipe and axiomatic knowledge was consistently higher in Case Study 1 than in Case Study 2, which seemed to be influenced by the enthusiasm of the briefing participants in Case Study 1, which added to the dynamics of interactions during their briefing meetings.

### 3.3 Holders of knowledge

The clinician subgroup in Case Study 1 reflected the highest knowledge held among all subgroups, affirming an earlier finding on the enthusiasm and assertiveness shown by the group and that, at the same time, passiveness seemed to result in lower cultural knowledge being held. It is also interesting to note that the level of knowledge held by the contractors and the consultants was also higher in Case Study 1, indicating that dynamics of interaction initiated by the clinicians seems to have influenced not only the knowledge held by themselves, but also triggered the utterance of knowledge held by others. Analysis of Case Study 1 also suggests that knowledge exchange was enhanced through conflicts and disagreements among the clinicians themselves. This is similar to the "creative chaos" referred to by Nonaka *et al.* [19], which therefore is desirable during briefing. While consensus is eventually required, this indicated that some chaos is first needed to encourage cultural learning. In Case Study 2, although the clinicians did not hold much knowledge overall, they uttered more axiomatic knowledge than the other subgroups.

## 4. Conclusion

This paper has discussed cultural knowledge exchange during the hospital briefing in a partnering project. The analysis indicated that the sharing of axiomatic knowledge seemed to emerge only during a lengthy and deep and thorough discussion on specific topics. Furthermore, there appeared to be an unclear boundary between the groups and among members of the same group in the sharing of knowledge, when members learned about their own facility requirements. It was also found that in both case studies the sharing of axiomatic knowledge was largely initiated by the clinicians as they participated in the negotiation and bargaining process of facility requirements during the briefing meetings. Not only it meant that briefing process involved a social construction of meaning, but it highlighted that the process can be purposeful and extremely subjective, as briefing participants competed against one another to impose their version of knowledge. Finally, the sharing of all types of knowledge also seemed to be facilitated through problems, disagreements, and conflicts in facility-related issues. The implication for briefings is that "creative chaos" in the form of problems, disagreements, and conflicts should be encouraged and managed, so as to facilitate cultural knowledge exchange.

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# Grading maintainability parameters for sanitary-plumbing system for high-rise residential buildings

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*Sanitary-plumbing system can waste energy and even become a source of fatal contamination unless designed, constructed or maintained properly. This research was aimed to identify, analyze and grade the maintainability parameters of complex sanitary-plumbing systems of modern high-rise residential buildings. From five detailed case studies in Singapore, 113 common defects were identified for ten major system components. Out of them 56 were graded as significant by 33 experienced facility managers based on frequency of occurrence, and adverse effect on: economy, system performance, environment and health. Poor maintainability consideration in design stage was apparent as inaccessibility for regular inspection and maintenance was common for many components as detected by the comprehensive defect analysis.*

**Keywords:** Contamination, Defect analysis, Maintainability, Sanitary-plumbing, System performance.

## 1. Introduction

Poor design, construction or maintenance of sanitary plumbing system can cause wastage of energy and fatal contamination. As human health is a major design concern, only clean water of quality hygienic standard is acceptable. Tropical climate and high population density of Singapore can cause waterborne diseases to spread rapidly unless a high standard of public health is maintained. Design-construction guidelines [1-5] for sanitary-plumbing in general are plenty along with detailed concern for piping, valves, pumps etc [6-8]. Yet problems such as leakage, contamination, and bio-fouling are frequent. Many of these issues are caused by corrosion [9]. The individual solutions are neither well communicated in design-construction-maintenance guideline nor quantified in the whole system. To address this knowledge gap, this study investigates the common defects in sanitary plumbing system of high rise residential buildings of Singapore and identifies the significant ones.

## 2. Research methodology

### 2.1 Data collection

Based on existing literature [10-12], major system components were listed for a systematic data collection. After an in-depth site investigation at five residential towers, discussion with facility managers (FM), the common defects were identified, analysed and collated in a comprehensive defect list as survey questionnaire. The manifold repercussions to each defect were captured by frequency of occurrence and impacts on: (1) economy, (2) system performance; (3) indoor environmental quality; and (4) occupants' health and well-being. In a face to face interview, 33 experienced FMs graded the frequency of the defects in a five point Likert scale, where, 1= 'rare', 2= 'sometimes', 3= 'quite often', 4= 'very often' and 5= 'always'. The significance four consequences were graded also in five point scale, where, 1= 'Negligible', 2= 'Slight', 3= 'Moderate', 4= 'Serious' and 5= 'Very serious / fatal'.

### 2.2 Data analysis

Mean ratings for determining the level of seriousness of the defects were calculated from the feedback received. Mean rating for frequency was defined as $\overline{X}$ FR, while impacts on four impacts, namely, economy, system performance, IEQ and health & well-being were denoted by $\overline{X}$ EC, $\overline{X}$ SP, $\overline{X}$ EN and $\overline{X}$ HW respectively. For each defect, the mean level was calculated by a general formula:

$$\overline{X} = \sum_{i=1}^{5} i \times n_i \Big/ \sum_{i=1}^{5} n_i \qquad (1)$$

Where, $i$ = frequency rating.
$n_i$ = number of responses for $i$-th rating

Using statistical tool SPSS 12, the significance of each mean was analyzed and the one tailed T-test was carried out using the midpoint test value of 3 (by definition) to measure whether the defects have a significantly large enough mean with $p<0.005$.

## 3. Results and discussion

In Singapore, gravity type water supply and ventilated stack system are primarily found in high-rise residences. From the analysis of survey result, a total of 113 defects related to ten major system components were identified, out of which 56 were found serious and among those 13 were referred by FMs as frequent and 17 occurs in two or more categories (Table 1).

Economy, system performance, IEQ and health & wellbeing were affected by 40, 34, 9 and 20 defects respectively. One defect was observed to give rise to a chain of defects. For example, corrosion may cause leakage, which in turn results in water ponding, backflow of dirty water from surrounding soil and wastage of water. Especially poor accessibility for regular inspection, cleaning and routine maintenance was found to be one of the major and prevalent defects.

*Table 10: Significant defects in water supply system*

| Components | Significant Defects |
|---|---|
| Supply main | Faulty valves, less flow, dirt accumulation |
| Service pipe | Damage (settlement), corrosion, leakage, contamination, poor accessibility supply-discharge interference, difficult to locate pipes, difficult cleaning, inaccessibility of valve, interrupted supply, corroded fittings |
| Storage | Corrosion, leakage, poor ventilation, flooding, clogging, back-siphonage, stagnation, contamination, faulty controls, corroded accessory, entry of dirt / insect |
| Distribution pipe | Settlement, damage (settlement), contamination, decayed pipe, head loss, noisy flow, ugly pipe arrangement |
| Hot water supply | Wastage of water, heat loss, short circuiting, corroded pipe, corroded tank |
| Pumps | Damaged valves, pumps, automatic control |
| Sewage ejector / solid diverter tank | Water penetration, ponding, corrosion, unable to dewater |
| Sewage pump | Clogging, choking |
| Sanitary piping | Noisy flow, mosquito breeding, contamination, poor accessibility, no discharge, slow discharge, leakage |
| Fixture and fittings | Disconnected pan, collapsed pan, leakage, clogged trap, damaged flush, slow drainage |

It was established that most of the defects can be prevented by considering four maintainability criteria, namely, design, material, construction, and operation & maintenance (O&M). It is vital to know at which stage what defect arise for selecting appropriate preventive measures. It was found that maintainability concept adopted in design stage had maximum benefit followed by O&M.

## 4. Conclusion

The study had identified 56 persistent defects out of total 113 defects commonly occurring in ten major components of sanitary-plumbing system. The single significant defect found common for almost all the component was the inaccessibility for maintenance. From the analysis based on feedback provided by 33 experienced FMs, it was established that addressing maintainability aspects was most effective during design, next comes O&M practices, followed by construction quality, and material selection. This comprehensive defect analysis was aimed to help the designers, contractors and facility managers to realize the long term effect of their decisions and form the basis of a maintainability scoring system to promote efficient and safe functioning of highly maintainable sanitary-plumbing system at a lower life cycle cost. This generic research method is applicable for any other building services.

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# Performance management approaches used by facilities management services in hospitals

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*The idea of this paper is to understand the methods of managing performance in healthcare facilities management in the UK. The findings presented in the paper are discussed with a specific focus on the control of Healthcare Associated Infections (HAI). The paper first reviews different definitions and concepts of performance management (PM). It then discusses some of the common performance management approaches used by facilities management (FM) services in hospitals in the UK. These discussions of the paper are based on the findings of a mixed methodology approach. The data sets obtained were subjected to rigorous qualitative and quantitative analyses. Based on the findings of the data analysis, the paper finally concludes that there is a need for a robust performance management approach in order to improve the quality of the National Health Service (NHS), UK.*

**Keywords:** Domestic services, Healthcare Associated infections (HAI), Facilities management, Performance management

## 1. Introduction

This paper is based on research titled 'the role of Facilities Management services in the control of Healthcare Associated Infections' (Liyanage, 2006). Studies throughout the world document that Healthcare Associated Infections are major causes of morbidity and mortality. According to Ayliffe et al (1999) the acquired infection rate is approximately 5-10% in the UK and other developed countries. A review of literature suggests that errors in clinical practices dramatically contribute to the emergence of HAI (Bennet and Brachman, 1998). Nevertheless, some suggest that, if HAI is to be controlled effectively, it is also essential to focus on non-clinical areas such as Facilities Management (FM) as well (Meers et al, 1992; Horton and Parker, 2002).

The main aim of this paper is to present and discuss the methods of managing performance in FM services in hospitals from a control of HAI point of view. In doing so, specific attention is drawn only to the cleaning service (part of FM), which for the purposes of this paper is classified as 'domestic services'.

## 2. Existing performance management approaches in FM services

It is necessary for organisations to measure and manage their performance in order to know where they stand in terms of performance levels, to compare results with past performance levels or with others and to set goals for future improvements.

The existing performance management approaches used in FM services (specifically domestic services) for the control of HAI was identified using the findings of qualitative and quantitative methodologies. The qualitative methodology employed a case study approach involving 26 semi-structured interviews with key parties in the control of HAI in domestic services. Two different types of domestic services were chosen for the case study approach. The selected cases were: an in-house domestic service (*In-house case*) and a Private Finance Initiative domestic service (*PFI case*). Findings gleaned from the 26 interviews prompted the need to further investigate the most common PM approaches in-use in the control of HAI in facilities management services (specifically domestic services). A questionnaire survey was therefore carried out as the next step of the research study. A total of 412 completed questionnaires were received out of the 1304 sent out, giving an overall response rate of 31.60%. The data collected from the survey was analysed using Statistical Package for Social Sciences (SPSS) version 12.0.

As identified from the case study findings, much of the focus of performance management in the *In-house case* and the *PFI case* is on performance audits. However, it is understood from a thorough review of literature that number of other PM approaches which exist in organisations. Therefore, a list of PM approaches (14) was put together, drawing on the literature and discussions with the participants of the case studies. These are given in Table 1 together with the overall mean scores and the rankings of the frequency of use of the PM approaches in the control of HAI in domestic services.

As table 1 results reveal, of the fourteen performance management approaches only the audits carried out by the domestic service is 'very frequently used' in domestic services (overall mean score is 1.62). Four other approaches are also significant and fall in the category of 'frequently used' with mean scores in the range of 2.57 (audits by the Infection Control Teams) to 2.95 (patient satisfaction survey). As the results further reveal, even though Balanced Scorecard and the EFQM Business Excellence model are supposed to be the most used approaches in organisations in-general (Neely, 1999), from a domestic service point of view, they can be identified as the least used approaches of PM.

*Table 1: PM approaches in-use in the control of HAI in domestic services*

| PM approaches | Overall mean score | Rank |
|---|---|---|
| Audits by domestic service | 1.62 | 1 |
| Audits by infection control teams | 2.57 | 2 |
| Environmental audits | 2.58 | 3 |
| Audits by the National Audit Office | 2.86 | 4 |
| Patient satisfaction survey | 2.95 | 5 |
| PA for domestic managers | 3.31 | 6 |
| Benchmarking techniques | 3.37 | 7 |
| PA for domestics | 3.44 | 8 |
| Personal Development Plans | 3.48 | 9 |
| PAF by the NHS | 3.74 | 10 |
| Programme evaluation techniques | 3.87 | 11 |
| ISO 9001:2000 | 4.25 | 12 |
| BSC | 4.41 | 13 |
| EFQM | 4.72 | 14 |

Meaning of scale (frequency of use):

**1** (Very frequent), **2** (Frequent), **3** (Fairly frequent), **4** (Not frequent), **5** (Not Applicable/not at all used)

The overall research findings suggest that the use of performance indicators and measures is very limited in domestic services. Financial performance is considered the prime performance indicator especially in the *PFI case*. This is mainly driven by the budget constraints occur in FM services in hospitals. Resources (including staff) are the other main indicator used by the domestic services in the control of HAI. The absence of a robust PM approach could be the main reason for the lack a comprehensive set of performance indicators and measures in domestic services. It was understood from the above discussions that most of the domestic services have only performance audits to gauge their performance. Even if they have other performance management approaches, most of them do not use its results to 'manage performance'. For example, the domestic services do not feed back their performance results to the staff and managers, which can help to prevent repetition of mistakes. The domestic managers should not collect performance data simply because it is available, or because having large amount of data proves that they work. Instead, they should choose performance measures that can help describe the overall performance of their service, and directions towards the required goals and accomplishments. If these are not properly identified and measured, the domestic service, without a doubt, could be faced many challenges.

## 3. Summary and conclusions

Despite its importance, little has been researched or published in the areas of performance management in healthcare organisations, and even less so in the context of domestic services. There is evidence of a lack of common understanding of what is meant by performance, or how performance could be measured in practice, especially with regard to the control of HAI in domestic services. The main approach to performance management in domestic services is performance audit. While the domestic managers, nationally, would agree that they are striving to improve their services in hospitals; the standards of performance remain extremely variable, mostly due to resource limitations such as budget constraints and staff shortages (because of high staff turnover and sickness absence) and tight time schedules. Besides, the lack of an overall yardstick (i.e. benchmark) to compare the variations in performance standards has exacerbated the problems in domestic services. A new mindset is, therefore, needed that moves away from the traditional one-sided 'cost' or 'snapshot' audits to a new multi-faceted approach of performance management.

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# A Reliability Based Approach for Management of Council Owned Buildings in Australia

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*With an aging stock of public buildings, development of innovative methods for management of risk of failure and optimizing of maintenance expenditure has become extremely important to Australian public work engineers. A major challenge in many sophisticated asset management systems is identifying the type and quantity of data required to establish a reliable predictive model for maintenance and renewal expenditure forecasts. With the high variability of condition data, a reliability based approach is more appropriate for predictive modelling. Another important observation made of traditional asset management systems is that the deterioration models are mainly a function of age. This has been observed to be unrealistic on many occasions.*

*The paper presents an innovative approach based on Markov process for deterioration modelling of buildings owned by local councils in Australia. The concept for the complete asset management model is presented with input data clearly identified. Using some preliminary data established from council records and consultation of experts, transition matrices for Markov process modelling have been established for major elements of council buildings. The complete process for deterioration prediction is demonstrated with a typical example.*

## 1. Introduction

Management and sustainability of built infrastructure is an important issue being addressed by many researchers through following approaches:

- Conditions of different elements were rated through condition inspections. Deterministic life cycle analysis is conducted assuming the time period of progression of deterioration to be fixed in one state [4].
- Similar to above with modifications for different exposure conditions and usage, through fixed factors calibrated [2; 6].
- Reliability based methods using the discrete Markov chain for deterioration modelling.
- Reliability based methods using continuous Markov process.
- Predicting life cycle of assets integrating three drivers such as Market drivers, physical deterioration and functional obsolescence.

The most common approach used by the industry is a deterministic method based on condition data and fixed deterioration curves. However, these approximate methods lack the ability to account for uncertainties, which is essential to manage risk of maintaining assets to provide the required level of service delivery. Preliminary research at RMIT have indicated that to consider majority of the issues affecting management decision making for effective service delivery of councils a reliability-based approach incorporating some attributes of the ISO factorial approach and consideration of other drivers such as market and functional issues [1] is essential. Use of Markov chain for deterioration modelling and decision-making is being explored at RMIT University in Australia to address this need.

## 2. Proposed methodology

In deterioration modelling the attributes of a model randomly change over time. A Markov chain is a probability model, which has a finite-state, for describing a certain type of stochastic process that moves in a sequence of phases through discrete points in time according to fixed probabilities. In this chain the future states are dependent only on the present state and independent from the any state before the present states.

The first step for using Markov Chain modelling is evaluating the condition of building elements to assess their physical, operational and maintenance conditions. For any building element a condition rating scheme constitutes of four ratings A, B, C and D as explain below.

| | | |
|---|---|---|
| A | Excellent | Element is as new |
| B | Satisfactory | Minor maintenance required |
| C | Unsatisfactory | Major maintenance required. |
| D | Failing | Element should be replaced |

Although the deterioration processes evolve over continuous time, discrete time steps (Discrete Time Markov Chain) was considered in this paper for predicting the life cycle for building element. In predicting the future costs for an element, two kinds of costs: inspection cost, and replacement cost or repair cost, when the element makes a transition from one state to another were considered.

An absorbing state: A state from which there is a zero probability of exiting. Calculating the expected number of steps to absorption (elements pass from different states to end up in state D) can help to obtain an overall view about the estimated life cycle for that element.

Long term behaviour of the Markov Chain: If there are recurrent actions taken to repair or replace the element in any state it leads to a steady state probability, which help to set a stable maintenance plan and expenditure.

Building Weights: In linking the Markov model to a decision making process, the building weighting method is appropriate.

Application: A major challenge in application of the proposed concepts is the quality and quantity of the data needed. A probability distribution is needed for all major data categories for elements of an infrastructure system. With the support of the Brimbank City Council in Victoria, data are currently being collected for this purpose.

## 3. Demonstration of the method

Process is demonstrated with a division of a building into five key components. A weighting system has been developed in consultation with Brimbank City Council. Then the transition matrix is developed for a given element type, the cost of maintenance can be calculated as a function of the deterioration curves.

The first step towards this is determining maintenance action matrix. From this matrix future cost and status can be predicted. The asset manager can then identify the percentage of elements in each condition after reaching a steady state for a given maintenance regime. If this is not acceptable by the organisation, maintenance regime can be changed to reflect the strategic objectives of the asset manager.

To calculate the buildings weight, all building elements should be inspected and then overall building network weight formula could be applied. In this paper, the effect of current physical condition of external wall finishes on the building weight is calculated.

## 4. Conclusions

The paper presented the concept of using Markov chain for deterioration modelling of buildings. Application of the methodology considering a fixed maintenance regime and an associated cost was presented. The methodology is quite powerful in establishing the relationship between an established maintenance regime and the future cost. This is then incorporated into the decision making through a building weighting method which can be used to enhance the outcomes of the Markov analysis process. Whilst the method requires a significant initial investment to establish:

- The deterioration matrix
- Maintenance regimes and associated costs
- Building weighting,

Once the method is established, self calibration can be incorporated into the information system making the functioning of the system quite smooth. The concept is currently being implemented with a project funded by the CRC for Construction Innovation at RMIT University.

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# Procurers, Providers and Users (PPU): towards a meta-role model for conceptualising product-service in the built environment

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*The product-service paradigm requires a shift in focus for many engineering disciplines, forcing them to change from providing products to providing products and associated services. Such a shift is likely to present several challenges to the built environment due to its inherent organisational fragmentations and through-life discontinuities. This paper presents a preliminary conceptualisation of the product-service paradigm as seen from a built environment perspective. The proposed PPU model represents the meta-roles and the information flows, considered as key to sustaining the product-service concept within the built environment.*

**Keywords:** product-service, PPU, knowledge management, through-life management, built environment

## 1. Introduction

Companies engaged in complex engineering projects are perceived to be going through a paradigm shift, from providing products to total service business models. This paradigm shift, often referred to as product–service, requires the shift in focus from designing and selling physical products, to sell a system of products and services, which are jointly capable of fulfilling specific client demands. This paper is aimed at presenting a preliminary conceptualisation of the product-service paradigm as seen from a built environment perspective. Firstly this paper will briefly introduce the concept of product-service paradigm. Secondly the specific research focus of the paper is presented. The procurer, provider and user (PPU) model is presented next as a preliminary conceptualisation of the product-service paradigm for the built environment.

## 2. Product-Service paradigm

Product service paradigm presents a different approach to the way engineering systems are considered. It puts the user at the heart of the system. This means that the satisfactory servicing of user requirements is a key priority, and in most cases dictates performance measurement. For example Maloney [1] states that there is no natural demand for the construction product; the demand for the constructed product is derived from the intended use of the facility. This entails that design, production, operation / use, maintenance / refurbishment, are no longer separate activities, but are part of a seamlessly integrated, multi-agent, multi-cyclical, long term supra system. Therefore the focus on whole life cycle of the product's ability to provide sustained services is an essential requisite. It requires new business, operational and information system models that extend many years into the future.

Designing for product-service is extremely challenging. Designing systems to co-evolve with the changing circumstances may be an avenue worth exploring in this regard. Need to support globally distributed design, production and use are also key considerations. The through-life aspect of product service paradigm means that information will be continuously generated. McMahon [2] observes two issues that requires attention. Firstly, how to ensure that the information created and the knowledge gained during the design and subsequent operation of the product are recorded and organised in such a way that they are accessible through the whole life of the product, and of most value in product support and in further design work. The success of through-life support depends heavily on the integration of a network of organisations such as specialised component suppliers, subcontractors and service providers. It is vital that procurement and contractual arrangements move towards providing integrated solutions.

## 3. Challenges for the built environment

Blyth [3] notes that the relationship between organisations and buildings is dynamic and continuously changing. The predominant approach to building procurement has tended to assume that a building project is a self-contained event. Adaptability and flexibility are not necessarily 'explicit' priorities during the briefing, design and construction of buildings; they often seem to be implicit;

Product – Service approach to the built environment (i.e. buildings, public and private infrastructure and other associated services) requires significant attention being paid to the involvement of stakeholders and their roles, over time. Since built products are expected to last for a comparatively longer life span, through-life issues related to how the buildings and the intended services evolve, bears a significant impact on the successful leverage of the product-service business models.

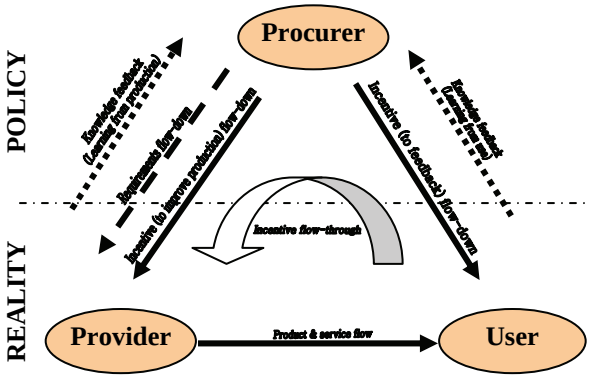
Most buildings and infrastructure are built to last for a considerable period of time. Koskela [4] highlighted several approaches namely life cycle assessment, product-service systems, product-life cycle management, systems engineering, integrated solutions, public-private partnerships, design studies and concurrent engineering, which claim to indicate life cycle considerations in engineering contexts. In a systematic comparison of the mentioned approaches, it was concluded that major focus tends to be directed towards the front-end of the life cycle, especially to redesign and design decisions, which

conventionally are considered of crucial importance, especially from a life cycle view point, with relative less attention on the subsequent use, maintaining, refurbishment and disposal.

Multiple life cycles can be observed within built products over time. They include component life cycles, space and functional life cycles, physical life cycles and legacy life cycles. It could therefore be contented that conceptualising product-service for the built environment requires the consideration of changing roles of its stakeholders over time and the whole life cycle issues, tied together by information and incentive flows that facilitate continuous product and service delivery improvements.

## 4. PPU model

The main aim of the PPU model is to encapsulate the changing roles of the stakeholders over time, and the resulting shifts of the flows between them. It is important to note that over time, the roles (the type of vested interest) that stakeholders have is likely to change. Therefore, the terms procurers, providers and users are time dependent (meta) roles. The arrows in the diagram indicate the various types of flows that are considered as important for the sustaining effective product –service delivery in the built environment.




The research team is currently engaged in field work studies in healthcare and education sectors, and hope to report the findings in forthcoming publications.

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# Asset Management Planning for Developing Countries

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*The built environment consists not only of buildings but also of the essential support infrastructure such as highways and utility services. These assets frequently fail because of inadequate maintenance and investment as they reach the end of their useful lives. Only with a system for the replacement of assets, when they become obsolete or beyond reasonable repair, can those responsible ensure the effectiveness and efficiency of their businesses. The methods employed in asset management have much in common with the accountants' approach to depreciation but differ significantly in that condition and performance are the prime drivers rather than age and fixed asset lives. The setting up of an asset management system is well within the capabilities of any organization and much time and effort can be saved if the tasks are dealt with in a structured manner. Thus the primary tasks can be organized into a sequence involving: inventory compilation, grading and costing. The resulting information can then be used to provide a valuation of tangible assets and forms the basis to drive the rehabilitation and replacement aspects of a capital investment program.*

**Keywords:** asset management, inventory, grading, valuation, investment

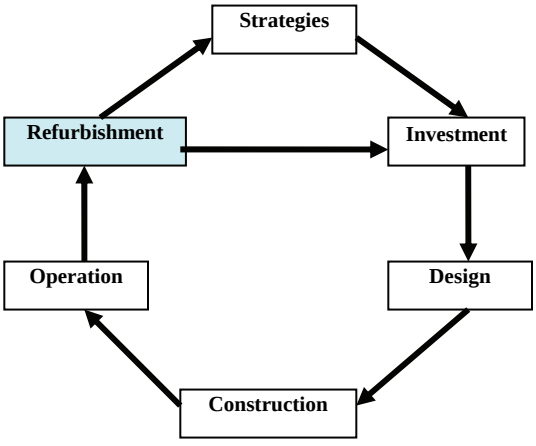
## 1. The External Context

The funding agencies, who bankroll much construction in developing countries, have recognized that, with finite resources, they cannot continue to pour unlimited funds into the premature replacement of neglected assets. This view is well founded and along with the concept of 'appropriate technology' coincides with the new morality of only providing that which can be sustainably managed thus avoiding problems for the next generation. There are many others who have a part to play in ensuring that constructions are sustainable. These include local politicians, board members, consultants, operators and of course the main stakeholders – the customers.

## 2. The Internal Context

An asset management plan needs to be administered and placed within a structure which is organized to deliver the planned benefits to the intended 'customers'. These 'technical' functions, which relate to the spending of funds, include: strategic planning; asset management planning; project appraisal and investment programme management.

Whilst some of the detailed tasks may be contracted out (e.g. to consultants), all of them must be present and effective for the outputs of a construction programme to be sustainable. The more advanced processes (especially design, tendering and construction) are normally outsourced. The asset management component is concerned with the refurbishment or replacement of the assets before they wear out and fail.




The need for an Asset Management Plan is most evident in those areas where maintenance and rehabilitation have been neglected resulting in a lower level of service to customers. Where the care of buildings and operational plant is not properly managed, early renewal becomes the only option to abandonment. Thus heavy (re)investment is undertaken by funding agencies often on a (roughly) ten year cycle and little is done locally between interventions.

## 3. Benefits

The benefits of an AMP include: a central inventory with unique references; consistent information; linked investment with service levels through performance grades; valuation of assets; planning and prioritization of investment; measurement and recording of improvement.

Whilst these are not detailed here, one can see immediate benefits such as the ability to feed designers and project planners with up-to-date system information.

## 4. Procedure

The procedure for compiling an AMP is detailed in the main text and consists of : (1) collation of existing data; (2) structure database tables and headings; (3) collect sample condition grade data; (4) test database with sample data and design input formats (forms); (5) undertake condition grade assessments (site surveys) and compile database; (6) develop LoS standards; (7) undertake performance grading with operational staff and enter data; (8) input asset lives; (9) input cost data (10) design queries and output reports; (11) run valuation and prioritization reports

## 5. Conclusions

An asset management plan is essential for the long term sustainability of any group of constructed assets.

Whilst there is expensive proprietary software available, a simple system can be set up using a PC and a simple database.

The methodology described can be adapted by any organisation or business for its own use.

It is not necessary to specify all of the requirements before commencing work; a gradual development involving the users of the data is preferred. Subjective judgements of grades may be made initially and later replaced with objective data based on measurement and observation.

To be effective, both condition and performance of assets should be recorded. Whilst condition is easily measured, performance relies on levels of service and requires local definition according to circumstances.

The high level grades (1=excellent to 5=awful) are fundamental and must not be amended. Lower level descriptions depend on the local environment and levels of service.

Little is objectively known about the reasons why constructed assets fail within their expected lifetime which can be due to neglect, lack of funds for refurbishment, vandalism, obsolescence and irregular financial transactions. Research into the reasons for asset failure could be undertaken to determine the reasons why asset management is not universally understood and employed. With this understanding the sustainability of the constructed environment may, hopefully, be improved.

The possibility of creating an on-line, easy-to-use AMP system is now opportune within an academic or commercial organization concerned with the sustainability of the built environment.

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*copies may be obtained from the author

# Infrastructure Asset Management (IAM): Evolution and Evaluation

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*Despite its rapid development in the last decade, infrastructure asset management today suffers from an identity crisis as the definition and scope of infrastructure asset management remains a contentious issue. The purpose of this paper is to trace the evolution of infrastructure asset management and evaluate the current practices. In the process, a framework defining the scope of infrastructure asset management is proposed. Notwithstanding the systematic approach that many organisations adopt to manage their infrastructure assets, this paper argues for the need to adopt a more integrated and strategic perspective in the light of the dynamic contemporary operating environment.*

**Keywords:** Infrastructure, asset management, strategic, performance

## 1. Introduction

Infrastructure asset management (IAM) has emerged as a discipline to provide a more systematic approach to the management of infrastructure assets. The purpose of this paper is to propose the need for an integrated and strategic approach to infrastructure asset management through examining the current practice of infrastructure asset management in the industry. The paper opens by discussing the development of IAM. The next section evaluates the current practices of IAM and puts forward a framework that encapsulates the scope of IAM. Finally, the paper reviews the current challenges to the management of infrastructure and concludes by arguing for the need of a more integrated and strategic approach to the effective management of infrastructure asset.

## 2. The Evolution of Infrastructure Asset Management

The concept of IAM is not a new but an evolving idea that has been attracting attention of many agencies operating and/or owning some kind of infrastructure assets.

Infrastructure investment and maintenance decisions in the past were made in accordance to tradition, intuition, personal experience, resource availability, and political considerations. There was no systematic application of objective analytical techniques in such decisions. To address this deficiency, many asset management systems with inherent investment analysis capabilities have been developed, in practice, and have been used for years. These asset management systems focus on databases, asset inventories, technical models and other analytical tools. Such asset management system focus is more on individual assets rather than the long-term asset management needs of an organisation.

Due to the relatively long life-cycle of infrastructure asset, the consideration of a whole life cycle approach is becoming increasingly important in infrastructure investment decisions. This shift has forced the design, procurement and decision-making on infrastructure asset to be based on whole life value. Thus, life cycle approach is becoming central to asset management by taking account of the total cost of an asset throughout its life [1].

## 3. Current Practice and Scope of Infrastructure Asset Management

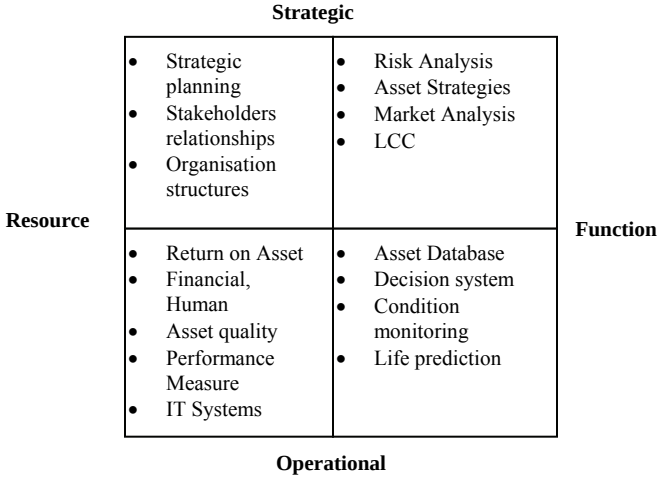
The preceding discussion suggests that the management of infrastructure assets has traditionally been approached from a *functional* perspective i.e., to ensure the optimum performance of the asset. However, there is evidence to suggest a broadening of this perspective to include infrastructure asset as an important business *resource* that is capable of contributing to the organisation's goals. In this context, the main goals of infrastructure asset management are to achieve maximum return on assets, optimise total cost of ownership and fulfil safety and environmental requirements. In other words, asset management can and should contribute to the broader corporate goals.

In the age of competition, especially with more involvement of the private sector in the provision of infrastructure, there is an increased emphasis on the management of valuable assets. The goals of IAM must reflect business goals i.e. infrastructure asset must generate revenue and ensure that business needs are met without compromising the competitiveness of the business in future. The scope of IAM activities thus extends from the establishment of an asset management policy and the identification of service level targets which match stakeholder expectations and legal requirements, to the daily operation of facilities required to meet the defined level of service [2].

In this regard, it can be said that infrastructure asset management responsibilities are today numerous and complex. A framework that synthesises the current practice of infrastructure asset management is useful for forging a common platform upon which future discussion on infrastructure asset management can be based.

The scope of infrastructure asset management can be depicted through four quadrants. The north and south axes represent a strategic vs operational perspective. The operational aspect of asset management involves the practical business of keeping the infrastructure in working conditions. The strategic perspective of infrastructure asset management considers the integration of

the user needs, the environment and the business functions of the organisation in the longer term. The east and west axes are anchored on each end by distinguishing asset as a function versus asset as a resource to business. Asset as a function concentrates on what can be done to improve the performance of the asset, i.e., asset optimisation. Asset as a resource on the other hand, considers how asset can best used to enhance business goals.




## 4. The Challenges of Infrastructure Asset Management

Accountability has emerged as a requirement for any organisational structure, public or private. Those in charge of economic resources, such as infrastructure must give account of their stewardship. In addition, globalisation is intensifying economic and other linkages among countries making it increasingly necessary to plan, develop and finance infrastructures across national borders. The key players too change over time, as the roles and responsibilities of the public and private sectors shift and evolve.

In this challenging environment, infrastructure owners/providers need to focus on stewardship to meet the expectations for quality including safety characteristics, operational efficiency and durability and accountability as guardian of infrastructure assets. For this to happen, infrastructure asset management should be an interdisciplinary and comprehensive business strategy. It should include all the dimensions proposed in this paper. In other words, IAM must not be approached only from a functional perspective but to also incorporate infrastructure asset as a important business resources from a more strategic perspective.

## 5. Conclusion

The practice of infrastructure asset management has broadened in scope and complexity. Due to the lack of an integrated framework, it has led to an unsatisfactory state of confusion in practice and research. The contentious issue of defining IAM is a stumbling block to the advancement and accumulation of the IAM knowledge base. This paper has reviewed the development of IAM practices and formulated an IAM framework that categorised the practices into 4 quadrants. Most organisations have concentrated their IAM practice in one or two of these quadrants. However, with the increasingly challenging operating environment, such disparate practice of infrastructure asset management may not be sufficient to create maximum value and contribute to business success. Consequently, there is a need to adopt a more integrated approach to IAM through the incorporation of all the dimensions proposed in this paper. Only then, can infrastructure asset management be satisfactorily accountable to the different stakeholders.

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# Opinion Study on Garbage Disposal System for Condominiums Using Quality Function Deployment

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*Management of solid waste has become as a major problem in most of the countries due to lack of proper separation, collection and disposal systems and insufficient legal framework. Among the sources of generating solid waste, high-rise residential developments are paramount importance. The paper is reviewed an existing garbage disposal systems, and improving functionality while enhancing the occupants' satisfaction using Quality Function Deployment (QFD) Technique.*

**Key words:** Customer Satisfaction**,** Garbage Disposal System, Condominiums, Demanded Quality, Quality Function Deployment

## 1. Background

At present, the disposal of solid waste is becoming as severe logistic and cost consuming issue in many countries including Sri Lanka. Due to poor infrastructure and resources for waste collection in most part of the country and lack of forward anticipation and planning, uncontrolled scattering and dumping of garbage is spread out in most part of the country [1], [2].

Over the past few years, considerable growth has taken place in the real estate sector particularly in terms of condominium developments. De Alwis [3] points out, the per capita generation of solid waste has increased and the expected value in the year 2010 is 1.25 kg per person per day. Since there are hundreds of families have been living in Colombo, sources of generating waste from high-rise apartments are becoming more scrutinized.

## 2. Waste Handling in Condominiums

The solid waste can be minimised through the proper controlling or reducing the amount of waste generation through the usage of proper mechanism. Thus reduction, reuse and recovery before disposal are vital to enhance the above concept. Basement storage, outdoor storage and specially designed vertical chutes are common garbage disposal modes that can be identified in those entities. Both positive and negative impacts exist with the aforementioned systems. Under the Apartment Ownership Act (Amendment), no.39 [4], there are no strict provisions pertaining to the solid waste management within the apartment itself. But there are certain requirements need to be fulfilled. However, though there are several by-laws, rules and regulations and guidelines these are not being currently implemented and are only drafted rules for public comments. The research paper is thus planned to review an effective design and operational guidelines of garbage disposal that can be used for future developments.

## 3. Research Methodology

The survey was conducted by taking 130 occupants in middle income apartments with response rate of 69%. The questionnaire consisted of nine (9) attributes related to function of a garbage disposal; same attributes were used to assess importance among the designers. Further interviews and participatory approached were used to support the questionnaire surveys. The data collected were summarized and a hypothesis test (t-test) was carried out to identify the factors which were significant. QFD technique was evaluated to identify the demanded quality of solid waste management.

## 4. Results and Discussion

### 4.1 Level of Importance and Satisfaction

Basically, from occupants' point of view, satisfaction occurs when outcome meets or exceeds the user's expectations. Dissatisfaction occurs when a negative discrepancy is present between users' anticipated and the actual outcome. Data presented in Table 1 revealed that all the attributes are identified as critically important by both parties and no significant difference. However, occupants are highly dissatisfied with all the attributes.

### 4.2 Expected Quality Vs Perceived Quality

The quality gap is determined the mean difference between degree of importance (expectation of service) and level of satisfaction (perception of service performance) of each attribute. The large gaps provide where designer/developer need to pay more attention. The tabulated data illustrated the significant quality gaps in, attributes of G, D, and A.

To improve the expected quality of the occupants, these areas need to be prioritised. Interviews conducted with designers revealed that developers are not bothered about the quality aspects they are hurrying in completing the design and construction and prime intention is to maximize the profit. And also developers are come up with fixed budget and their goal is to increase the rentable area as much as possible.

*Table 1- Attributes with Quality gap between expectation & satisfaction of occupants*

| Item | Attributes | Satisfaction (Occupants' | | Importance (occupants') | | Quality Gap | Importance (Designers') | |
|---|---|---|---|---|---|---|---|---|
| | | Mean | t-score | Mean | t-score | | Mean | t-score |
| A | Sufficient space for service area | 0.28 | -27.80 | 4.27 | 16.88 | 3.39 | 4.61 | 24.04 |
| B | Convenience of collection points at each floor | 2.62 | -4.35 | 4.43 | 24.34 | 1.81 | 4.44 | 18.92 |
| C | Eliminate bad odours | 2.41 | -6.64 | 4.76 | 38.75 | 2.35 | 4.67 | 30.00 |
| D | Effective collection and temporary storages at each floor level | 0.28 | -27.80 | 4.04 | 8.97 | 3.76 | 4.56 | 20.37 |
| E | Ease of transfer to final storage within premises | 1.92 | -13.66 | 4.82 | 45.22 | 2.9 | 4.56 | 20.37 |
| F | Effective final storage method | 2.17 | -10.16 | 4.59 | 29.32 | 2.42 | 4.61 | 24.04 |
| G | Regular collecting and transferring solid waste to final storage | 0.32 | -23.29 | 4.51 | 28.68 | 4.19 | 3.94 | 12.05 |
| H | Regularly collect by statutory authority | 2.87 | -1.76 | 4.62 | 31.74 | 1.75 | 3.89 | 9.49 |
| I | Precautions to deal with accumulated solid waste due to failure of statutory authority | 1.89 | -11.40 | 4.62 | 28.02 | 2.73 | 4.50 | 22.05 |

### 4.3 Integrating QFD and Survey results

Traditional quality systems react to what customers say or their basic expectations, the QFD proactively finds what customers needs and delivers better solutions ahead of the competition. Data presented in Table 2 shows results of House of Quality (HOQ) matrix which is the heart of the QFD. Quality elements reflected design guidelines /solutions. The high RI values address and have the great impact on the most important customer requirements.

*Table 2: Relative Importance (RI) for identified QE*

| | Quality Elements (QE) | RI |
|---|---|---|
| Design (50.72%) | **D1.** Effective design layout | 13.54 |
| | **D2**.Effective air locks / ventilation system | 10.12 |
| | **D3**.Well ventilated storage area | 12.65 |
| | **D4**.Sorting out of garbage | 14.79 |
| | **D5**.Selection of effective vertical transport mechanism | 13.62 |
| | **D6.** Effective structural accessibility to disposal truck | 2.58 |
| Operation (49.28% | **O1**.Cleaning of garbage rooms after removing | 7.27 |
| | **O2**.Efficiency of collection by the statutory authority | 11.56 |
| | **O3**.Effective building management | 13.87 |

The results revealed D1, D2, D3, D4, D5, O2 and O3 were found to be most important quality elements in order to meet customer requirements. Therefore these quality elements will have greater influence towards optimizing of quality of existing facility and end user requirements. This shows design and operation phase have same influence towards the successful of the project as a whole. Therefore, the appropriate way of exercising design activities right can lead to better and quality product, subsequently to address this goal QFD technique ought to be usable and useful.

## 5. Conclusion

It may be concluded from the above results that the attributes are considered as significantly important by both designers and occupants though all the attributes are dissatisfied by the occupants. Therefore comparatively higher quality gaps can be identified in all attributes. The areas having comparatively higher quality gaps are need to be given more priority when designing a garbage disposal system. Finally, the identified design and operational guidelines would be useful for both designers and developers in their future developments.

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# SECTION X

## POST DISASTER RECONSTRUCTION

# The Tragedy of Errors: Lessons for Local Government Reform in Pakistan's Earthquake Reconstruction Programme

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*This paper reviews the rural housing reconstruction implemented by the government of Pakistan in the aftermath of the devastating earthquake that struck northern Pakistan on October 8, 2005. This government reconstruction programme, in the form of cash grants distributed in several tranches conditional upon the meeting of earthquake-resistant construction parameters, makes for an interesting case study on post-disaster reconstruction policy formation and implementation. Further, lessons learnt from the successes and failures of this programme may inform effective development and service delivery in developing economies of the region, such as Pakistan.*

**Keywords:** Reconstruction, earthquake, local government, law, cash grants, grievances

## 1. Background

On October 8, 2005, an earthquake measuring 7.6 on the Richter scale hit the North West Frontier Province of Pakistan and the state of Azad Jammu and Kashmir, causing more than 70,000 deaths, incalculable injuries and wide-scale destruction of private houses and public infrastructure. Immediately after the earthquake, the government and non-governmental organizations (NGO) focused on relief to help victims survive the impending winter. As part of its relief scheme, the Government of Pakistan (GOP) provided a financial assistance grant to those who had suffered a death within their family, those injured in the earthquake and those who had suffered damage to their homes. Whereas the death and injury 'compensation' were a one-time payment, the housing grant was envisaged as the first tranche of a broader long-term private housing reconstruction scheme designed to help victims reconstruct earthquake-resistant homes. The task of designing and implementing the private housing reconstruction programme fell to another new centralized federal-level agency called the Earthquake Rehabilitation and Reconstruction Authority (ERRA).

Given its goals, the private housing reconstruction program can be viewed as a revolutionary government-sponsored service delivery and development program, albeit in this specific post-disaster environment. In the context of the Musharraf government's 2001 local government reforms and their heavy focus on local development and service delivery, the housing reconstruction performance offers interesting lessons for the reform of local governance in Pakistan. This paper evaluates the performance of the rural housing reconstruction process and identifies policy and administrative failures to highlight requirements for effective development and service delivery in Pakistan.

## 2. The Earthquake Reconstruction And Rehabilitation Program

On April 7, 2005, ERRA unveiled an elaborate cash assistance program for private housing reconstruction. The policy identified three categories of housing assistance recipients. Owners of completely destroyed houses (Category A) qualified for a total package of Rupees 175,000 (approximately USD $ 2,920), including the first tranche. Per this policy, an additional three tranches would be disbursed and qualification for each subsequent instalment would be subject to fulfilment of reconstruction conditions. This payment schedule was created in order to incentivize recipients to adhere to the designs for earthquake resistant housing and to facilitate inspections to ensure compliance. The second category of housing assistance (Category B) recipients included those whose houses were damaged but reparable. These individuals were entitled only to a second and final tranche of Rs. 50,000 (approximately USD $ 830).

To accomplish its goal of distributing earthquake-resistant designs and training artisans and homeowners to construct in accordance with them, ERRA created a vertical structure. This unduly complex multi-tier arrangement includes institutions with divergent command and reporting mechanisms, making coordination between them virtually impossible. A large number of grievances were reported with the administration of the housing assistance scheme.

## 3. Other Issues with the Reconstruction Process: Designs, Timing, Inspections and Subsequent Tranches

In addition to grievances with the administration of the first and second tranches, there appear to be a number of problems with the remainder of the housing reconstruction policy. First, there have been several problems with preparing and distributing earthquake-resistant designs. An issue that has arisen in some parts of NWFP is the landlord-sharecropper issue, such that sharecroppers are only given the housing grants after receiving permission from the landlord, causing resentment and insecurity amongst sharecroppers who form nearly 20% of the population. The earthquake has caused landslides in many areas, with the result that people in these high risk areas have been rendered landless. The implementation of the cash grants scheme and reconstruction in urban areas has suffered from even greater delays than in the rural areas. A range of legal disputes have erupted in the aftermath of the earthquake which have been exacerbated by the maladministration of the housing reconstruction

programme. Vulnerable groups, including widows, orphans, and the disabled, have suffered disproportionately from many of the glitches associated with the financial assistance scheme. The lack of information regarding processes and procedures, the need to stand in line to receive cheques, open bank accounts, and register grievances, for example, has been especially difficult.

## 4. Analysis of the Causes of Policy and Administrative Failures

The rural housing reconstruction plan suffered from a number of policy and administrative failures that may be attributed to centralization of (i) policy-making; (ii) absence of institutional memory and feedback mechanisms; (iii) delay in establishing the administrative structures; (iv) weak chains of command; and (v) information management failures.

## 5. Conclusions

The design of and the problems that have plagued the implementation of the housing reconstruction program of ERRA can teach us a lot about how to reform local government institutions in order to enable them to efficiently undertake service delivery and development functions. Many of the issues identified in this paper relate back to the debate over the efficacy of the devolution plan and the reform of local government in Pakistan. That the GOP did not entrust the reconstruction program wholesale to the local government may be attributed partly to the disorientation and capacity gaps caused by the earthquake in local government institutions. Nonetheless, the fact that when the local government was co-opted for aspects of the program even these were not fully entrusted to it, indicates the central government's lack of confidence in the competence and integrity of these institutions.

The analysis of the reconstruction program also indicates that it is important that policy-making should be done at, or at least informed by local level considerations. This can only be achieved if there is genuine public participation in policy-making. In addition, there should be political accountability to the public in order to ensure that elected LG officials are swayed by local requirements rather than extraneous considerations. Finally, there should be means through which those especially aggrieved by LG decisions should be able to seek redress and hold LG officials legally accountable. Existing means are not proving to be effective in establishing legal accountability of elected officials or bureaucrats. An effective system of administrative law at the local level is a pressing necessity.

The design of the housing reconstruction program and its failings has highlighted the acute need for developing additional capacity at the LG level. This capacity includes an appropriate administrative structure, the necessary infrastructure, adequate financial resources, and the development of social mobilization and information management capacities.

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# An exploration of current planning, design and building issues in post-disaster housing reconstruction

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*A number of housing projects funded by charities and NGO's in response to disasters, in developing countries are deemed to be inappropriate due to poor project management and limited resources which may comprise one or more of the following: limited knowledge of local climatic conditions; local materials; and the way people live and work within their communities; and often simply lack of experience. The introduction of structured decision making to allow for the audit of the cognitive processes adopted, alongside access to appropriate tools and techniques to engender the adoption of local knowledge, will reduce the risk of unsustainable building projects. Research is currently being undertaken to capture tacit, implicit and explicit knowledge and map the project management practices of leading aid agencies (NGOs and charities working in disaster relief) to understand decision making practices that result in best practice amongst these organisations.*

Keywords: disaster relief, decision making, housing, knowledge management, sustainability

## 1. Background

Housing recovery passes through four stages in the aftermath of a disaster: emergency shelter; temporary shelter; temporary housing; and permanent housing [1]; consequently reconstruction of housing stock after a disaster is not the same as providing shelter immediately following an event [2]. In general, research on disaster relief as it relates to permanent housing provision and associated social concerns, is still deficient [3]. There is a perceived gap in the understanding the longer-term impacts of post disaster reconstruction. Implementing agencies rarely have the time and/or expertise to document properly what they have done or undertake comprehensive research on the value of their interventions.

## 2. Natural Hazards and Disasters

There has been a significant rise in the number of disaster events over the past decade, as well as in the number of people affected by disasters associated with natural hazards; as documented since the beginning of reliable recording in the 1960s [4]. Far from being under control, evidence suggests that losses associated with the built environment due to these extreme natural hazards are increasing rapidly [5]. As a result disaster relief work has increased substantially in the past two decades [6]. However questions have arisen surrounding the appropriateness of the responses made to these disasters and how they are monitored in order to assess their effectiveness over the short, medium and long term [7].

## 3. Climate change and increasing vulnerability

As climate change exacerbates vulnerability, measures to mitigate increased risk need to focus on reducing built environment vulnerability in the context of development efforts; particularly building adaptive capacity and technology transfer. Indeed the unpredictability generated by climate change places more emphasis on the need to identify and support generic adaptive capacity alongside hazard-specific response capacity [8].

## 4. Hazard risk and appropriate mitigation

As the incidents of natural disasters increase, it is imperative that NGO's and other agencies involved in disaster relief manage risk by learn as much as possible from each disaster recovery and reconstruction process they are involved with; its successes and failures [9]. NGO's play important roles in different stages of the 'disaster cycle', and different elements are attributed to its successful operation. For example, technical skills are important for rescue, whilst coordination is essential relief activities. These require different knowledge skills, competencies and attributes. There is a general consensus that disaster management should shift its focus from response and recovery to sustainable hazard mitigation [10]. Hazard mitigation and planning should therefore be considered as more than an auxiliary issue and disaster risk reduction needs to be incorporated into the construction management process. The construction management decision-making process requires an in-depth integrated understanding of how to avoid and mitigate the effects of natural disasters. In order to be effective, resilience needs to be systematically 'built in' to the planning and design process and not simply added on as an afterthought [11]. It is therefore necessary to increase the participation of NGO's and the affected community within the construction process.

## 5. Sustainable Strategies

An appropriate response when reconstructing housing environments following a disaster is one that delivers solutions that optimise the design (its functionality and configuration) and manufacture (materials) of the build in terms of ecology, economy and social needs [12], if a sustainable solution is to be found. All too often reconstruction responses are driven by technology, limiting wider engagement with cultural and social issues [7]. End-users must be recognised as active stakeholders; aware and conscious of their own needs and wants, rather than as passive recipients, who need to be educated as sustainability can only be achieved by using local resources (materials and labour) and cultivating skills and knowledge, thus creating micro-economies

for those trying to get on with their lives post-disaster [13]. Ultimately, the success of any project hinges on co-ordination (organisational and managerial), both at local and regional levels, within and between organisations. The performance of housing reconstruction projects was directly related to the design and management of the project team itself [14]; highlighting the importance of studying decision making in project teams and analysing organisational processes for best practice.

## 6. Conclusions

There are large uncertainties associated with the future performance of the built environment due to changes in regional and local scale climatic conditions. To ensure that every house that is reconstructed following a disaster will work with or withstand future potential disasters, there needs to be an understanding and awareness of potential future risks (including climate change mitigation) alongside the development of strategies to survive or combat them. This study of the literature reveals that it is both prudent and necessary to establish to what extent local knowledge and technical and scientific information is exchanged between the different stakeholders and what is encouraging or constraining locally adapted solutions. Research is currently being undertaken to capture tacit, implicit and explicit knowledge and map the practices of leading aid agencies (NGOs and charities) currently undertaking post-disaster housing reconstruction projects, to understand decision making practices that are working towards sustainable solutions and demonstrate best practice. The results of this research will be published at a later date.

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# Capacity Building for Sustainable Post Disaster Waste Management: Construction & Demolition Waste

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*Disasters, both natural and man-made, have been occurring with increasing frequency and effect in recent decades in many countries around the world. Among many other reasons it has been identified that lack of awareness on the mechanisms and systems for post disaster waste management is a critical issue of concern. To address these issues, this research aims to enhance capacities to develop new mechanisms and systems for sustainable post disaster waste management focusing on construction and demolition waste. The research methodology includes a comprehensive literature review, semi structured interviews and case study with selected personal views on management of disaster waste management. In this context, the objective of this paper is to present the current scenario of disaster waste management based on the results of a secondary survey.*

**Keywords:** Capacity enhancement, Post disaster management, Waste management, Construction and demolition waste.

## 1. Introduction

Disasters cause substantial damage around the world every year [1]. There has been an increase in natural disasters over the past few years and their impact in terms of human, structural and economic losses has also increased considerably. According to the European Commission among the key issues that need to be addressed after emergency relief, the rehabilitation of the environment including waste management and the strengthening of local governance in related aspects is emerging as an important area of consideration [2].

Demolition of ruins and the reconstruction of buildings generate further construction waste in the post disaster scenario. If such waste is not properly managed, it may cause serious environmental and economic burdens on normal living conditions as well as on the reconstruction phase itself.

In recent years, several major disasters have occurred in coastal areas worldwide. Among them the Asian Tsunami which hit the coast of Sri Lanka on 26th December 2004, was considered the highest ever recorded value of disaster/destruction damage caused by a single event, in the Sri Lankan context.

However, United Nations Development Programme (2005) [3] highlights poor performance of post-Tsunami rehabilitation operations affected by a lack of responsive capacities with local government institutions to address needs of an event of such magnitude. This was mainly caused by the fact that strategic and operational level capacities of institutions responsible for public and commercial facilities were not expected to cater for a devastation of this magnitude. This is a critical issue that needs to be addressed for purposes of effective post disaster rehabilitation.

Therefore, this study is aim to identify capacities that need to be enhanced for a sustainable post disaster construction and demolition waste management process.

## 2. Research methodology

A comprehensive literature survey and review will be done on the concepts of post disaster management, waste management and capacity building. The Tsunami, which hit Sri Lanka on the 26th December 2004, has been selected as the case study for this research since it was the major disaster which occurred recently in coastal areas of the Asian region. Both structured and unstructured interviews will be conducted with selected personnel in governmental and non-governmental organisations to collect information on post tsunami waste management strategies, their suitability, applicability and to identify key factors which hinder progress of disaster waste management. In addition, a questionnaire survey will be conducted among tsunami victims in order to identify issues relating to post tsunami waste management programmes so far adopted. Subsequently, a framework will be developed by incorporating the above findings to enhance the local capacities which contribute to sustainable post disaster waste management processes. The framework will be tested with real life scenarios and evaluated using domain experts.

## 3. Discussion

The following section provides a brief discussion on post disaster waste management strategies applied for the tsunami and its successfulness, based on information collected through secondary surveys.

The destruction and damage generated a large volume of solid waste. A specific proportional breakdown of the tsunami-generated waste is not available. A rapid inspection of waste generated at damaged areas was observed at unauthorised dumps and unplanned landfills indicate that a large part of related waste consist of spoiled soil, damaged building material and vegetative matter, including branches, wood and domestic refuse. Smaller proportions of waste include plastic, metal (of

various types and condition) and items of undetermined origin were also noted. No significant presence of hazardous chemicals or technological items (e.g. computers, televisions) was noted. Overall, an estimated 80% of waste consisted of spoiled soil, building materials or vegetative matter.

Local government and volunteers are working diligently at removing debris and cleaning up neighbouring areas. Land owners are also cleaning their premises and depositing waste at locations for collection. At present, the waste collected is being deposited in unplanned landfills in environmentally sensitive sites. Limited, unorganised scavenging is taking place but it is focused on easy ways to collect high value items, principally usable sawn wood and metal. Owners of some waste, for instance a destroyed building, are also retrieving bricks, wood and other reusable objects. These efforts, are to be encouraged, will reduce the waste stream, but probably not significantly.

The collection and disposal of tsunami-generated waste should expand to include recycling of all appropriate materials. A large part of recycled material can be used to assist in the tsunami recovery process, including the rehabilitation of affected lands. Recycling will also reduce the volume of material which needs to be deposited into landfills, thus reducing overall negative impact of the cleaning and disposal processes.

## 4. Conclusions

The generation of waste during a disaster is unavoidable and the only solution is waste minimisation. The primary area observed through this secondary review is the available opportunity to divert construction and demolition waste into reusable/recyclable building material. Many constraints such as inconsistent nature of demolition debris, instability in the secondary material market, lack of interest, lack of government regulations, lack of interest for sorting, unavailability of required technology, improper and insufficient attention paid to quantification and identification of waste materials were identified as main reasons for being at the preliminary stage of waste management programmes. Finally, it can be concluded that the impact on the environment and economy from disaster waste can be minimised through proper benchmarking, being aware of consequences and trying to eliminate them. Therefore, this study will focus on enhancing local capacities for post disaster waste management process that will lead to sustainable waste management.

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# Post tsunami recovery capacity gaps in Sri Lanka

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*Poor response capacities have been identified as a major inhibior for successful post tsunami recovery attempts in Sri Lanka. Despite level of incentives received from the international communities, Sri Lanka has evidently failed to deliver expected level of performance in post tsunami recovery activities mainly due to capacity gaps. Accordingly, the country must fully understand the nature and the scale of its capacity gaps related to the post disaster recovery. Addressing this issue, the EURASIA (European and Asian Infrastructure Advantage) international collaborative research programme has conducted a series of interviews with key personnel in Sri Lanka to explore the nature and magnitude of this problem. The main objective of this paper is to present the outcome of these key expert interviews highlighting the priority attention areas and possible actions towards minimising the post tsunami recovery capacity gaps in Sri Lanka.*

**Keywords:** Capacity building, Disaster management, Developing countries, Post disaster reconstruction, Long term recovery.

## 1. Background

### 1.1 Disasters and the developing world

During the past decade, the number of worldwide disasters has risen sharply. This emphasises the need to focus on disaster management related issues more than ever before. Within a typical disaster management scenario, 4 distinguishable stages exist [1]. These are: Pre-disaster planning, Immediate relief, Transitional phase, Medium/Long term recovery. As the "Mind the gap" report [1] highlights, even though the developing countries often receive financial and other humanitarian support from international communities as immediate relief aid, traditionally the donors and other organisations working towards humanitarian relief pay less attention to the long term recovery aspect of disaster management. Thus, not surprisingly, developing countries who witness disasters often fail to launch successful long term disaster recovery programmes due to lack of resources and capacities, both in financial and intellectual terms. For these reasons, there is a real need to assess the long term disaster recovery issues in developing countries.

### 1.2 The case of post tsunami Sri Lanka

The case of post tsunami Sri Lanka exemplifies the issues related to the post disaster long term recovery in developing countries. Four years on, Sri Lanka is yet to recover fully from the devastation of the December 2004 tsunami. In fact, after a successful immediate relief phase [9], Sri Lanka is going through its transitional period between the short term relief and the medium/long term recovery.

### 1.3 Capacity building for post disaster recovery

Post tsunami recovery (long term) attempts in Sri Lanka are less than successful compared to the government's expectations and plans [2]. One of the problems that the governments of developing countries often face, with regards to post disaster recovery, is their response capacity. Generally, capacity at local government level to plan and implement post disaster recovery strategies is limited and incapacitated as a result of the disaster itself. In the light of this, strengthening local capacities for the disaster recovery process has been identified as a main priority [3]. In the light of this, this paper addresses the following research question: "What priority capacity gaps exist within the relevant authorities and institutions in Sri Lanka that need to be addressed to achieve successful long term recovery from the December 2004 tsunami?"

## 2. Methodology

The overall approach to this research took the shape of a case study. The data collection approach was centred around a series of semi structured interviews conducted with 12 organisations involved in the post tsunami recovery programmes. All the interviews were transcribed and analysed to identify key capacity gaps which hinder the success of post-tsunami recovery in Sri Lanka. The data analysis strategy was based on a QSR NVivo qualitative data analysis software which is based on the principles of content analysis where the concepts related to the phenomena are captured through analysing the contents of the interviews qualitatively.

## 3. Results

### 3.1 Capacity gaps related to skills shortages and human resources

During the interviews, skills shortages emerged as a main capacity gap in post tsunami Sri Lanka. Six main skills areas that require capacity enhancements have been identified from the research. These are: coordination skills, management skills,

planning skills, research skills, technical skills, and training skills. Out of these capacity gaps in skills; coordination, management and planning have been identified as key areas of concern. In addition, the capacity gaps in research and training have also been identified as shortcomings in order to implement successful post tsunami recovery actions. The interviewees felt that in general, the research activities are underfunded Sri Lanka. It has also been identified that some of the required technical skills for post disaster recovery in Sri Lanka is lacking. Interviewees have commented especially about the shortage of construction technical skills to cater for the massive demand created with the start of the post tsunami reconstruction work.

### 3.2 Institutional and financial capacity gaps

Within this category governmental organisations have been the most cited with relation to the areas of lack of institutional capacity in implementing post tsunami recovery actions. The areas of main concern are the lack of: central statistics, experience, good practice transfer, incentives, planning, lack of communication, poor quality assurance, and poor requirements capture. Out of these areas, lack of planning and poor communication has been cited frequently by the interviewees. poor quality assurance has also been identified as an area where the government institutions show significant capacity gaps. It has further been identified that the lack of experience to deal with the scale of the December 2004 tsunami as a main cause for the governmental organisations to demonstrate capacity gaps in various areas. From the non-governmental organisations' (NGOs) point of view, the institutional capacity gaps have been identified in two perspectives: as donors and implementers. From the donor's perspective, rigid policies and decision making capacity on funds disbursements were identified as the main capacity gaps. The main issue from the perspective of an implementer is their incapacity to carry out relevant reconstruction work in some areas due to security issues. Due to the ethnic problem prevailing in Sri Lanka, some of the worst tsunami affected areas cannot be reached by the organisations who are carrying out the reconstruction work.

## 4. Conclusions

Identifying capacity gaps is an essential task for Sri Lanka to overcome the problems they face with their post tsunami recovery attempts. It is evident that the government had ambitious plans and high expectations for speedy recovery but with less success rate. Among the reasons, various skills shortages such as coordination and planning skills have been identified as main capacity gaps which need immediate attention. In addition, at institutional level, governmental institutions suffer from capacity gaps such as lack of central statistics and poor quality assurance. From the perspective of non-governmental organisations such as donor agencies and implementing organisations, the lack of coordination, security restrictions and policy issues have been identified as main areas of concern. Dealing with donor organisations, unrealistic ambitions, rigid funding policies and lack of coordination with government organisations have all been identified as issues which need to be addressed and at the same time leading to financial capacity gaps Sri Lanka is experiencing within the context of post tsunami recovery.

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# Study of factors affecting Post Disaster Housing Reconstruction

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*Sri Lanka was hit by a Tsunami in 2004 and was damaged severely. As a result there is therefore an urgent need for an effective post disaster housing reconstruction programme in Sri Lanka. This paper identifies the issues involved in reconstruction through the interviews with stakeholders involved in it. The research findings reveal that the post tsunami reconstruction programme is prolonged for various reasons and the smooth flow of the reconstruction process has been disturbed by certain gaps arising from it. An inconsistency of tsunami housing policy and lack of coordination are major issues.*

**Keywords:** Tsunami, Housing Reconstruction, Sri Lanka, Issues, Disaster

## 1. Background

The world is experiencing an inherent intensity of disasters – natural and man made - with devastating impacts. When disaster strikes individuals and communities are affected, seriously disrupting their normal functions. While the number of geophysical disasters (earthquakes, tsunamis and volcanic eruptions) has remained steady, the number of hydro-meteorological events (including droughts, windstorms and floods) has more than doubled since 1996 [1]. On December 26, 2004 the deadliest tsunami known in history hit Sri Lanka, triggered by a massive earthquake of momentous magnitude (9.0) - the largest earthquake recorded in 40 years. Sri Lanka is facing a big challenge in rebuilding the nation as a country that had not previously experienced such a disaster. Among the main four pillars of the reconstruction, housing takes the lead in achieving the recovery for the community. Donor-driven and owner-driven are the main housing reconstruction programmes involved in the current post disaster reconstruction process. Whether the reconstruction of housing starts on time, is carried out properly in order to achieve recovery of livelihoods as the planned output, are some major issues affecting the success of the reconstruction process. This research paper addresses the issues in post tsunami housing reconstruction programmes in Sri Lanka and identifies how these are delaying the reconstruction.

## 2. Research Methodology

Interviews were adopted to collect the information regarding post tsunami housing reconstruction. Semi-structured and unstructured interviews were conducted with Governmental and non-governmental organisations and communities to collect data on post tsunami housing reconstruction work. The purpose was to identify the involvement of various stakeholders in the reconstruction process, their success rate and identify factors that hinder progress of post tsunami housing reconstruction work. Five leading government organisations and five non-government organisations were selected to interview.

## 3. Survey findings: issues in post tsunami housing reconstruction

Several issues in post-tsunami housing reconstruction programme were identified through the interviews. The main reason is the inconsistency of the tsunami housing policy. This is followed by the lack of effectiveness of the regulations provided. There is a mismatch of co-financing policy and what has taken in practise.

The relocation housing programme has been delayed mainly due to the: unavailability of appropriate land to build large housing schemes, unavailability of clear beneficiaries list for consultation, unwillingness of beneficiaries to be relocated, an inadequate provision of infrastructure by government and an unavailability of good construction companies. Donors were unable to complete the number of units they have pledged to build due to the challenges of the construction industry - complexity of work, high inflation rate of raw materials and labour etc. After the relaxation of the buffer zone some families preferred to return to their own land even though they were meeting with houses under donor driven housing programme. Some donor driven houses are unoccupied as a result. Absence of a technical quality control system in donor driven housing programmes is another major issue. It has resulted in defected housing being constructed by the donors. Some of those houses were demolished and reconstructed. Both time and money have been wasted leaving the achievement of development goals far away.

The owner driven housing reconstruction programme has suffered from certain gaps mainly due to insufficient grants. In particular, in phase I of the housing reconstruction programme, households were provided with a maximum amount of Rs. 250,000 to construct the houses. This was not sufficient due to the high inflation rate of prices of construction materials, labour and professionals etc. To overcome this, in phase III, the government changed the method of issuing grants for housing reconstruction. However there were a lot of equity issues. Absence of the government in handling issues regarding top up grants is the reason behind this. In some instances the community has mis-spent the grants on alcohol etc.

In addition, both reconstruction programmes were affected by lack of adequate technical capability and unclear delegation of responsibilities between divisional, district and central government agencies in Sri Lanka and a lack of coordination between community and various other parties such as affected/non-affected community, INGO, NGOs, private sector, donors etc. Enforcement of the buffer zone delayed the housing reconstruction programme by about six months. Due to lack of construction activities at that time some donors left the country and Sri Lanka missed out on a considerable amount of grants that have now delayed the latter stage of the reconstruction programme. In the first phase of the housing reconstruction policy community based construction was not allowed and some donors and communities who had started construction faced problems. The declining security situation is the main reason for the slow progress of housing reconstruction in North and Eastern provinces.

Absence of government involvement to control the provision of grants caused equity issues all over the country.

## 4. Conclusion

A housing reconstruction programme is a major task in the post disaster recovery phase. Therefore the success of post tsunami recovery mostly depends on the degree of success of the housing reconstruction programme. The family is the basic unit of the society and needs to recover well in moving toward developing the country. It is clear that much work has been done and is ongoing, relating to housing reconstruction in Sri Lanka. However there are certain issues that have arisen in the housing reconstruction programme. Inconsistency of tsunami housing policy, land title, lack of coordination and communication and war can be identified are the major reasons behind unsatisfactory performance levels of current housing reconstruction practices. A huge amount of money that comes from foreign countries/local donors, as funds, is mis-spent due to the inefficiency of the government to handle the reconstruction programme. Hence, the opportunity given by tsunami to develop the country is not optimised. The number of completed houses only, cannot be used to measure the progress or the degree of success of the post disaster housing reconstruction programme. Post disaster housing reconstruction programme has to be more humanitarian than other developments.

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# Economic development perspectives of post-disaster infrastructure reconstruction in Sri Lanka

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*Sri Lanka was found to be a disaster prone country in the recent past. Impact appears in many forms; loss of lives and property, economic impact, social impact etc. As a developing country, Sri Lanka is much more concerned with the country's economic development. Therefore, it is wise to look in to post-disaster activities in development perspectives and integrate disaster risk reduction concerns in to economic development activities. The paper reveals the importance of post-disaster infrastructure reconstruction in economic development. A comprehensive literature review was carried out regarding the role of infrastructure in disaster management, economic development together with the key indicators of economic development.*

**Keywords:** Tsunami 2004, Disaster management, Post-disaster infrastructure reconstruction, Economic development.

## 1. Background

The whole world is prone to natural disasters. An average of 354 natural disasters occurred a year in the period 1991 to 1999. From 2000 to 2004, this rose to an average of 728 a year. The total number of people affected each year has doubled over the last decade. The destructive ocean waves, the tsunami 2004 killed more than 35,000 people and displaced nearly 2,500,000 people in Sri Lanka. The coastal infrastructure was also significantly affected.

According to Munich Re 1998, Asia, which accounts for half the number of the natural catastrophes in the world and 70% of all floods, the average annual costs of floods over the past decade is approximately 15 billion USD [1]. Much of the damage inflicted by floods is to the infrastructure [1]. By some estimates, infrastructure loss accounts for 65% of all flood loss [1]. For Asia, this would account for an average annual infrastructure loss of approximately 12 billion USD for the past decade [1].

## 2. Disaster management and infrastructure reconstruction

This paper deals with the economic infrastructure, which primarily consists of transportation, energy and utilities, water supply and sanitation services and telecommunication systems. Infrastructure is critical to a safe and a resilient economy. Therefore, a sudden disruption of infrastructure affects the whole humanity.

Investment in disaster management is essential as it can result in reduced loss of lives in the event of a disaster. The physical infrastructure can be developed to withstand disasters, reduce and even prevent damage from natural disasters. Infrastructure reconstruction programmes should aim to change the vulnerable conditions for the development of the country. As a nation, Sri Lanka should demonstrate a firm resolve in protecting infrastructures from further disasters, compared to what significantly affected by the Tsunami 2004.

## 3. What is economic development?

From a policy perspective, 'economic development' can be defined as efforts that seek to improve the economic well being and quality of life of a community. It should be strongly focused on low-income developing countries where poverty is especially acute [2]. A very wide variety of indicators can be used to measure the economic development differences between developed and developing countries. Key indicators among those are GDP per capita, life expectancy, literacy rates, quality of infrastructure, access to safe infrastructure, poverty reduction etc [2].

## 4. Economic development through post-disaster infrastructure reconstruction

Disasters provide physical, social, political and environmental development windows of opportunity that can be used during the post disaster recovery and reconstruction not only to reconstruct the impacted areas, but also to improve the socio-economic and physical conditions of the impacted population in the long run [3].

In the World Development Report 1994, The World Bank makes the direct link between infrastructure and poverty [1]. Freeman [1] has admitted that the clear link of natural disasters to poverty is through infrastructure. Further, access to infrastructure for the rural poor, primarily irrigation and transportation, increases income that enables the poor to manage risk [1].

The World Bank stands out among international organisations who work towards socio-economic development of developing countries, as it's mission is to 'reduce poverty and improve living standards through sustainable growth and investment in people'. In achievement of the above aim, The World Bank has a clear objective of promoting economic growth strategies based on expanded infrastructures, which are environmentally responsible and socially acceptable, and bringing a sustainable future closer to today's reality.

## 5. Sri Lanka's situation with regard to infrastructure reconstruction and development

Irrespective of other prevailing problems, the main issue in the current infrastructure reconstruction process in Sri Lanka is whether these reconstruction projects consider the economic development perspectives during the process**.** Moreover, whether they take into account the disaster reduction measures in the long-term construction?

According to 'The Central Bank of Sri Lanka Annual Report–2005' [4], infrastructure facilities have been expanding in Sri Lanka but not adequate or competitive yet, thereby constraining economic growth. South Asian Disaster Report called, 'Tackling the Tides and Tremors' authored by Duryog Nivaran [5] has identified a key challenge with respect to the longer-term and larger task of developing the infrastructure and services along the devastated coastal belt and to new settlements; whether recovery is used to address disparities in quality and access of infrastructure and services to communities? Duryog Nivaran [5] questions, in particular, the extent to which infrastructure re-development extend towards and deals with issues related to poor people's infrastructure and service needs, reconcile environmental-development complexities and link development to future disaster risk management? [5].

## 6. Conclusion

Natural disasters destroy critical infrastructure. Through this research, an effort was made to identify the importance of post-disaster infrastructure reconstruction in economic development. The infrastructure has a strong link to economic development. Infrastructure development plays an essential role in reducing poverty in developing countries. Post-disaster reconstruction is considered to be a good opportunity for focusing activities into development perspectives. In Sri Lanka infrastructure facilities have been expanding but are not adequate or competitive yet, thereby constraining economic growth. In addition, the quality of some of the services remains insufficient. In the post-tsunami context, a key challenge with respect to the reconstruction of infrastructure is whether recovery is used to address disparities in quality and access of infrastructure and services to communities.

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# Lessons learned from Asian tsunami disaster: sharing knowledge

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*Creating an organised common platform to capture, organise and share the knowledge on disaster management strategies is considered vital to enhance the effectiveness of future disaster management efforts. This paper highlights the importance of knowledge and good practice sharing in disaster management strategies, and discusses key lessons learned from 2004 Asian tsunamr, particularly relating to the Sri Lankan context. Good practices and lessons learned are discussed on five different themes: social, technical, legal, operational and environmental. Further, the ISLAND website is introduced and developed as part of a research aimed at increasing the effectiveness of disaster management by facilitating the sharing of appropriate knowledge and good practices.*

**Keywords:** Disaster management, Knowledge sharing, Lessons learned, Good practices.

## 1. Background

According to the World Disaster Report 2005 [1], the number of reported disasters has increased steadily over the past century and risen sharply during the past decade. This reflects the high value of the infrastructure and assets at risk. The disasters bring about the loss of lives, property, employment, and damage to the physical infrastructure and the environment. The Asian tsunami that struck on the morning of December 26, 2004 is widely acknowledged as the largest, most devastating natural catastrophe in the Asian region. This disaster left behind widespread destruction, killing over 250,000 people, damaging natural ecosystems and coastal infrastructure [2]. Effective lesson learning should reduce the risk of future disasters. Ensuring the availability and accessibility of accurate and reliable disaster risk information when required entails an efficient system for knowledge sharing. In view of addressing the perceived need to share knowledge relating to disaster management strategies, the School of the Built Environment, at the University of Salford, undertook the research project '*ISLAND*' (Inspiring Sri-Lankan reNewal and Development), partly funded by the RICS Education Trust.

## 2. ISLAND project

ISLAND is aimed at increasing the effectiveness of current disaster management strategies by sharing appropriate knowledge and good practice about post-tsunami programmes, particularly in Sri Lankan context. The research was built around the following objectives:

- To create an infrastructure for developing, sharing and disseminating knowledge about disaster management for land, property and construction.
- To develop a knowledgebase on post-tsunami recovery efforts, including but not limited to, disaster mitigation strategies.
- To develop case materials on post-tsunami responses.

The research was carried out according to three Work Packages (WPs): WP1 - Develop knowledgebase infrastructure; WP2 - Populate knowledgebase; and WP3 - Disseminate research and identify future research directions.

## 3. ISLAND website

As part of WP 1, the ISLAND web portal and knowledgebase was developed to capture, process, and disseminate the lessons learned from the Asian tsunami in the form of policy advice and good practices to guide future post-disaster interventions. The knowledgebase was created addressing several themes of disaster management based on published case materials collected on the Asian tsunami disaster 2004, particularly cases from the Sri Lankan context. Case materials are organised into type of disaster, phase, country, source, research methodology followed, level, scope and access to the study is stored in a MySQL database using a PHP-Database interface. The web portal acts as the public interface to share and disseminate the lessons learned, and good practices on disaster management.

## 4. Good practices and lessons learned

As part of WP2, an analysis on good practices and lessons learned from the Asian tsunami disaster was carried out based on case material collated, particularly from Sri Lanka.

### 4.1 Social

The importance of community participation within the reconstruction process, public awareness and education, and job creation programmes like Cash for Work (CFW) are emphasised in most of case material collated. Major benefits of the community based risk assessment, mitigation planning and implementation processes underscored include; building confidence, pride in being able to make a difference, and enhanced capabilities to pursue disaster preparedness, and mitigation as well as bigger development responsibilities at the local level. A lack of awareness has been identified as a major reason behind the huge loss of lives and property from the 2004 Asian tsunami. Indeed, the term "Tsunami" was heard by most of the ordinary Sri Lankans only after this devastation.

### 4.2 Technical

The tsunami affected two-thirds of the coastline of Sri Lanka, and it also resulted in the destruction of nearly 100,000 houses and infrastructure like roads, bridges etc [2]. According to Dias et al., [3], there are two common threads that run through the structural failures. The first is that structures have to be tied down in addition to being held up. The second thread is that soil scouring has to be accounted for or anticipated. Damage to roads induced by the tsunami included erosion of embankments, erosion of abutment backfills, and collapse of bridges following the loss of stability of the abutments.

### 4.3 Operational

Coordination is often a scarce resource in disasters, yet remains the key operational principle for effective response. The importance of effective coordination of disaster management work at international, regional, national, organisational, group and individual level is overwhelmingly highlighted within the case material.

### 4.4 Legal

Coastal zones and small islands are often densely populated areas that increase the risk to and vulnerability of the people. Beyond preparing for evacuation and emergency response, communities can reduce their tsunami risk by modifying their land use, planning and development approval practices. Through zoning, creation of open space and not allowing new development in potential tsunami areas, safer land use will be better able to protect people and buildings. Further, reports emphasise the necessity for a national and institutional level legislative framework governing disaster management efforts.

### 4.5 Environmental

The tsunami worsened pre-existing environmental management problems on the inhabited islands. While there is damage to the natural and built environment in affected coastal areas, there are no major life-threatening environmental emergencies as a result of the tsunami. Re-mapping affected areas before redevelopment begins can ensure the identification of hazardous areas created by tsunami-induced changes, such as mass graves and locations vulnerable to flooding.

## 6. Conclusion

Good communication and exchange of critical disaster management information and knowledge could enhance coordination and integration of stakeholders' actions in disaster mitigation and response. The ISLAND website is introduced an organised common platform to capture, organise and share the knowledge on disaster management strategies. It could be extended to create mini-hubs of expertise in order to act as the mechanism by which needs for expertise in a range of areas could be identified. Further, case material relating to different phases and types of disasters could be collated and populated using available infrastructure of ISLAND website.

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# A comparative study of donor driven vs. owner driven post disaster housing reconstruction programmes

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*Until December 2004, the phenomenon of tsunami was far from the minds of most of the world's population. That was changed by the Indian Ocean tsunami of 26th December 2004, which devastated many countries of the region including Sri Lanka. In addition to the tremendous loss of life and injuries, the tsunami caused extensive damage to property and disruption to fisheries and other livelihood activities and business assets. As a result, the construction industry has blossomed due to the massive scale of post tsunami reconstruction works in Sri Lanka. This research is aimed at exploring local perceptions of housing reconstruction in the aftermath of the tsunami. The district of Matara was therefore chosen to base the comparative study on post tsunami housing reconstruction approaches based on Donor driven and Owner driven.*

**Keywords:** Disaster, Donor, Housing, Owner, Reconstruction.

## 1. Background

### 1.1 Indian Ocean tsunami of 26th December 2004

The International Strategy for Disaster Reduction – ISDR (2002) has defined a disaster as a "serious disruption of the functioning of a society, causing widespread human, material, or environment losses, which exceed the ability of the affected society to cope using only its own resources". The scale of the disaster is unprecedented, the loss of life immense and the level of physical damage very significant. On 26 December 2004, a magnitude 9.0 earthquake occurred off the west coast of northern Sumatra in Indonesia. The first of the earthquakes was the fourth largest earthquake in the world since 1900, and generated a tsunami that was among the deadliest natural disasters in modern history. According to up to date information in the Sri Lankan context, the tsunami killed 35,322 people, displaced around 1,000,000 people and affected over two thirds of the island's coastline and 13 outlying districts.

### 1.2 Disaster management

Disasters are not totally discrete events. Their possibility of occurrence, time, place and severity of the strike can be reasonably and in some cases accurately predicted by technological and scientific advances. It has been established that there is a definite pattern in their occurrences and hence we can to some extent reduce the impact of damage though we cannot reduce the extent of damage itself. This demands the study of disaster management in methodical with an orderly approach (Thirunavukarasu 2005). Disaster management has a different emphasis in every different discipline. According to the Central Emergency Relief Organisation (2004), disaster management is a collective term encompassing all aspects of planning for and responding to disasters, including both pre- and post-disaster activities. It may refer to the management of both the risks and the consequences of disaster. Disaster management can be divided into four parts Emergency Response and Relief, Recovery and Reconstruction, Mitigation and finally Preparedness - which are in the main respectively categorised into two routes - Crisis Management and Risk Management (Kawata 2001).

### 1.3 Reconstruction

Reconstruction programmes offer an opportunity to set new standards of quality to mitigate the impact of future disasters. Barenstein (2006) contributed to explaining the local perceptions of housing reconstruction in the aftermath of the earthquake that hit Gujarat in India on 26 January 2001. Through comparative analysis, five different approaches have been explored: the owner-driven approach; the subsidiary housing approach; the participatory housing approach; the contractor-driven approach in situ; and the contractor-driven approach ex nihilo.

In the Sri Lankan context, resulting from the Indian Ocean tsunami on 26th December 2004, these housing reconstruction strategies are mainly described into two ways – a donor driven reconstruction programme and homeowner driven housing reconstruction programme.

### 1.4 Donor driven reconstruction programme

Simply, the term can defined as 'relocation of affected families from the buffer zone'. All affected families are entitled to a house built by a donor agency in accordance with Sri Lankan government standards.

### 1.5 Owner driven reconstruction programme

'Damaged housing (partially/fully) outside the buffer zone' can categorised in this scenario. The Sri Lankan government provides a cash grant, reimbursed by different development banks and bilateral donors, to an affected homeowner for the reconstruction of their house.

## 2. Success of the housing reconstruction programme

To gain a more reasonable conclusion throughout the tsunami housing reconstruction strategy selection, conducted in the Sri Lankan context, it was necessary to carry out a comparative study of both donor driven and owner driven housing programmes. These were mainly focused on housing strategies not only in the selected district of Matara but also 12 other affected districts.

Therefore in the research, the main focus has been to identify the successfulness of the above mentioned two reconstruction strategies separately.

### 2.1 Donor driven vs. Owner driven

The main objective of this research has been concluded under this heading, which is the degree of success of the housing reconstruction programmes in respect to donor driven relocation programmes and owner driven resettlement programmes. To discuss it comparatively the following salient parameters have been used:

- **Coverage**
- **Timeline**
- **Dwellers view on their permanent residence**:
  Quality/strength/durability, functionality, space availability, aesthetics, flexibility to make any changes in the future, agreement to change the design as required, land size, location, overall facilities provided.

Comparative results from the above salient parameters are concluded under Conclusions.

## 3. Conclusions

The main outcome from this survey is that dwellers in owner driven housing programmes are more satisfied than the dwellers in donor driven housing programmes when concerned with the above parameters. According to the research, it is argued that the owner driven housing programme is more prominent in terms of: quality/durability, space availability, flexibility to make any changes in the future, agreeing to change the design as required, land size, location, overall facilities provided (electricity, water connection and sanitation). When looking at these parameters, which are superior in terms of owner driven, they proved that the dweller involvement throughout inception & design to construction stage resulted in a better success rate in the owner driven housing programme than those who were under the donor driven housing programme.

By contrast with the owner driven programme, the donor driven programme has been more superior in terms of aesthetics and functionality. Furthermore, it has been identified that the two main reasons behind this were that the donor houses had been designed by professional architects and most of the houses in the owner driven programme were half built and occupied with the intention of completing them in the future.

In addition, it was noted that the donor programme started later than owner programme and progress in the district of Matara on the donor driven programme is fairly high compared to the owner driven. Compared to other districts, the coverage in the both programmes in Matara district is high, but the dwellers' views on timeliness to delivery of permanent houses to the donor driven and compensation to owner driven house have been identified to be less. That was particularly noticeable in the donor driven programme. Although, they found an increased amount of donor driven houses at the present, many victims are still living in temporary houses. Additionally, the assistance given to sub- families' victims could be seen in erroneous manner and for 3 years after the disaster most of the sub- families are still in temporary housing despite excess amounts of vacant donor houses.

The reconstruction process should be considered as a development opportunity and should open access to different types of innovative solutions. These innovations should lead to vulnerability reduction, and should enhance human and other security activities in the long term.

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# Capacity of the construction industry in post disaster reconstruction

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*Natural and man-made disasters have been causing increasing losses to human lives and damages to assets over the years. Sri Lanka is prone to natural disasters and there is growing recognition that there should be more concern about the subject of disasters. The need for managing disasters through construction has been gaining importance in recent years. The capacity of the construction industry is therefore a critical issue. Capacity building and construction industry development are becoming inevitable in successfully managing disasters. This study attempts to explore the organisational capacity of the contracting organisation and associated challenges in housing reconstruction. The findings of the research reveal that, contractors give importance to the human resource, finance and management capacities within capacity building. The contractor's financing base has changed by a considerably smaller proportion in response to housing reconstruction circumstances. The capacity of contractors was explored in many ways in terms of organisational capacity. Credit facility of the contractor's shows the its increasing nature in the last three years. The main challenges faced in the successful implementation of the reconstruction are non-availability of labourers and materials.*

**Keywords:** Capacity, Construction industry, Housing, Post disaster, Reconstruction.

## 1. Background

The increasing nature of impacts from disasters has inevitably made post disaster reconstruction of significant importance to the body of research in the developing countries. Sri Lanka is prone to natural disasters and the tsunami gave a surprise warning of their vulnerability for disasters. International and consequently national capacities for coordination, funding and implementation of post-disaster aid are structured to offer support in independent sequential 'relief ', 'recovery/rehabilitation' and 'reconstruction/development' phases, regardless of whether the support is to water supply or shelter [6]. Further it states that the reconstruction required after a disaster is a high-cost and long-term commitment per capita. According to the Asian Development Bank Report [1], the impacts of the damages due to the 2004 tsunami were highlighted and the housing became significant amongst the devastation. The construction industry did not posses the capacity in terms of human, finance, management, etc. Therefore, it has had a much broader role to play in order to avoid adverse effects in reconstruction. Ofori [4] states that it is necessary to provide the requisite capacity and capability to the construction industry.

## 2. Research methodology

A comprehensive literature review was carried out to identify the concepts relating to capacity and reconstruction and to identify factors to facilitate the data collection. A survey approach was used and the 'unit of analysis' selected for this study is 'contracting organisations' in the Sri Lankan construction industry. Thirty contracting organisations contributed. The ICTAD grade of the contractors ranged from M1-M6. The research design revealed the demand for primary as well as secondary data. Data collection was undertaken through the questionnaire survey and document survey. The relative importance index (RII) and frequency analysis were used as an analysis technique. The contractors were based in the Colombo area. Housing only was considered for the reconstruction activities and the contractor's capacity was considered for the construction industry's capacity. This was the basis for this research.

## 3. Housing reconstruction in post disaster

The aftermath of disasters is mainly concerned with the loss of lives and the damage to assets. The post disaster situation provides the opportunity for many developments. Therefore, the task of reconstruction after a disaster can be of greater challenge to stakeholders. Effective planning and coordination efforts are required for the affected community to survive. Disaster management is a new and innovative method for preparing organisations to address the substantial risk of disasters [5]. Disaster management aims to reduce, or avoid the potential losses from hazards, assure prompt and appropriate assistance to victims and achieve a rapid and effective recovery [2]. The housing sector often becomes of major significance due to the impact caused by the disaster. The reconstruction of houses in the post disaster scenario can be categorised into different periods. Successful implementation and completion can be achieved if such periods are planned and monitored well during housing reconstruction.

## 4. Capacity of the construction industry

Among the many factors that delay the progress of the housing reconstruction, the capacity of the construction industry is one. There is growing recognition of managing disasters through construction. The development of the construction industry can therefore play a beneficial role in successfully managing disasters. The construction industry has to be considered for the organisational capacity in order to develop the industry, since most of the stakeholders can be categorised into an organisation.

In simple terms, an organisation's capacity is its potential to perform successfully, apply its skills and resources to accomplish its goals and satisfy its stakeholders' expectations [7]. Therefore, to improve the capacity of organisations some capacity building activities could be implemented. The definition of capacity building varies depending on the context in which it is being used. According to the International Development Research Centre [3] organisational performance refers to the ability of an organisation to meet its goals and achieve its mission. Better organisational performance can result in a higher organisational capacity.

## 5. Conclusion

It is clear that preparing well for disasters is inevitable to avoid economic losses and loss of human lives in the future. The tsunami was the major cause for the housing reconstruction and yet the demand for housing reconstruction was not met by the construction industry. The current status of housing reconstruction is little above 75% in terms of completed houses at the latest count. Human resource, finance and management are the important factors of capacity building in housing reconstruction. In terms of organisational capacity, the contractors have above average potential capacity in financial management systems, financial ability, diverse and sustainable funding and internal performance analysis. However, in management and staffing capacity, client satisfaction orientation, the contractor's potential capacity are below average and shows the needs for capacity development. The credit facility of contractors shows the steady increase after years of tsunami devastation. The most significant challenges in successfully implementing housing reconstruction are the non-availability of materials and labourers according to the contractors. The remedies to overcome such challenges are planning of material and pre-demand for construction workers.

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# The role of knowledge management in post disaster housing reconstruction

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*A disaster is a serious disruption for the operation of a society, causing extensive losses to lives and property. The most visible consequence of a natural disaster is the destruction of housing. Houses are one of the major outputs of construction industry, especially in a developing country like Sri Lanka. Since construction activities are highly knowledge-intensive, Knowledge Management (KM) and its sub processes will encourage continuous improvement, effective monitoring of initiatives, efficient and effective use of available resources, improved decision-making, and a quick response to beneficiaries, etc. in post disaster housing reconstruction.*

**Keywords:** KM sub process, KM, Knowledge, Natural disasters, Post disaster housing reconstruction

## 1. Background

A disaster is a serious disruption of the functioning of a society, causing widespread human, material, or environmental losses, which exceed the ability of affected society to cope using only its own resources [1]. Disasters are often classified according to their speed of onset (sudden or slow), or according to their cause (natural or man-made) [1]. Natural disasters such as floods, tsunamis, tropical storms, landslides, drought, high wind, rock falls, etc. affect Sri Lanka from time to time.

The stakeholders of post disaster projects are the government, donors, lending agencies, beneficiaries, contactors, and social, environment and religious groups. Routine processes may be adequate for the small-scale disasters, but higher-level coordination is needed for larger scale disasters like the tsunami that affected Sri Lanka in 2004. Further, Gunasekera [2] added that all the phases and activities of a project carried out under normal conditions would have to be carried out when managing projects after a disaster and all phases and activities need to be balanced with the time factor.

### 1.1 Post disaster housing reconstruction

Quarantelli (1995 cited [3]) proposed four stages of housing activity in the recovery process - such as: immediate relief (within hours), immediate shelter (within day or two), temporary housing (preferably within weeks), and permanent housing reconstruction (probably within a few years). Post disaster housing reconstruction is considered by many experts as one of the least successful sectors in terms of implementation [4]. Further, a lack of effective information and knowledge (K) dissemination can be identified as one of the major reasons behind the unsatisfactory performance levels of current disaster management practices [5]. According to Banerjee (2005 cited [5]), a lack of prior K and proper point of reference have turned most of the recovery plans into guessing games, eventually failing without adding appropriate values to the recovery attempts. The demand for efficient knowledge management (KM) to help the agencies improve post disaster housing is widely recognised. Therefore, applicable KM based on actual reconstruction processes will play a crucial role in promoting post-disaster housing reconstruction.

## 2. K and KM

K can be defined as a dynamic human process of justifying personal belief toward the "truth" (i.e. a justified true belief) (Nonaka and Takeuchi, 1995 cited [6]). K sources mean the 'reservoirs of knowledge' [7]. There are two main categories of K sources; they are sources internal to the organisation and sources external to the organisation.

KM: the systematic strategy to collect, store and retrieve knowledge and then help distribute the information and knowledge to those who need it in a timely manner [8]. KM tools can be distinguished as two types, KM techniques (non-IT based tools), and KM technologies (IT based tools).

### 2.1 KM sub processes

The KM sub processes have been identified as locating and accessing, capturing and storing, representing, sharing, and creating [7]. K acquisition is the process that involves imbibing information including making meaning of situations and other stimuli from the internal and external business environment [9]. Nonaka and Takeuchi (1995) defined K production as a continuous, social process, which is a never-ending spiral of tacit and explicit K through K conversion, socialisation, externalisation, combination and internalisation (Sverlinger, 2000 cited [7]). According to Kululanga and McCaffer [9], K sharing encompasses thinking, speaking and perceiving and is not merely 'transferring' K and such a process is called 'creative sharing'. K transfer can be defined as a sub–process of KM that occurs when two or more individuals exchange information, in order to move towards each other (or apart) in the meaning they ascribe to certain events [10].

## 3. Conclusions

KM can be used as a tool to store, retrieve, disseminate and manage information related to post- disaster housing reconstruction. It can be concluded that most of the donors and consultancy firms, involved in disaster housing reconstruction in Sri Lanka, have become involved in tsunami housing reconstruction work compared with other disasters. Further, the respondents were mostly focused on permanent housing reconstruction rather than other types of disaster housing. While competence was the most significant internal K source to the organisation, repositories were the most significant external K source to the organisation. Analysis of the sample revealed that a project-monitoring document was the highly used repository internal to the organisation.

While the e-mail system was used predominantly as an IT based tool for KM, the project reviews, task teams and face-to-face interactions were the most significant non–IT based tools for KM. The findings suggest that the lack of compiling and synthesising the accumulated data, information, and knowledge, storing and organising was the major challenge in managing the K. This may be due to the sense of urgency shown by the parties. The improved performance was viewed as the key benefit of KM in post disaster housing reconstruction.

The KM sub-processes are important in order to: avoid duplication of K creation, store K on local technical people, carry out future disaster reconstruction, change the quality of construction, disseminate K, grow K, get best decisions, get more resources (e.g. attract new donors), give good output to beneficiaries, improve performance, improve relationships, increase organisation's asset, plan better, reduce cost by avoiding repetitive tasks, and save time and energy.

Although the study presents most of the elements of KM, most of the organisations have not implemented KM formally into post disaster housing reconstruction works. It can be concluded however that the awareness of KM is there in the industry to implement KM in post disaster housing reconstruction to improve performance.

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# Post disaster reconstruction as an opportunity for development: women's perspective

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*Many nations have experienced quite a large number of natural disasters during the last decades. Although many systems have been developed for recovery, still they are struggling to manage it effectively. Post disaster reconstruction is a significant period in disaster management where it can provide a window of opportuniy to communities and nations. Since women are one of most vulnerable groups in disasters there is a need to recognise this human resource for their own development and for the community's benefit. This research looks into women's experiences in post disaster reconstruction. The study aims to present their experiences during post disaster reconstruction by considering their roles and challenges in order to understand the importance of post disaster reconstruction on the development of women.*

**Keywords:** Disaster management cycle, Empowerment, Post disaster reconstruction, Women.

## 1. Introduction

Generally disasters are large intractable problems that test the ability of communities and nations to effectively protect their population and infrastructure and, its capacity to recover rapidly [1]. During disaster management, the post disaster reconstruction stage is confronted with many barriers in making the disaster an opportunity for development due to its ineffectiveness and inefficiency. Reconstruction is a rebuilding measure which involves not only constructing physical structures but also building the confidence, self-respect, self-esteem, self-dependency, mutual support and mutual trust as well as rebuilding communities. This long-term process focuses on human and material resource development, coordinated effort towards independence, and sustainability.

Present literature on disaster management emphasises the importance of gender sensitivity in post disaster reconstruction (PDR) [2]. It argues that gender consideration in PDR will help for better targeting of resources to reach people in greatest need; for more accurate service provision to meet actual needs; to decrease vulnerability to future disasters; etc. [2]. The study identifies women's experiences with regard to their roles and challenges related to their development during PDR. In addition this study discusses whether PDR fosters or hinders women's development. This research has been based on theoretical and practical knowledge obtained through a comprehensive literature review.

## 2. Natural disaster management cycle

Generally natural disasters can occur as slow-onset natural disasters such as droughts or as rapid-onset disasters. Although it is difficult to differentiate between different disaster stages, for management purposes there is a standard disaster cycle and each phase merits special considerations. The cycle includes disaster mitigation and prevention, preparedness, emergency, rehabilitation and reconstruction [1]. Previous study defines [3], disaster management as a collective term encompassing all aspects of planning for and responding to disasters that includes both pre and post disaster activities.

During mitigation, activities are related to elimination or reduction of the probability of disaster occurrence or reduction of the effects from unavoidable disasters. During the disaster preparedness phase, measures are under taken to control the impact of disasters through ensuring structured response and establishing mechanisms for effecting a quick and orderly reaction to the event. The stage immediately after the disaster is the emergency response, which aims to provide immediate assistance to maintain life, improve health and support the morale of the affected population. The rehabilitation phase includes medium term interventions such as construction of transitional housing, provision of basic food to the affected population, provision of social services, etc. Finally the reconstruction period includes the long-term and often substantial investment in rebuilding the physical and social infrastructure of affected regions. In disaster management PDR is a process that is the interaction of complex social, technological and economic factors and actions [4].

## 3. Women's experiences in post disaster reconstruction

### 3.1 Women's participation

Generally women's roles in post disaster stages are categorised under three main areas: reproductive roles; community roles and productive roles [3]. Reproductive roles include roles within household and the family. Women's community roles include: maintaining kinship relations; social interactions and ceremonies; communal survival activities, etc [3]. Although these are usually related to reproductive function, there are instances where it includes work related to relief and reconstruction including the physical reconstruction of their homes. Finally productive roles give economic remuneration for manual labour, professional labour and subsistence activities. During the reconstruction phase and especially in temporary shelters, women

take on a triple duty of reproductive work, community organisation and productive work in the informal economy, while men tend to return to their traditional role of waged work outside the home.

### 3.2 Women's challenges

According to the International Labour Organisation report [5], there are four general impacts that disasters have on women's work. Firstly women's economic insecurity increases. Since their productive assets are destroyed they often become sole earners, their household entitlements may decline, their small-businesses are hard-hit and they lose their work. Most importantly the gender stereotypes limit women's work opportunities especially in the PDR stage. In addition due to economic downturns after natural disasters women lose their jobs more quickly and in greater numbers than men [5]. Generally women's workload increases significantly after disaster and their working conditions in the household and paid workplace deteriorate eg. as lack of child care and increased work and family conflicts [5]. This in turn limits women's mobility and time for income generating work.

## 4. Discussion

Reconstruction is a long-term process and it focuses more on human and material resource development, coordinated effort towards independence and sustainability. In order to achieve the above objectives the concept of empowerment can be used as a tool. In reconstruction the most vulnerable and marginalised sections like women, children, the poorest sections of society, etc. are the primary stakeholders who need to be considered as partners in the empowering process. A few earlier disaster experiences reveal that women take an active role in tasks which are traditionally considered as male tasks. This activity can have an effect of changing society's perceptions of women's capabilities. In addition women are most effective at mobilising the community to respond to disasters. Therefore in disaster circumstances, empowerment would enable women to increase their human and economic developmental goals.

## 5. Conclusion and the way forward

Disaster response needs partnership between all the actors in society including the marginalised groups and individuals at all levels. During the PDR phase although women play a major role it has not been recognised yet. Therefore the hidden resilience displayed by women affected by disasters need to be revealed to build upon it. This would entail a conscious strengthening of local knowledge and wisdom, applying appropriate solutions to crises. The concept of empowerment can play a significant role in raising their status. This study has been undertaken as a part of a research study that focuses on the empowerment of women in post disaster reconstruction.

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# Supply chain and material procurement for post disaster construction: the Boxing Day Tsunami reconstruction experience in Aceh, Indonesia

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*Following the Boxing Day Tsunami in 2004, the procurement and supply of sustainable and legal construction material for the reconstruction became the first priority of almost every organisation involved in this process in Indonesia. As a result, the competition for limited resources and the lack of effective coordination between reconstruction agencies has nearly tripled the cost of a standard house and leaving thousands of people in transit living conditions three years after the disaster. Based on the reconstruction experience in the worst affected area, Banda Aceh, this paper will examine the modern literature on supply chain management (SCM) and analyse this process in practice associated with construction material procurement, review the problems inherited in the Indonesian context and analyse the proposed procedures of local and international procurement of construction materials to streamline the supply. Conclusions will then be made for future development and adoption of an integrated SCM concept in post disaster reconstruction.*

**Keywords:** Supply Chain Management, procurement, disaster reconstruction, Tsunami, Banda Aceh

## 1. Literature review

In order to accommodate the growing complexity of construction process, various management systems and methods have been developed in academic researches and well applied in industry practices. Among those, supply chain management (SCM) becomes increasingly popular. A typical supply chain is illustrated in the following model developed by Chen and Paulraj (2004) as "simply a network of materials, information and services processing links with the characteristics of supply, transformation and demand".

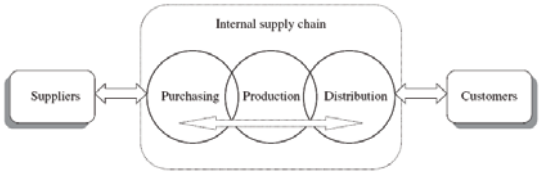


*figure 9: A typical supply chain model (Chen and Paulraj, 2004)*

Traditional practices of supply chain management tend to contract with multiple suppliers even for the same material or component. This is partially due to the consideration of risk reduction with multiple options and avoidance of becoming source dependent. However, reduction of the supplier base is a unique characteristic of contemporary buyer–supplier relationships (Newman 1988, Helper 1991), because the administrative or transaction costs associated with managing a large number of vendors often outweigh the benefits (Dyer 2000). This is especially the case in the Aceh reconstruction given the limited availability of construction materials and often inadequate administrative abilities of reconstruction agencies.

Long-term relationships between supplier and buyer have become a crucial characteristic of modern supply chain relationship (Shin et al. 2000). Through close relationships, supply chain partners are willing to share risks and reward and maintain the relationship over a longer period of time (Cooper and Ellram 1993, Stuart 1993).

Integration is another key word in SCM involving the new building construction process. research has concluded that the effective integration of suppliers into new product development can yield such benefits as reduced cost and improved quality of purchased materials, reduced product development time, and improved access to and application of technology (Ragatz et al. 1997, 2002, Primo and Amundson 2002).

## 2. Supply chain and material procurement experiences in the Aceh Tsunami reconstruction

During the 2004 Boxing Day Tsunami, some 130,000 people were killed in Aceh alone and 37,000 remain missing. These consequent tragedies caused immense economic, social and environmental devastation to Aceh and surrounding areas that were already under the poverty line. It is estimated in an official report (BRR April, 2006) that approximate 123,000 new houses are needed for re-establishment, relocation and resettlement of Acehese tsunami victims, let alone the accompanying tremendous reconstruction of infrastructure in the whole country

A major problem faced by almost every organization involved in the Aceh reconstruction is the supply and procurement of legal and sustainable construction materials, especially the massive needs of timber.

In spite of a moratorium on logging in Aceh implemented pre-Tsunami, extensive illegal logging is currently taking place in Aceh forests. Bribes and illegal payments of inland transportation not only constitute a major cost for timber supply but also

has negative influences to potential timber dealers from outside provinces. There are other specific problems in timber procurement in Aceh, such as the legitimacies of importing timber and associated timber treatment methods. In spite of these difficulties, timber for Aceh reconstruction is still procured legally and sustainably, or at least non-illegally and non-unsustainably, from some sources to some organisations. All of them can be categorized either as locally supplied or internationally imported/donated. The procedures followed in both categories were introduced and reviewed in details in the main paper.

## 3. Conclusion

The needs for improved communication between reconstruction agencies and their material suppliers are well recognized, but hardly addressed. Good communication is the basis for building a long-term relationship with reliable suppliers. This should be encouraged in order to reduce the supplier base and minimise the administrative or transaction costs associated with managing a large number of vendors. Certain certificates or well-designed criteria for pre-qualification will contribute to the supplier selection process and supplier base consolidation (e.g. require timber bidders for Aceh reconstruction to provide valid forestry permits as well as SKSHH before further consideration of their tenders). Integration, another key principle in contemporary SCM, is suggested in the Aceh reconstruction practices at both supplier and logistics levels.

In relating to timber procurement process, the procedures of international and local timber supply for reconstruction in Aceh are reviewed in the paper followed by discussions on alternative ways of using steel trusses or coconut timber as solutions to the current problem. It is suggested that reconstruction agencies should seek every possible way of using local timber sources with policy clarifications and transportation suggestions from local reconstruction authority BRR, while exploring the legal, economic and logistic feasibility of imported timber. In order to facilitate the process, it would be better to have an overall procurement plan for the whole project rather than the range of small ones before starting any negotiation with potential vendors. More studies are required into the use of coconut timber. It remains an attractive potential for rural areas and isolated islands. The possibility of milling and use of seized timber or timber from other sources should also be investigated.

The use of familiar and locally available materials for reconstruction should be encouraged. The sustainability dilemma with the use of timber is the balance between the preservation of the environment and the provision of housing. The supply of timber offshore might provided great relieves at initial response, but in long term, it means that the important economical "kick start" provided by aid in country (and specifically in Aceh) is lost and the aftermath are housed people in a context of greater poverty. This leads into the need for alternatives such as the use of coconut timber and possible substitutions for the major uses of timber in house reconstruction. Recycling certain construction materials from damaged houses remains another possibility since most steel doors and window frames from the disaster were not seriously damaged and are in large demands. Substitutions could be the use of light gauge steel sections, roofing that can span without the need for timber trusses, and different door and window frames. lthough more expensive than timber, steel trusses could be a back up option given the short time and high demand. With a more integrated supply chain, the price could be lowered with mass production. This could be made possible with joint efforts of other reconstruction agencies.

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# SECTION XI

## DEVELOPING THE LAW CURRICULUM IN BUILT ENVIRONMENT EDUCATION

# The Teaching of Law to Non Lawyers

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*Teaching law to non law students can raise concerns of perceived relevance, accessibility, engagement, purpose and pedagogic issues surrounding delivery. This paper considers these matters against the background of law teaching on the RICS (Royal Institution of Chartered Surveyors) accredited rural practice estate management programme at Harper Adams University College in Shropshire. Various teaching methods engaged by the authors are explored, with particular concentration on the introduction of case studies / scenarios at an early stage of studies to ensure that the relevance and practicality of the course, in the context of future careers, is better understood by all students.*

**Key Words:** Law, Teaching, Non-law students, Estate management.

This paper concentrates on teaching law in the context of the requirements of a professional body (the RICS) on an estate management programme. Having established that law needs to be taught for substantive content, to comply with professional, educational and business needs and to develop transferable skills beyond the acquisition of core knowledge - what problems have been encountered in attempting to impart the law syllabus to these non law students?

## 1. Problems

Issues explored are the academic range of entrants (particularly marked in a vocational degree), the perceived irrelevance of law, the perceived difficulty of law and the background and approach of some law lecturers.

An important element in designing and delivering law courses to non law students is a consideration, *regardless* of practical problems, of what the students actually need to get out of their law modules. Reference to subject benchmarking statements, professional guidance (from both organisations and employers) and the experience of colleagues has been drawn on to determine the mix of factual, substantive knowledge and the transferable (NCIHE, 1997) research and

evaluation skills needed on the law modules. Over all of this is a sense that there are key elements to be transferred across the disciplines, which might encompass:

- where the law is to be found

- that the law is constantly changing (Soetendorp, 1999)

- the ability to identify legal issues (Cownie, 2004)

- the ability to go beyond the surface learning of facts, through to a deeper understanding (Marton and Säljö, 1976 and Meyer and Land, 2005)

## 2. Modes of Delivery

The medium of delivery in trying to address some of the problems raised above is then reviewed, encompassing traditional lectures, provided notes, scenarios and case studies.

## 3. Case Study Teaching

The most fundamental development in teaching practice which has evolved to address the problems encountered has been the introduction of the case study as a *starting point* to learning. (That is 'case study' meaning problem / scenario, not in depth study of a legal case.) The aim is to lead the student to see the relevance of their legal studies, to direct the lecturer away from too dry and formulaic an approach, and to help make materials more accessible in giving purpose and focus to private study.

Case studies have traditionally been used after a body of legal rules have been imparted by lecture, addressing none of the issues raised above and resulting in students lacking engagement before they ever get to assimilate the information and attempt to reach the higher level educational objectives of analysis, synthesis and evaluation (Bloom, 1956 and Anderson and Krathwohl, 2001).

One example of such a scenario, in the area of professional negligence with the added complication of contractual relationships, looked at the inadequate report of a surveyor on a domestic property. Rather than starting with the rules of negligence and discussions of decomposing snails in Scottish cafés nearly 80 years ago (*Donaghue v Stevenson* [1932]), students can see immediately that the issues relate to work they may well be undertaking, or be closely involved with.

A second example involved compulsory purchase, drawn from a final (honours) year module called Revenue Law and Statutory Valuation. This is a challenging exercise integrating statutory valuation principles, the development planning system in the UK, valuation methods, and general land law regarding the discharge or modification of restrictive covenants. The students can see how these various facets must be combined to generate a strategy for dealing with the requirements and, indeed, management of the client through the process. Student feedback on this exercise has been extremely positive.

The two case studies show how the complexity of professional problem-solving can be developed from a first year module with its emphasis on two complementary legal strands (contractual and tortious liabilities), to the final year module which seeks to integrate a number of disciplines which make up the modern estate management syllabus. Both case studies are grounded in an appreciation of the professional context in which students and practitioners must apply and interpret the law, while the latter study also provides an opportunity to explore some of the specialised legal decision-making machinery which covers landed interests.

## 4. Conclusion

In conclusion, the teaching of law to a diverse range of students whose primary interests might lie well outside the content of the law modules requires careful thought, planning, a willingness to try a range of teaching and assessment ideas and the grace to alter and abandon 'pet' theories which fail to engage or prove effective.

It is hoped that the combination of course materials and delivery vehicles has, at least in part, addressed some of the problems in the law modules at Harper Adams and may provide some ideas for others.

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# Landlord and Tenant Law for Surveyors – A Problematized Case Study

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*A lawyer new to higher education reflects on the initial delivery of a Landlord and Tenant Law module to Level 2 full time surveyors. The paper identifies specific challenges to learning that this delivery posed. These include the relative inexperience of the lecturer; the amount of syllabus to be covered; the tension created by the twin characteristics of the module, being at the same time both obligatory and, arguably, peripheral to the main degree; the aptitude and inclination of the students; and the teaching and assessment methods implemented. These challenges are contextualised against the assessment performance of the students. Having problematized the delivery, the paper assesses it in the context of current thinking regarding pedagogical 'best practice' for facilitating deep legal learning in non-cognate cohorts and proposes some areas for development..*

**Keywords:** Law, Pedagogy, Non-Law Students, Teaching and Learning

## 1. Context

This paper is a reflection on the delivery of a series of lectures on the topic of Landlord & Tenant law to level 2 undergraduates enrolled on non-law programmes by a novice lecturer. These reflections on practice were prompted primarily by the stark mismatch between the lecturer's expectations of student achievement and actual achievement as demonstrated by the end of course exam. The aim of this paper is to draw out ideas for the future development and improvement of this, and similar, courses.

## 2. Lecture Practice – The Good Points

Considered reflection on my practice does suggest that my lectures - as lectures - had quite a lot to commend them. Moreover, though they may have been manifestations of belief not theory, and were certainly examples of 'flying by the seat of my pants', along the way I stumbled across quite a few practices that are supported in the literature.

I adopted a pretty informal delivery style. I was keen to get input from the students and tried to bring the subject matter to life as best I could. This type of approach is arguably what Eble describes as a 'generous' attitude towards knowledge [18:207] whereby knowledge is freely shared with students, not retained as mysterious arcana by the academic 'priesthood'. Similarly, research into student attitudes and response to varying teaching styles is strongly in favour of *enthusiastic* lecturers (e.g. Hodgson [19], Coats and Smidchens [20], Murray [21]). As Ramsden notes [22:95], 'truly awful university teaching is most often revealed by a sheer lack of interest in and compassion for students and student learning'.

This is not a criticism that could fairly be levelled at me. During course delivery I captured student views on two occasions. First during the fifth session when I sought views via a stop/start/continue exercise [see Race and Brown 23:34] when 22 of the 38 registered students were present, and around 10 provided feedback; and again in the 9th session when I administered a Module Evaluative Questionnaire ('MEQ'). On that occasion 21 of the 38 students were present and 18 provided feedback. No comments specifically regarding lecturing style were captured on the first occasion, but in the MEQ 78% of the students polled noted as a positive the 'engaging' lecture style. This was the most unanimously expressed view by a factor of around 3; 5 other groups of positive points were noted, but each of these polled at around 30%.

I also structured my lectures carefully using diagrams to illustrate points, and picking images to associate with certain concepts. Research confirms that individuals are better able to recall sentences that have meaning than sentences which do not [24]. At a micro-level, this suggests the importance of lecturers using simple language to explain themselves, whereas at a macro-level it suggests the importance of giving students information in a logical and structured way [13]. Bligh further argues that it is not enough that the material actually has a logical structure, that structure must be shared with the students, and consistently and repeatedly referred back to, in a cyclical 'taking stock' exercise, as, otherwise, students risk losing the thread of the lecture [13:70]. There is also support for the use of visual representations to assist explanations, as these are more likely to be retained in long term memory [25], although the effectiveness of such resources depends not so much on the resource themselves but on how they are used [26]. This implies there must be a clear rationale for the choice of resources and a strategy for how they are to be used within the lecture to enhance student learning.

I also provided hand-outs, generally in the form of powerpoint slide printouts. I did not operate consistently with the timing of the provision of these; sometimes I provided them at the end of the lecture on the basis that I wanted the students to concentrate on what I was saying. Whilst the literature is supportive of the use of hand-outs, it is not supportive of providing them retrospectively in this way. Research indicates that handouts should be used to get students to make notes, not just to write down what is being said or to copy slides [27]. Creativity and variety in handout design, including short learning tasks to encourage interaction, enables students to make good notes in lectures [28]. If intended as a guide to the structure of the lecture with spaces to make notes, there is support for issuing these at the beginning of the lecture [13], whereas Neuble and Cannon indicate that handouts which provide additional or more detailed information should be issued at the end [29].

Whilst there remains considerable room for improvement, it is also encouraging that some of my intuitive approaches can be justified theoretically.

## 3. Lecture Practice – The Bad Points

The belief which arguably did most to shape my approach to course delivery was the belief that I had to cover all of the topics in the Module Specification. This document has a broad reach ranging from the doctrine of tenure, through adverse possession, and on into landlord and tenant law. Despite my belief that I had to deal with all items, fitting all that content into 11 two hour sessions was an impossibility and I rationalised coverage (see Fig 1). Nonetheless, I did endeavour to cover as much of the syllabus as I felt was possible.

In both the informal and formal feedback captures referred to above, a recurring feature was that I went too quickly. 50% of those who completed MEQs expressed this view, and this was the most unanimous negative view expressed; 6 other groups of negative views were provided, but with a frequency ranging between 6% and 33%. Fewer responses were provided in the informal feedback exercise - a total of 18 comments provided by around 10 students – but of the eight 'negative' comments, 3 were heartfelt requests for me to slow down. If additional confirmation were needed, my teaching sessions were observed on 4 separate occasions by 4 separate academic colleagues as part of my study for the University of Salford's Post Graduate Certificate in Higher Education Practice and Research. Each of these observers, while commenting favourably on other aspects referred to above, also noted that I was moving quickly through material.

I did incorporate interactive elements into each of my sessions – and these were well received - but my desire to achieve coverage kept such elements within quite tight bounds. Likewise, I did provide guidance regarding assessments, but did not provide an opportunity – in class time – for students to practise their skills. Large amounts of primary legal material was made available on the VLE, but little guidance regarding how best to exploit it.

Engagement with the literature suggests, to quite an extreme degree, that this is precisely the wrong approach to take in the circumstances of my course. Much pedagogical literature centres around the opposition, posited by Marton, F. & Säljö [30], between deep and surface approaches to learning, with the surface approach being characterised by rote learning, and the deep approach being based on conceptual understanding. Biggs [12] emphasises that a teaching approach driven by a desire to achieve syllabus coverage will tend to encourage a surface approach to learning. Bligh's substantive review of the literature relating to the didactic lecture mode indicates that, on its own, the mode is not well suited to promoting deeper levels of understanding noting that 'little thought can take place in a lecture' [13:129]. Fyrenius identifies two stages in the process of understanding; 'sifting', where information is received and condensed, and 'building', where the information received is related to previous knowledge in order to understand it, own it and eventually reshape it [31]. The didactic lecture typically promotes the sifting stage but does not tend to encourage the building.

In opposition to this, the type of learning which is needed in order to perform to a high level in law is deep learning. Allen cites Cownie et al that 'law is an argument not a statement, it is to be debated and discussed' [16], and to engage in a debate a student needs to have absorbed the arguments, merely pushing superficial facts around will not produce a quality response.

Formalised feedback to students was also not factored into my course delivery, save in relation to the one piece of coursework. Yet, it is considered that formative assessment is crucial to knowing how well students understand and to enable continuing development of effective practices in teaching and learning [28].

A final underpinning – but unarticulated - belief that I brought with me to my course delivery was that of the *teacher* being central to the learning process. This is implicit in the approach to course design which I adopted. There is a considerable body of literature which argues for the reverse with the student being placed at the centre of learning (e.g. Ramsden [22]). Maharg [32] highlights the potentially revolutionary implications for legal education of Rogers' argument that that 'the only learning which significantly influences behavior is self-discovered, self-appropriated learning.'

## 4. Conclusion

The reflection on practice informed by theory which this paper represents, however incompletely, enables some conclusions to be drawn which have particular significance for me, as I prepare the next iteration of the Landlord and Tenant module, but which may also have wider relevance for those facilitating the legal learning of other cohorts of non-lawyers elsewhere.

My driving force remains to encourage students to acquire a real understanding of the legal concepts that form the basis of the course; I have no wish simply to dole out 'prophylactic law'. Yet my approach must take into account the circumstances of course delivery, including the amount of student contact time, and the degree of student aptitude and inclination. It is these which must dictate the approach, regardless of the literal extent of the curriculum.

A student-centred approach, in the model of that implemented by Soetendorp and Byles has its attractions. Certainly the focus of delivery should be to encourage the development of understanding in those who struggle with the subject (those to the left of the red line in figure 3). Adopting a less didactic stance, covering less material, but in more student focussed ways, to achieve deeper understanding must be the aim. There must be concentration on encouraging the acquisition of threshold concepts and providing more opportunities for students to practise the skills and knowledge deployment which will be assessed.

It is these considerations which will guide me in my development of the next cycle and this time around I hope not to be 'flying by the seat of my pants'.

# BELFAST: Built Environment Law, *Flowing* Assessment.

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*It is widely recognised by teachers in Higher Education (HE) in the U.K. that learning is more enjoyable and meaningful when motivation to learn is intrinsic and accords with Csikszentmihalyi's 'flow' theory. The paper reviews key literature to construct a conceptual framework on why we assess, what we assess, and how to assess. It reports on a longitudinal study of the developing assessment design of an undergraduate Built Environment Law curriculum that focuses on construction contract law and administration, and a postgraduate Built Environment Law curriculum that focuses on legal studies for the construction Project Manager. The paper includes an examination of those factors external to the learning process that impinge on, and shape, assessment design. The conclusions highlight those things that create educational difficulties and argue that curriculum design for Built Environment Law, that incorporates only informal assessment with inherent flexibility and freedom, can promote intrinsic motivation to study and promote deeper student learning in this discipline.*

**Keywords:** assessment, flow, motivation, learning, impingements.

## 1. Introduction

The idea for the paper was instigated as a consequence of an in-house teaching and learning debate, in the School of the Built Environment, on student engagement and motivation in construction management subjects. There was a strong consensus that new thinking is required on teaching and assessment methods generally to motivate students to engage more deeply with their learning. It was put forward that textually based subjects, such as Built Environment Law, need particular attention because there is an increasing reluctance to read on the part of many students today. The purpose of the paper is to instigate a dialogue on assessment design for Built Environment Law through an examination of assessment practices, and to report on what works, and suggestions for enhancement, in terms of promoting student learning whilst satisfying the demands of the HE system. The term '*Flow*' as used in this paper, refers to the work of Dr. Mihalyi Csikszentmihalyi [1], a Hungarian-born painter and psychologist who gave the term 'flow' a new meaning in his 1990 publication. With the rugby world cup taking place at the same period as the writing of this paper, there have been many references to players and teams '*being in the zone'*. I like to think that this is analogous to the flow experience. As a Built Environment academic, I would argue that our Built Environment assessment strategy should be constructed using a goal of transforming the learning experience into one that *gets students in the zone* and engenders the 'state of flow' during appropriate and significant learning episodes. Our aim should be establish assessment strategies that focus on instilling a deep learning approach by students so that students retain the requisite knowledge and study skills for their professional careers. The paper was informed by the general findings of data collected from the larger study. These data were collected from interviews with academics, carried out in three distinct stages, on their constructions of assessment practices, and from focus group interviews with students on their attitudes to assessment. The data on the development of assessment strategies for Built Environment Law was collected from an ongoing longitudinal study of an undergraduate and a postgraduate module in the discipline.

## 2. Conceptual Framework: the assessment process

Assessment of student learning in higher education is required to fulfil a multiplicity of purposes and play several different and, possibly, conflicting rôles. The same assessment task can be used in a formative way, in a diagnostic way and in a summative way in respect of the individual student learning. The outcomes of this assessment task can be, and are, also used, individually or collectively, as an evaluation of a module, a subject, a programme or an institution. The variety of purposes and rôles played by assessment of student learning in higher education influences the method and type of assessment used. It is proposed that the design, setting and marking of assessment should ensure that the utility of the key, central function of student assessment is not lost to these collateral purposes and rôles, and is properly dealt with. I would argue that assessment is impinged upon and shaped by factors external to the students learning process and, as a consequence, assessment is a compromise and because of this the learning experience is likewise compromised.

## 3. Longitudinal study of developing assessment design for Built Environment Law

The development of assessment of Built Environment Law over the past ten years has been the subject of monitoring research using an undergraduate module and a postgraduate module. This section reports briefly on the changes and developments of these two modules. The rationale for these changes emanated from a study and presentation by McLernon *et al* [2] in which was coined the term 'disguised learning' to describe a means by which students acquire particular knowledge from carrying out a task not expressly related to that knowledge.

## 4. Conclusions

Built Environment Law is a vital component of the body of knowledge needed by the construction professional to operate successfully in the commercial world of construction. Those things that create educational difficulties by interfering with the pedagogy and smooth implementation of proven educational practices should be removed from the curriculum delivery. The goal of deep learning is more likely to occur if students are motivated to learn and enjoy their studies. Students need an

enjoyable incentive to engage deeply with textual studies such as Built Environment Law. An assessment strategy and regime which encompasses the theory of 'flow', which has an element of informality, and which focuses on the optimal attainment of the pre-determined learning outcomes, goes some way towards the achievement of this goal.

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# Injecting Real-Life Law into Construction Education Role-playing in Group Projects

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*Practical applications of principles of law are common in the construction industry. Thus students of construction project management need to acquire relevant basic legal knowledge and practical skills for solving problems with legal implications that they may encounter. Yet, traditional lectures and tutorials still seem to dominate preferred methods for teaching law in construction education at many universities. With the emerging experience gained from the development of legal education, a variety of methods have been experimented with, to facilitate the uptake of legal knowledge and their practice in real-life problem scenarios. One of these is through role-playing. The University of Hong Kong used role-playing in a group project in a postgraduate course on construction contract claims, for developing an authentic type of learning experience. This paper reviews the above, along with other experiences, such as in mock mediations, as well as in role-playing in non-legal courses. Comparing with traditional teaching methods, this paper illustrates how role-playing can be better used in a group project for enhancing the effective learning of law in construction education. In addition, it also highlights some tested approaches to providing feedback and conducting more reasonable assessments of individual students within such group activities that have proved effective at The University of Singapore. Through this paper, it is expected to share useful examples with other construction educators as well, with a view to enhancing the learning processes and outcomes in our field.*

**Keywords:** Legal Education; Construction Education; Role-Playing; Group Project; Assessment

## 1. Teaching Laws to Construction Professionals and Students

Construction professionals need to handle more application of laws now than previously and construction problems usually call for solution by a combined and balanced use of technical knowledge, management skills and legal principles. Hence, how best to bring about interactions among the technical, management and legal knowledge and other considerations encountered on site daily is a real-life challenge to most construction educators.

## 2. Conventional Methods

Like many other countries, lectures are one of the overwhelmingly used methods for primary delivery of course materials for teaching law in undergraduate courses in the built environment in Hong Kong. For teaching 'soft' skills, it has been recognised that conventional teaching styles such as lectures and seminars alone are not always appropriate.

## 3. Role-Playing as a Learning Tool

Role-playing in education is gaining popularity as it benefits via combining the use of problem-based learning and collaborative learning principles. Role-playing has been particularly applied to deliver learning of 'soft' skills, such as problem-solving, critical thinking or presentation, though is has also been applied in teaching other subjects. Both its use and content can be flexible to suit the education needs; it further allows learning from each others, whether as a role-player or observer. Role-playing can also be fun. Traditional use of role-playing goes through 3 stages --- briefing, role-playing and debriefing.

## 4. Experience Sharing

The University of Hong Kong has used role-playing in a group project, in the format of a group presentation, in its postgraduate programme. The question was modeled on real and typical cases of disputes between the employer and the contractor over the areas of extension of time, liquidated damages, valuation and payments. These were contained in four self-standing questions. Students were divided into 8 groups, each being assigned to answer one of the four questions, from either the perspectives of the employer or the contractor. It hence called for a critical analysis of the facts and the application of the relevant legal principles to the facts. The group presentation was followed with question and answer sessions from the instructors and peer students. Each student was also required to submit an individual report, answering all four questions, and was given a group and an individual mark. Keen interests in participation at all stages were shown. Exchange was particularly heated when questions or responses were from the opposite groups answering the same questions. Most of the students were so 'in' their roles, treating the presentation seriously. These benefited all by brining out all potential arguments for full discussion during the debriefing.

The University of Hong Kong has also recently engaged this model in the B.Eng. in Civil Engineering (Law) programme. The focus here was on design presentation and communication skills. Two groups were given a factual scenario of an extension of

time and liquidated damages disputes between an employer and a contractor. Each group acted as an expert witness for the employer or the contractor, being required to prepare proposal and reports and make oral presentations. Their final reports were sent for the other group's response and comments before the final oral presentation. Again, positive feedback was received from the students.

Another example of beneficial group work and role-play is seen in the course, where second years students were assigned in groups of around six to real-life problems from multi-discipline perspectives such as feasibility studies for a potential development, each student acting as, for example, 'architect', 'engineer', or other professionals as needed to model a multi-disciplinary consultancy firm. They were required to prepare reports and make presentations to the client (role-played by the academic and industrial instructors). In another example, year three civil engineering undergraduates are assigned in the groups of eight that include students from the architectural and building services engineering undergraduates to foster an even more real-life inter-disciplinary design project. Judging from feedback, group projects of this sort were welcomed by the students and valuable learning outcomes were demonstrated, help giving them first-hand experiences of working with other disciplines and aligning their approaches to a project from more than one perspective.

## 5. Evaluating Groupwork More Realistically

In relation to the design of assessments for group projects, there were two further initiatives adopted in Singapore by a course leader at the National University of Singapore --- getting students to evaluate their group-mates and getting students to evaluate their peers' performance [1].

In group projects, with the problem of identifying, or indeed discouraging, 'free riders' or 'social parasites [2], it is not always easy to accurately assess the individual's contribution to the overall output. Students may get through the project abusing the extra efforts put in by other group members. However, with confidentiality in the evaluation, by getting students to evaluate their group-mates and telling students up-front about this, it can help discourage, if not weed out, such free riders. This method can be summarized as getting a student's own group mates to evaluate his/her performance during the *process* of preparing group project work.

Another method is to get students to evaluate their peers' *output* performance, getting students in parallel groups to evaluate the performance of the group of students who are presenting their project *output* to the class. The marks awarded by them account for a significant portion of the student-presenter's continuous assessment marks, and the student-evaluators are given marks for making an objective evaluation. As student-evaluators will only score marks if their ratings are within the specified range from the instructor's, they have to think critically, learn to respect other people's ideas and make sure that their evaluations are not affected by leniency or their own biasness. Students who are presenting need to defend their work and 'sell' their ideas; and through this process learn communication skills.

## 6. Conclusions

This paper provides a review of the experience in Hong Kong, Singapore and some suggestions and feedback on how role-playing, as an education tool, can be better used in a group project for enhancing the effective learning of law in construction education, with a view to enhancing the learning processes and outcomes.

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# SECTION XII

## DESIGN

# Design Management System with the Collaboration for Curtain Wall Design Work

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*In this study, we aim to establish a product model for Curtain Wall information management with which participants in its design—the designer and Curtain Wall engineer/technician—can share in the decision-making process and design information with one another. The proposed model is a preliminary study for the establishment of a design management system that allows the parties involved in the design to determine the information flow and conduct a continuous and consistent management in the decision-making process. In this study, we investigated the theoretical concept of collaborative design management system.*

**Keywords:** Curtain Wall, Product Model, Collaborative Management, Design Management System

## 1. Background and Goal

In this study, we aim at establishing a product model for Curtain Wall information management with which the parties involved in the design—the designer and Curtain Wall engineer/technician—can share and collaborate in the decision-making process by considering in advance the issues in the actual design stage before the Curtain Wall construction.

## 2. Research Scope and Process

In this study, we implemented the following methodologies: (1) performing a theoretical investigation on the collaborate ground for the Curtain Wall design management; (2) performing a theoretical investigation on the concept of *Problem Alternative Solution*; (3) establishing a Curtain Wall information model based on the concept of *Problem Alternative Solution* for sharing engineering information and performance D/B in the design stage; (4) analyzing Curtain Wall design management information; and (5) proposing a product model using the information created, referred to, and discussed in the Curtain Wall design process based on the analytical results and Problem Alternative Solution.

## 3. Theoretical Review

### 3.1 Collaboration in the Architectural Design Stage

Collaboration is a broad concept, and includes judgment, decision-making, dialogue, and feedback after a decision has been made. Terminology such as collaboration should be considered essential when managing curtain wall work for a high-rise building, which has complex processes that require many participants to communicate with one another frequently.

### 3.2 Concept of Problem Alternative Solution

The Problem Alternative Solution is the concept of improving linkage between the existing PMIS (Project Management Information System) and the KMS (Knowledge Management System), to support decision-making in the project being implemented. The PAS derives the optimal solution from the diversity of alternatives suggested, in order to solve the problems that arise during the process of decision-making. Fig. 1 is a diagram of the concept of the information model, based on the Problem Alternative Solution.

## 4. Analysis of the curtain wall product information

### 4.1 Considerations in Decision Making for Curtain Wall Performance

This chapter discusses the main decisions to be made related to characteristics of the curtain wall by each participant in the curtain wall design stage based on the curtain wall process model and influential factors on decision making. Of all the characteristics of the curtain wall, the characteristics that affect the whole building design and the curtain wall design are found as wind pressure, air infiltration, water penetration, sound insulation, thermal insulation, moisture condensation proof, fire resistance, seismic-resisting and smoke characteristics.

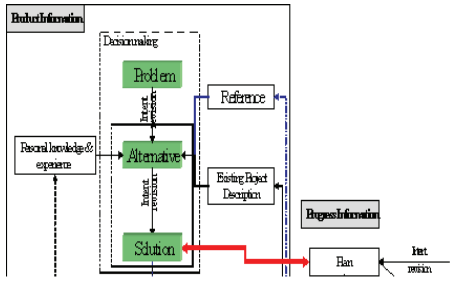


*Figure 10: The concept of the Problem Alternative Solution-based information model*

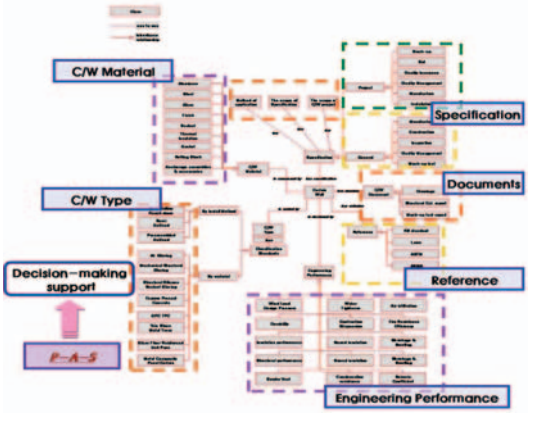


*Figure 2: The Product Information Model*

### 4.2 Proposal of Curtain Wall Product Information Model

The curtain wall information consists of the standard specification, particular specification, materials to be used, design standard, the curtain wall time, a variety of documents and references. The product model proposed in Fig. 2 comprises of five parts: the curtain wall type class related to the curtain wall type, the curtain wall document class showing the curtain wall drawing and related documents, the engineering performance class showing design standards for the curtain wall, specification class showing specification information of the curtain wall and the reference class used as references in decision making for material and design standards. In calculating the wind pressure, the calculation method recommended by the KS(Korea Standard) takes the region and conditions into consideration, but there are no Standards for other items, or although there is KS for them, people are using the ASTM (American Society of Testing Materials,) AAMA (American Manufacturers Association), and JIS (Japanese Industrial Standards)

## 5. Conclusion

In this study, we proposed a product model with which the participants in the design of the Curtain Wall design and construction process will be able to effectively use and manage the flow of information involved in designing the Curtain Wall. The product information model proposed by this study presented a simultaneous execution method, not a serial design method, in the design process for each design party by proposing a collaborative method through the sharing of information and enhancing the communication in the decision-making process of the Curtain Wall design stage.

## 6. Acknowledgements

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# Universal Design for People with Disabilities: A Study of Access Provisions in Public Housing Estates

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*Freedom of movement from place to place is recognized as a basic human right. Everybody regardless of his/her age and physical condition should have proper and convenient access to certain places in their daily lives. In order to ensure that all residents including those with disabilities can access to places that the public is entitled or allowed to enter or to use, adequate provision of unobstructed access is required. In Hong Kong, Disability Discrimination Ordinance and the code for Barrier Free Access Design are two major pieces of legal control regulating unobstructed access. In this paper, a comprehensive review of these requirements or other relevant regulations is conducted in order to identify whether there is room for improvement in the building laws regulating access for people with disabilities (PWDs), to aim for Universal Design. In addition, this paper also presents the result of a study which has investigated the accessibility of PWDs in public housing estates serving the majority of Hong Kong population. This case study is valuable to identify the inadequacies of current access provisions for PWDs and highlight the areas requiring further improvement. Based on the review of existing legislative controls and the case studies, some possible solutions for improving present building regulations are generated.*

**Keywords:** Barrier free access, Universal design, Public housing estates, Building Regulations

## 1. Introduction

The main purpose of this research is to review the current regulatory controls on unobstructed access, and investigate the accessibility of PWDs in public housing estates serving the majority of Hong Kong population.

## 2. Controls over unobstructed access for PWDs

### 2.1 Disability Discrimination Ordinance

The Disability Discrimination Ordinance (DDO) Cap.487 was enacted in 1995 and became fully operative in December 1996. It ascertains that PWDs have their entitlement to an equal right on accessibility. In addition, it prohibits discrimination against PWDs for failing to provide reasonable means of access to any premise that the public or a section of the public is entitled or allowed to enter or to use, or for refusing to provide appropriate facilities.

### 2.2 Design Manual: Barrier Free Access

Apart from DDO, the Buildings Department, in administering the Buildings Ordinance, also issued a design guide called Design Manual: Barrier Free Access 1997 (BFA). Compliance with the BFA is deemed to have satisfied the statutory requirements for barrier free access under the Building (Planning) Regulations. Basically, the BFA sets out design requirements for new and substantially altered buildings. It also aims at providing proper access to appropriate facilities in a building for PWDs. The design manual not only encompasses obligatory design requirements but also recommended design requirements to better provide a "Universal Design" environment for the PWDs. In 2006, an updated version of the design manual "Final Draft Design Manual: Barrier Free Access" was issued by the Buildings Department for consultation. It is still a consultation paper not yet implemented as part of the regulatory control .

## 3. Universal design in public housing estates

The new draft design manual not only encompasses obligatory design requirements but also recommended design requirements to better provide a new concept of "Universal Design" environment for everyone. Universal design is a relatively new concept that emerged from "barrier-free" and "assistive technology" [5]. Universal design takes into account of other issues such as the aesthetics and appeals to a wide range of consumers. It provides a broad-spectrum solution not just for people with disabilities, but also for everyone. Therefore, apart from the BFA code used in Hong Kong, this study also referred to barrier free design codes used in other overseas countries to look for ways to better provide a "Universal Design" environment for the PWDs.

## 4. Research methodology

To achieve the aims of the project, a methodology for carrying out this project was formulated and it could be described in 4 stages as follows:

- Establishment of local/ overseas regulatory controls

- Selection of typical public housing estates;
- Preparation of checklists;
- Carrying out of checkwalks; and
- Data analysis

## 5. Data analysis

After summarizing the survey results of domestic blocks and communal areas of all concerned estates, the team members found out that the estate which was built in 1990s, has minimum defects comparatively while the rest of them has some common defects in the aspect of accessible design. For the housing blocks, the defects include substandard ramp at lobby entrance, large door threshold of the flat entrance, deficient signage for exit, no tactile strip at landings and at bottom and top end of staircase, no raised directional signs on handrails, insensitive detection device and no infra-red sensor, no audible signal and verbal annunciation for lift car, lack of indication system for lift and no visual alarm signal at prominent locations. For the communal area, the defects include substandard ramps, missing Braille map and tactile guide path, presence of narrow corridors, and substandard lift provisions in terms of the height of control button, the sensitivity of detection sensor and notification of both audible signal and verbal annunciation.

## 6. Recommendations

In this paper, priority lists are recommended for existing buildings because the Research Team takes into consideration practical needs, difficulties in rectifying existing works, and any special situation. There is no justification for future newly built public housing estates not to comply with the latest BFA code. In this paper, the Research Team also suggested lists of recommended items for future improvement in all estates. The assessment exercise will also provide feedback to the new development design team to refine or improve their design for new buildings. The recommendations in this paper should be taken up to review the existing standard designs for public housing, and to look for design solutions that could incorporate the recommendations in their future housing designs.

## 7. Conclusion

This study was a meaningful exercise to investigate the accessibility of PWDs in public housing estates that affected a large proportion of residents in Hong Kong. Although the generalized results and the specific recommendations may not be based on thorough inspection of all detail areas, the study is carried out with reasonable sampling for statistical analysis.

## 8. Acknowledgement

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# Towards a more 'robust' technology? Capacity building in post-tsunami Sri Lanka

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*In fast urbanizing economies such as Sri Lanka, the construction industry tends to fragment into almost separate spheres of production with little or no reciprocal connection in training, know-how and career development paths, and consequent limitations in internal knowledge dissemination and technology transfer. This type of industrial compartmentalization is detrimental to the social acquisition of skills, and restricts the operational frameworks of given technologies, especially in low-cost sectors. Against this background, the paper speculates on how design can act as an engine of social and economic growth for those involved in its production.*

**Keywords:** Developing economies, Design practice, Robust technology, Capacity building

## 1. Reconstruction challenges

The tsunamis that hit Sri Lanka in 2004 caused an unprecedented natural disaster with huge loss of lives and severe devastation to infrastructure. Many believed that reconstruction efforts would spur the Sri Lankan economy and give a fillip to the stagnant construction industry battered by the country's 20 years of war. However, a question lingers as to whether the construction industry was mature enough to facilitate effectively the massive rebuilding process required. After 3 years from the disaster, the people who have been made homeless are still residing in refugee camps or temporary structures, while most townships remain plagued by damaged buildings and ruined infrastructure.

Natural disasters and war conflict combine with economic restructuring and urbanization pressures, particularly in developing/transitional economies. Yet responding to these challenges is not going to be easy. If one looks at the whole spectrum of activities carried out within the building industries of developing economies, the relationship between product supply and product demand varies highly in social efficiency. Institutional and professional responses to urbanization and population pressures have largely ignored the spatial needs of the poor, and allowed the proliferation of informal settlements as a social pressure release mechanism. The planning and implementation of social housing and infrastructure - the supply of which was traditionally seen as a government prerogative - have not risen to the challenge. Market-based commercial development, by contrast, is being strongly encouraged by the government, and facilitated through zoning, land use concessions and tax cuts. Architectural design, for its part, has been limited to few individual buildings identified mostly by high patronage or by top-end tourism.

This paper is the first result of a thesis-in-progress that, on the basis of the type and amount of building work carried out in Sri Lanka at the moment, is considering ways to overcome the inherent misallocation of intellectual energy behind it.

## 2. Labour pools

The point to start is informal labour. In Sri Lanka, in fact, the formation of construction labour and the consequent transfer of knowledge across the industry occur largely through informal relationships. This is so mainly for two reasons. The first reason is that the majority of construction work is still organized via traditional networks led by a small-scale, one-man contractor and craftsmen manager, conventionally known as the 'baas'. These individual contractors establish informal organizations of limited size and rely on a few skilled workers competent in all the aspects of traditional building construction, with a larger team formed around them. The acquisition of skills takes place informally on the job, through the relationship between stable and temporary employment, thus generating a tacit working knowledge of building.

The second reason is that rural-urban migration has led to a progressive growth of the informal sector by generating a steady supply of unofficial workers, characterized by low capital-labour ratio, lack of job protection, dominance of self-employment, easy entry, and low productivity [1].

When considering both the formal and informal linkages serving the construction process in Sri Lanka, the building industry provides employment to more than 1,000,000 people [2]. These numbers include the staff of around 2,000 ICTAD-registered building contractors, and 100 consultancy/design organizations belonging to state and private sectors. In addition, over a dozen major institutions provide assistance on construction industry issues. Yet, the industry's involvement in public-sector development has been minimal in recent times, especially when compared to the scale of construction work required to upgrade the battered socio-physical conditions in many parts of the country.

## 3. Workforce fragmentation

The informal nature characterising the social structure of building production in the country combines with the failure of the industry as a whole to respond appropriately to current challenges to suggest that new analytical models of the sector may be needed, not only to appreciate the structural limitations of the present situation but also to delineate adequate policy responses that could help Sri Lanka take advantage of the situation rather than becoming a victim of its own opportunities.

Workforce dynamics are likely to occupy a central place in this discussion. With regard to internal migration patterns, an early model introduced by Lewis foresees a one-stage process of labour transfer where, with unlimited human supply, migrant workers from low-productivity rural jobs are absorbed into high-productivity urban industrial jobs [3]. Other authors, on the other hand, are more inclined to envision a two-stage migration process, whereby migrants first enter the 'urban traditional sector' (informal sector) due to their limited access to the 'modern sector' (formal sector), and then acquire the necessary skills that will eventually enable them to graduate to the formal sector [4].

Yet the research conducted for this thesis in Sri Lanka shows that both positions lack the necessary dose of realism under actual market conditions. The reason is simple: the construction industry is fragmented into almost separate spheres of production, with little connection in training, know-how and career development paths, and consequent limitations in cross-system application of technology transfer. In such a context, the advance of labour from entry-level informal workers to skilled workers does not occur as smoothly as labour scholars may have implied: construction workers tend to find themselves confined to insular activity pockets, characterized by the building markets they serve and the original social status that brought them there in the first place.

Attempts to stretch these boundaries almost inevitably lead to sensitive technological environments, i.e. environments characterised by sub-standard or inadequate application, performance or use of specific technologies. Such compartmentalization, with its associated repercussions, is detrimental to the social acquisition of skills, and needs to be overcome.

## 4. Robust technology

Defying such fragmentation requires defining technical options that can tolerate changes in the economic variables of projects on the one hand, and manage the intricacy of buildings' cultural and technical attributes on the other. A 'robust' technological framework, that is, which can adapt to the level of complexity required and the level of expenditure possible in a project without penalizing the expected performance of the building, neither culturally nor technologically.

Within this perspective, the architecture of a robust framework must incorporate, normatively, a series of performance parameters:

(1) The ability to save money and time by avoiding the use of scarce, expensive and labour-intensive materials and processes, thus making the components and subsystems cost-effective and environmentally responsive compared to other systems available in the market;

(2) The ability to allow for greater flexibility in production, assembly and use by making the components and subsystems to be scalable, and be coupled/decoupled as required to accommodate specific design and technological performances;

(3) The ability to tolerate errors in design, manufacture, assembly or use, and to achieve resolution of a problem via logic of construction and clarity of erection, without the necessity for care and precision in the making;

(4) The ability to ensure that the failure of one module or element of a system does not trigger a chain of failures;

(5) The ability to provide adaptable environmental performance;

(6) The ability to build workforce capacity by establishing easy transfer of knowledge through social acquisition of skills;

(7) The ability to establish broad collaborative links across the construction industry.

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# Cooperative Design Process in the Renovation Projects

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*In the design stage, the insufficiency in the ability to utilize the input information by project participants and improper decision making cause various problems in the subsequent construction and ultimately make it difficult to accomplish a renovation project that fully satisfies the residents. Therefore, the design of renovation is a very important stage to ensure a comprehensive understanding of the project performance process as well as the recognition of the design management technology. For this purpose, we aim to provide design work process in integrated respects and the role and responsibilities of every participant in the project, subject to the renovation design stage.*

**Keywords:** Renovation Project, Cooperative Design Process, Participants Roles, Decision Making

## 1. Background

### 1.1 Research Objectives

The major difference between renovation design and new construction design is that it is difficult to obtain the design information of an existing building, and any change in the design information occurs in the minute examination and judgment process. Moreover, the design of the structural reinforcing methodology is necessary to be progressed in detail from the design development stage. In this respect, the design management of a renovation project goes through a complex design process in which major requirements are simultaneously considered in the planning stage and the renovation workability in the construction stage.

Therefore, in this study, we aim to propose a basic project performance system for design management by analyzing the information the design work process subject to the planning →feasibility study→ design stages with various participant respects. The major contents proposed in this study are the following. First, we aim to set specific roles and responsibilities for all project participants and propose a general process for such projects in this study. Second, we will aim to establish a utilization method for the input information in order to propose an effective information management system for the renovation design in the after study.

### 1.2 Research Scope and Process

In this study, we aim to examine the basic process involved in a project in the renovation design stage and analyze the role and responsibility in the project of those in charge by each progressive stage. The performance method and the progress of this study are described in next paragraph.

(1) Study of the process in the renovation design stage

(2) Comparative analysis work flow in the new construction design and renovation design

(3) Analysis of the roles and responsibilities of project participants at each renovation stage

(4) Constitute integrated renovation design process.

## 2. Design Cooperative Process and participants

### 2.1 Renovation Design Process

A renovation design project can be classified into four stages: project ordering stage, planning stage, examination and judgment stage, design stage and construction stage. The following Table 1 describes the major business details of the general renovation business in design stage.

### 2.2 Cooperative Design Process

For Project participants in each stage of the renovation design have their own responsibilities and roles and the work is performed in consideration of their professional relationships in terms of cooperation, direction and supervision. In particular,

regarding the architect, the relevance between the construction design part and the structural design is very important and structural supervision is performed separately to ensure a consistent structural review during the construction.

Removal works generally proceed with construction documents stage together to reduce the project's duration. In this case, a special construction methodology review for the removal of building elements related to remodeling and extension of the renovation should be considered prior to the construction documents stage.

*Table 11: Major business details by renovation design stage*

| Stage | Major Work Contents |
|---|---|
| **Schematic Design** | - Understanding of the renovation requirements<br>- Review of the current status of the existing structure, performance and the plane figure |
| **Design Development** | - Review of the actual measurement of the plane of the jobsite and understanding of the major details of building components and checking of the bill of quantities of machinery facilities |
| **Construction Document** | - Confirmation and approval of the details of the basic design<br>- Confirmation of the uniformity and budget with the finishing methodology and structure of the design plan in various construction work areas |

### 2.3 Roles of project participants

For the implementation of the renovation project, each project participant will have particular responsibilities and level of authority by work stage. The following table (Table 2) outlines the responsibilities and level of authority of the project participants in the renovation design development stage.

*Table. 2: Role and Responsibilities of the Project Participants*

| Phase | Work Contents | Owner | project manager | architecture | contractor | occupants |
|---|---|---|---|---|---|---|
| **Design Development** | decision methodology | A | A/C | R | C | I |
| | cooperate management | - | A/C | R | C | I |
| | design development VE | A/I | R | C | C | I |

R: Responsibility, A: Approval, C: Consulting, I: Information

### 2.4 Cooperative Design Process

In the basic design stage, which follows the schematic design stage, detailed secondary examination and judgment are conducted. The design work progresses by pre-screening the dimension, column space, floor elevation, and compatibility of the systems, and by considering the structure, engineering, electricity, communication, etc. in the construction work, along with the architect. At this time, cooperative design is promoted by necessarily checking the mutual interference among construction works.

## 3. Conclusion

The major contents of this study, it determined the roles and responsibilities of the project participants. And it presents a base study on design work process with various participant respects.

Renovation business is promoted in very various forms according to its conditions such as the characteristics of the project, the owner's ability and the job site conditions etc. Therefore, this study is expected to be utilized on the whole or in parts according to the characteristics of the project's requirement subject to apartment buildings. It is expected that consistent performance of the study will contribute to the improvement of the efficiency of the design work as it informatizes the project management system of the renovation business as well as systemizes the utilization process of the design information by the project participants.

## 4. Acknowledgements

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# SECTION XIII

## INTERNATIONAL AND COMPARATIVE LAW IN THE BUILT ENVIRONMENT

# Special Features and Experiences of the Construction Industry - Arbitration in Sri Lanka

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*The construction industry in Sri Lanka covers complex and comprehensive field of activities involving many operative skills and conditions, which vary considerably from one project to another. The dispute might arise at any point during the construction process. Arbitration is a voluntary procedure available as an alternative to litigation . Construction industry needs a fast and cost effective methods for dispute resolution. In this regard the Arbitration Act No 11 of 1995 of Sri Lanka was enacted by Parliament of Sri Lanka, which became law on 1st August 1995.*

**Keywords**: Arbitration, Disputes, claims, Litigation, UNCITRAL Model

## 1. Background

The construction industry in Sri Lanka covers complex and comprehensive field of activities involving many operative skills and conditions. The dispute might arise at any point during the construction process.

## 2. Arbitration as a Dispute Resolution method

The main feature of arbitration is that it is consensual in nature and private in character. Most countries have legislative provisions which enjoin the court to facilitate the process of constituting the arbitral tribunal. Arbitration is a voluntary procedure available as an alternative dispute resolution method to litigation, however it is not enforceable as the means of settling disputes except where the parties have entered into an arbitration agreement. It originated as a method of resolving disputes quickly and without legal formality.

### 2.1 Arbitration Act of Sri Lanka and its Procedure

The Arbitration Act of Sri Lanka No. 11 of 1995 provides for a legislative framework for the effective conduct of arbitration proceedings as well as the most practicable mechanism for the enforcement of arbitral awards thereby making arbitration a viable and expeditious alternative to litigation for the resolution of commercial disputes. This Act treats arbitration in the field of construction without taking in to consideration the value of contract or the disputed amount. A stated in the preamble of this Act stated one of its objects is to make "Comprehensive legal provisions" for the conduct of arbitration proceedings and the enforcement of arbitral awards. The second object is to make legal provision to "give effect" to the principles of the Convention on the Recognition and Enforcement of Foreign Award of 1958 (The New York Convention). Hence Sri Lankan Act to a great extent follows the UNCITRAL Model Law.

Sri Lanka Arbitration Act provides that an arbitration agreement shall be in writing. It can be contained in a single document or in an exchange of letters telexes, telegrams or other means of telecommunication which provide records of the agreement. It also mentions challenge to jurisdiction, duties of the arbitrators , corrections and interpretation of statues and documents etc.

## 3. Loopholes of Arbitration Act of Sri Lanka

Most Arbitration Acts (including those following the UNCITRAL Model law) usually allow these parties to change the substantive law to be applied, if it is a transactional contract. The Arbitration Act of Sri Lanka goes a little further.[1] When there is an arbitration clause ,the aggrieved parties concerned cannot seek a remedy in courts because in such case the jurisdiction is ousted by virtue of the arbitration agreement.[2] An arbitration agreement must be in the duly prescribed up or formulated form . There should be in the standard form an arbitration clause (in Institute of Construction Training and Development of Sri Lanka (ICTAD) The ICTAD's Condition of Contract category provides an arbitration clause No.67 for building disputes). According to the arbitration agreement recommended by ICTAD the period for commencement of an arbitration must take place within a maximum of 90 days. In accordance with the ***Federation Internationale Des Enginieurs*** (FIDIC) the maximum period to appoint an arbitrator is 154 days to arrive at the final decision. Sri Lankan present Arbitration Act does not specify a time limit . However Sri Lanka all disputes arising out of contract agreements should be dealt with in accordance with the provisions of Arbitration Act No: 11 of 1995.

The Sri Lankan Courts refused to incorporate the arbitration agreement into a subcontract.(3) Arbitrators may keep away from writing reasons for the award . Only the final decision of the Arbitrators will be enough for a valid award. This will be very useful for the settlement of disputes relevant to construction industry.

## 4. New Trends by case law in Sri Lanka

**Mahaweli Authority of Sri Lanka Vs. United Agency Construction (Pvt.) Ltd.** (4) case was an appeal to the Supreme Court from an order of the Commercial High Court under section 37 of the Arbitration Act No: 11 of 1995 and it decided the time period necessary for leave to appeal to supreme Court.

**Southern Group Civil Construction (Pvt.) Ltd Vs. Ocean Lanka (Pvt) Ltd.** (5) was application for setting aside arbitral award under Section 32 of the Arbitration Act of Sri Lanka . The Supreme Court of Sri Lanka stated to need to set out in the application the grounds for setting aside the award period for making the application – whether grounds set out in written submission after lapse of that period can be considered. Hence those two cases were strengthed the arbitration procedure in Sri Lanka

## 5. Conclusions and Recommendations

Sri Lanka arbitration process has become very adversarial and expensive.(6) It is important to review and improve the process.

The serious criticisms against the arbitrations in Sri Lanka is the time factor. The Arbitration agreement incorporated in the ICTAD Conditions of contract under Clause No. 67 stipulates that the period within which the award should be made in 4 months. The present Arbitration Act does not specify a time limit. Parties are free to fix a desired time period for proceeding and award the agreement. However this may be an extension if done with the consent of the parties. According to the arbitration agreement recommended by ICTAD the period for commencement of an arbitration must take a maximum of 90 days ( Clause 67) and in accordance with the FIDIC the maximum period to appoint an arbitrator is 154 days. Hence the time factor remains a major drawback in the arbitration process. When we consider about disputes in the construction field, concerning or involving subjects relevant to Architecture, Engineering and Law , appointment of a Lawyer, Architect and an Engineer to the Arbitral tribunal may be very appropriate.

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# The EU model: An integrated approach to water protection and management in the built environment?

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*The environment that buildings occupy cannot be divorced from the structures themselves and it is vital that consideration is given to the impact of the construction process and the subsequent occupation and operation of buildings upon the environment. Regard needs to be given not just to the physical impact of these activities, but also to the potential social and economic consequences. In the context of water protection and management, new approaches have recently been adopted that look at a more integrative approach. In particular, the Water Framework Directive represents a revolutionary shift in the way the European Union addresses water legislation. This paper considers two aspects of the Directive's possibilities to act as an integrative force. Firstly, it examines the provisions for river basin management in the Directive, in the light of modern definitions of 'integrated river basin management' and secondly, the paper aims to identify features within the Directive that contribute to effective inter-instrumental integration, integration between the individual media and inter-agency integration; all of which have been identified as key elements in achieving an overall aim of internal integration.*

**Keywords:** Regulation, Environment, Water, Integration, River Basin Management

## 1. Background

River basin management entities generally now aim for 'integrated river basin management', although the terminology used is varied and somewhat confusing. Some commentators prefer to use the terms 'comprehensive' or 'holistic' [1] management and others draw distinctions between the different terms [2]. For the purposes of assessing the plans for river basin management within the Water Framework Directive, 'integrated river basin management' will be taken to include the five basic components identified by Downs et al [3], namely, water, channel, land, ecology and human activity. In addition, integrated river basin management should require consideration of all dimensions of water (surface water, groundwater, quality and quantity), the interaction between the water system and other systems (e.g. land and air) and its interaction with social and economic development [2]. This not only reflects an eco-systemic approach but also recognises the relationship between land use and water resources. Quite evidently, the idea of integrated river basin management, as it has developed and expanded in scope, has become increasingly complex, with a requirement to consider and to balance a multitude of often competing factors. In fact, it has been argued that this difficult and unwieldy task has led to disappointing results in effective management [1] and that a less comprehensive approach is necessary to gain practical success [2].

## 2. The Water Framework Directive

The framework for river basin management set out in the Water Framework Directive does embrace some of the features of the modern day concept of integrated river basin management. However, there are some glaring omissions, most notably a specific requirement to consider the interaction with other media, in particular with the land. Also, importantly, there is no elaboration within the instrument on how the river basin plans and programmes of measures are to serve the integrative aim. It should, however, be remembered that more comprehensive systems of integrated river basin management have been criticised for their complexity and lack of practical workability. Indeed, it has been suggested that, certainly at operational level, although an integrated approach is necessary, attention should be directed to a smaller number of variables that account for a large proportion of the problem [6]; an approach that may well be adopted by the Environment Agency in the United Kingdom. Nonetheless, land use planning should not be regarded as an expendable consideration when selecting the variables to be taken into account in river basin planning and management.

## 3. Internal Integration

The framework for river basin management outlined in the Water Framework Directive could not, therefore, be said to fully match the modern approach to integrated river basin management. However, although there is no specific requirement for inter-media integration within the river basin management planning process of the Directive, there is potential for this to be fostered through various other facets of the legislation. The remaining part of the paper assesses the Water Framework Directive's potential contribution to the general end of 'internal integration'. This aim should be distinguished from that of 'external integration', which is the most common usage of the term integration in EC law terms and refers to the integration of environmental considerations into other sectoral policies and activities. Faure defines 'internal integration' as cross-media integration in decision-making [4] and contends that this is crucial for effective environmental protection [4]. He identifies two key aspects of internal integration: cross-agency integration (both vertical and horizontal) and instrumental integration

## 4. Inter-Instrumental Integration

There is a clear aim and role for the Water Framework Directive in contributing to inter-instrumental integration. The Directive, as its name suggests, sets a framework for attaining good water quality in all nature of water bodies and, therefore, consolidates by repealing (in due course) a number of existing measures dealing with specific water environments. A good many legislative instruments are kept in place, although these are firmly tied to the Water Framework Directive. The requirement to identify and make provisions for the protection of drinking water and protected areas is illustrative of the inter-instrumental integrative capacity of the Directive. The overall approach taken in the Directive, in order to tackle point and

diffuse source pollution, is one of attaining the stricter standard between the legislative instruments that remain and the Framework Directive, thereby assuring a good level of integration between different pieces of water legislation. The Directive also takes a dual approach to protection of the water environment, requiring whichever is the stricter of emission standards or quality objectives to be met.

## 5. Inter-agency Integration

Inter-agency integration in both directions is fundamentally dependent on the inclusion and participation of relevant stakeholders. The provisions for public information and consultation contained in article 14 of the Water Framework Directive will, therefore, be of key significance in attaining successful integration in this regard. Essentially there are three forms of public participation contained within the Directive each entailing a different degree of stakeholder involvement; information supply, consultation and active involvement. In terms of vertical inter-agency integration, this can potentially be achieved by the means of active involvement of stakeholders on a multi-level basis (e.g. representatives of national, regional and local authorities) and likewise horizontal integration can be achieved by engaging stakeholders and the public in active involvement, but there is no absolute requirement for such a level of involvement in the Directive. How Member States approach the issue of encouraging active participation will be crucial in attaining the necessary inter-agency integration.

## 6. Conclusions

In summary, the scope of the Directive, in terms of contributing to internal or inter-media integration, is limited by its focus almost exclusively on one medium. Arguably, the Directive does have the potential to deliver on the European Commission's integrative aims in terms of bringing in all elements of water and consolidating existing legislation under a new and comprehensive piece of legislation, but it fails to succeed in inter-instrumental integration by virtue of failing to recognise the inter-relationship between water, air and, in particular, land use. The Directive does address the issue of stakeholder involvement. However, as is the case with so much of this framework measure, the comprehensive guidance on best practice in this respect is to be found in a non-binding guide to implementation. Reservations expressed by the UK Environment Agency suggest that the level of active involvement of stakeholders on either a horizontal or a vertical plane is likely to be limited.

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# Causes of Insolvency and Unethical Practices of Contractors in Pakistan Construction Industry

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*This study identifies the causes of insolvency in the construction industry and the unethical practices that may lead to such causes of insolvency in the industry. As contractors are the players who are most at risk, their inputs regarding the above issues were examined. To achieve the study objectives, a questionnaire survey was carried out to collect the relevant information. Questionnaires about issues relating to causes of insolvency and unethical practices were sent to 90 contractors. 30 questionnaires were eventually returned and ten face-to-face interviews were completed. After checking through the completed questionnaires, 30 questionnaires were found to be suitable for the data analysis. Eleven causes of insolvency were identified from the literature review in this study. These are diversification, absence of barriers, family firms, management buy-outs, cash flow problems, overtrading, poor financial control, knock-on effect, overwhelming contract claims, imprudent diversification and onerous conditions of contract. Five issues that significantly caused insolvency of contractors in the industry were identified and explained. These are absence of barriers, cash flow problems, poor financial control, knock-on effect and onerous conditions of contract. It appears that all these five causes, with the exception of absence of barriers, can be caused by unethical practices. The study suggests that the construction industry should pay heed to ethical behavior and practices in order not to jeopardize the financial stability of contractors in the supply chain. Special attention should be paid to the five significant causes of insolvency highlighted in this study to render the construction industry less onerous for the contractors.*

**Keywords**: Construction, Contractors, Insolvency, Unethical practices, Pakistan.

## 1. Introduction

Projects are complex because they involve many human and non-human factors and variables [1]. The project process can be influenced by changing variables and unpredictable factors that could derive from different sources. These sources include the performance of the parties, resources availability, environmental conditions, involvement of other parties and contractual relations [2]. As a consequence, the projects may face problems possibly causing delay in the project completion time. It is commonly accepted that the construction industry has for many years been criticized for not developing consistent projects that are on time, within budget and with high quality standard [3]. Generally, failure to deliver successful projects has been considered in relation to schism between design and construction, lack of integration, lack of effective communication, uncertainty, changing environment, and increasing project complexity [4, 5].

The term "insolvency" means the financial failure of individuals and companies and their position before and after the start of a formal insolvency procedure [6]. There are two different categories of insolvencies, namely short term insolvency and long term insolvency. The former means that there is a cash flow crisis where not enough money is coming in to meet a company's outgoings and the latter means that the company is able to pay its debts as they fall due but its balance sheet shows a deficiency of assets over liabilities [7]. The objectives of this study are first to identify and examine the causes of insolvency in the construction industry and second to identify and examine unethical practices that may lead to causes of insolvency in the construction industry in Pakistan.

## 2. Research Methodology

The research instrument used in this study is a questionnaire. A total of 90 questionnaires were sent to contractors randomly chosen, together with a covering letter explaining the purpose of the study and assuring them of anonymity. A self addressed, postage paid envelop was supplied with each questionnaire. The questionnaires were mailed to the president, vice-president, general manager or estimating manager of each company. Recipients of the letters were asked to complete the questionnaire themselves or to pass it to someone else in their company who are qualified to respond.

## 3. Background of Respondents

32 contractors responded to the survey and 10 face-to-face interviews were completed. After checking through the completed questionnaires, 30 questionnaires were found to be suitable for data analysis. This yielded a response rate of about 33.33%.

60% of the respondents were project managers. 30% of the respondents were senior managers. 10% of the respondents were directors of their organizations. As a majority of the respondents were professionally positioned at management level or higher, a certain level of accuracy in the data collected was assured.

## 4. Analysis of Issues Causes Insolvencies

These five significant causes of insolvency are indicated: Absence of Barriers; Cash Flow Problems and Poor Financial Control; Knock-On Effect; Onerous Conditions of Contract.

## 5. Unethical Practices and Insolvencies

Besides asking the respondents to rate their opinion on which issues they think would mostly cause insolvency, they were also asked to rate whether unethical practices will lead to the occurrence of these issues. The results from the survey show that out of the 30 respondents, 21 of them who think that absence of barriers to entry into the industry has caused insolvency in the industry have also felt that unethical practices do not lead to the occurrence of this issue.

It can be noted that for "absence of barriers" to entry, the respondents felt that it is likely to be caused by an unethical practice that fail to reconcile with the sub-contractor's concerns (mean score of 2.81). As for "cash flow problems", the respondents felt that these are likely to be caused by the unethical practice of the main contractor deliberately delaying payments (mean score of 1.93). As for "poor financial control", the respondents may feel that it is likely to be due to the misrepresentation of financial status by the main contractors (mean score of 2.17). This suggests that the main contractor may have created an impression for the contractors in making them think that they are financially stable when in actual fact, they are not.

## 6. Conclusion

Out of the eleven possible causes of insolvency in the industry, five were identified as most significant causes by the respondents. These are the absence of barriers to entry, cash flow problems, poor financial control, knock-on effect and onerous conditions of contract. All these five significant causes have a response rate of more than 70 percent. In addition, the respondents also perceived that all these five significant issues that will cause insolvency may occur because of unethical practices. According to the respondents, unethical practices such as deliberately delaying payments, misrepresentation of financial status, etc. are likely to lead to the occurrence of insolvencies among contractors. It is therefore important for the construction industry as well as main contractors to pay heed to ethical behavior and practices in order not to jeopardize the financial stability of contractors in the supply chain. Special attention should be paid to the five significant causes of insolvency highlighted in this study to render the construction industry less onerous for the contractors. Finally, as this study only surveyed contractors, future works can be extended to survey the consultants on the ethical behavior and practices of the client.

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# Contractor's Right to Stop Work on Non-Payment: A Comparative Perspective from Hong Kong

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*Cash flow is the lifeblood of the construction industry worldwide. Yet, unlike many other jurisdictions, Hong Kong does not yet have any security of payment legislation or any solid plan for the same. Hence, the right of contractors to stop work and terminate the contract in case of non-payment is essentially a matter still regulated by the ambit of the common law. In the circumstances, such unique features of Hong Kong also present a case worthy of investigation from a comparative perspective, in respect of the contractor's dilemma as to whether to continue working without payment. Through reviewing recent case examples in Hong Kong and other jurisdictions, this paper examines and compares the legal landscapes regulating the right to stop work on the part of contractors in non-payment situations. In addition, it also seeks to highlight those factors affecting the exercise of such a right that those who find themselves in such situations, or those who need to deal with such situations should be alerted to, in order to guide appropriate approaches to their resolution.*

**Keywords:** Non-payment; Security of payment; Repudiation of contract; Hong Kong

## 1. Lifeblood in Construction Industry

The construction industry in Hong Kong has gradually recovered from the economic recession in the past 3 years. However, the inherent features of the construction industry, when coupled with the extensive use of further sub-contracting, still renders cashflow critical for most small and medium sized contractors in Hong Kong, as in elsewhere.

When faced with the situation of non-payment during the progress of the works, the contractor may naturally wish to suspend or stop the works pending receipt of proper payments. This, without express contractual entitlement to do so, is often a breach or even a repudiation of the contract. Payment disputes may need to be referred to litigation or arbitration and are further complicated by the use of "pay-when/if-paid" clauses, allegations of defective works or delay to completion of the works, and set-off or abatement claims for contra charges or other deductions. However, the contractor is often still under an ongoing obligations to proceed with the works and invalid suspension or stoppage of works on site can expose it to disastrous consequences.

## 2. Law on Right to Stop Work

At common law, there is no general right in common law to suspend work if payment is wrongly withheld, as illustrated in the cases of *Lubenham Fidelities & Investment Co. Ltd. v. South Pembrokeshire District Council* (1986) 33 BLR 39, *Mersey Steel and Iron Co. v. Naylor, Benzon & Co.* [1884] 9 AC 434, and the New Zealand case of *Canterbury Pipe Lines Ltd. v. The Christchurch Drainage Board* (1979) 16 BLR 76. Hence, non-payment, in itself, does not normally amount to a repudiation that can be relied on to discharge the innocent contractor from further performance of its part of the contract. Much will depend on the facts and all circumstances have to be assessed to search for an intention not to be bound by the contract evinced from the defaulting party. Uncertainty and complications are further highlighted in *James Shaffer Ltd. v. Findlay Durham & Brodie* [1953] 1 WLR 106, *Sweet & Maxwell Ltd. v. Universal News Service Ltd.* [1964] 2 QB 699 and *Woodar Investment Development Ltd. v. Wimpey Construction U.K. Ltd.* [1980] 1 WLR 277, where it have been held that a party who *bona fide* relies upon an express provision in a contract in order to rescind or terminate a contract, should not, by that fact alone, be treated as having repudiated his contractual obligations if he turns out to be mistaken as to his rights.

Partly to cater for these problems associated with non-payment, legislative solutions have been introduced in various common law jurisdictions, since the UK Housing Grants, Construction and Regeneration Act 1996, providing contractors with a statutory right to suspend works on non-payment of contractual sums otherwise due, which is exercisable via a notice procedure. Legislation similar to the above have been enacted in various other common law jurisdictions, such as in Australia, Singapore, New Zealand and (soon) in Malaysia. However, Hong Kong does not yet have any security of payment legislation or any solid plan for the same. Hence, from the perspectives of common law principles, Hong Kong is a case worthy of investigation, from a comparative perspective, in respect of the contractor's dilemma as to whether to continue working without payment.

## 3. Approach in Hong Kong

Obviously, the starting point of a contractor's right to stop working on non-payment must be the contract and the commonly used standard form of contract in Hong Kong does provide for the usual two-notice procedure for determination of the contract by the contractor for non-payment of certified payments. Termination of the contract under clauses like this is often described as contractual termination, as distinct from common law termination.

In respect of terminating the contract at common law, the Hong Kong Court of Appeal has in the recent decision of *Creatiles Building Materials Company Limited v. To's Universe Construction Company Limited* [2003] 2 HKLRD 309 reviews the legal principles. The payment terms in that sub-contract to apply spray coating to a building provided "…*balance by each 14 days interim payment during work-in-progress*". When not getting paid, the sub-contractor therefore left the site and claimed for repudiation of the sub-contract on the part of the contractor. The contractor argued on whether interim payment was actually due under its understanding of the method of working in the sub-contract. In the judgement of Cheung JA, the Hong Kong Court of Appeal re-affirmed that there was no general right in common law to suspend work if payment was wrongly withheld but also accepted that the authorities clearly recognised that a deliberate refusal to make an interim payment was capable of amounting to a repudiation of the contract. After review of cases in other jurisdictions, the Court of Appeal concluded that "…*[u]ltimately one has to examine the facts of the case to see whether the non-payment amounted to a repudiation*", stating that "*[t]he principle is to consider whether the circumstances of the non-payment show an intention not to be bound*". The Court of Appeal also observed that, when the sub-contractor started work, the contractor was obviously aware that the plaintiff's method of working and rejected the defence of the contractor since there was indeed far from being a *bona fide* misconstruction of the terms of the contract and the reasons given were considered to be spurious reasons.

The approach of *Creatiles Building Materials* has been considered in a subsequent case of *Hongkong Underground Engineering Ltd. v. Welcome Construction Co Ltd* [2005] HKEC 1264, which concerns a specialist sub-contractor in underground tunneling work, where Sakhrani J was of the view that the payment of sums that are "…*simply a figure plucked out of the air without any calculation…*" can amount to an intention not to be bound by the contract.

## 4. Factors for Review

The legal approach that can be drawn out from the above cases is quite clear, though the application may be more complicated as being highly facts-sensitive. What matters most in deciding whether there is a repudiation for non-payment, thereby capable discharging an innocent contractor from continuing the work, depends on an evinced intention not to be bound by the contract, rather than the mere fact of non-payment itself.

From the above, there appear to be certain indicators or factors, as listed below, to watch out for:-

- Whether there is clear indication of refusal or inability to effect future payments;
- Whether there is a repeated pattern to pay the correct amount despite warnings;
- Whether there is a repeated failure to pay on time despite warnings;
- Whether payments already effected is of amounts with certain contractual basis;
- Whether there is response or reasonable response to support the refusal or default in payment;
- Whether there is prior or subsequent inconsistent knowledge or conduct against the alleged *bona fide* reliance upon the payment term to refuse timely or correct payment, based on mistaken understanding of the concerned term;
- Whether the reliance upon the understanding of payment term to refuse timely or correct payment is or otherwise can be *bona fide*;
- Whether there are other consequences evincing an intention not to be bound by the contract.

## 5. Conclusions

From reviewing recent case examples in Hong Kong and other jurisdictions, some factors affecting the exercise by the contractor of the right to stop work in non-payment situations can be identified and are presented in the format of a checklist of questions. It will be prudent to make reference to these to better assess and respond to such situations, avoiding pitfalls and effectively protecting the legal rights and interests of themselves or their clients.

# Impact of the 'Security of Payment' Act in New South Wales on clients, contractors and subcontractors

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*The Building and Construction Industry Security of Payment Act 1999 (NSW) ('the Act') was introduced primarily to improve security of payment for small scale subcontracting firms. Nevertheless, the aim of the study was to examine the impact of the Act on subcontractors, contractors and clients in New South Wales ('NSW'). Data for the study comes from a review of relevant literature by authors in the 'security of payment' field, on-going research by the authors, data collected and published by the NSW Department of Commerce, and face-to-face interviews conducted by the authors with three expert adjudicators in NSW. From subcontractors' perspective, the impact of the Act has been largely a positive one with subcontractors' being highly successful at adjudication. Contractors', on the other hand, have been exposed to 'ambush' claims by subcontractors, which is viewed as an unintended result of the strict time demands the Act places on the parties. Whilst no direct evidence is available to reliably establish the impact (if any) of the Act on client organisations, there is an emerging trend that clients' most commonly schedule to pay $ nil in response to payment claims. Further research is needed to establish the reasons for this trend.*

**Keywords:** Adjudication, Impact, New South Wales, Security of payment

## 1. Background

The main reason for the introduction of the *Building and Construction Industry Security of Payment Act 1999* (NSW) (hereafter referred to as 'the Act') was to improve security of payment for small scale subcontracting firms by eradicating the practice of clients and contractors of arbitrarily delaying or denying payment [1]. While subcontractors are seen as the main benefactors of the Act, the provisions of the Act also extend to contractors, suppliers of materials and suppliers of services, who also experience security of payment problems.

It is generally accepted that parties in the construction industry who seek payment under a construction contract for work carried out, services rendered, or materials supplied, experience consistent failure in receiving payment [2]. This practice not only affects profitability of those parties but it also causes serious cash flow problems, particularly to smaller firms [3].

This paper examines the impact of the NSW Act on the main parties to the New South Wales construction industry, namely, subcontractors, contractors and clients. Data for this paper comes from the literature review, on-going research by the authors and the information on the operation of the Act published by the NSW Department of Commerce.

## 2. Impact on Subcontractors

The underlying objective of the Act is to give subcontractors (as claimants) a right to make, and a process to recover, progress payments. Subcontractors, particularly the small ones, are expected to benefit most from the provisions of the Act.

Accepting that the aim of the Act was to improve security of payment of chiefly subcontracting firms, it was anticipated that subcontractors would be the most frequent claimants under the Act. This hypothesis was verified by the literature. Two surveys carried out by the authors in NSW show between 53% and 71% of all claimants to be subcontractors [15]; [16].

In-depth knowledge of the Act not only help subcontractors (as claimants) to comply with relevant provisions of the Act in their effort to improve the probability of a successful adjudication outcome, but it may also encourage them to use the Act to their advantage. Kennedy [19] alludes to the 'ambush' scenario employed by claimants in the UK construction industry. He describes two instances of ambushes: (i) when a payment claim is made against the respondent at the most inconvenient time for the respondent or (ii) when a claimant makes a payment claim prepared over a period of time, which is supported by a large volume of information and documentation. For the purpose of gathering data on the issue of ambushes, the authors conducted face to face interviews with three expert adjudicators in NSW. The expert adjudicators agreed that this practice is employed by both subcontractors and contractors.

Another example of the alleged abuse of the Act by claimants is referred to as 'adjudicator shopping'. Davenport [20] reports that when a claimant is dissatisfied with the result of an adjudication determination by one adjudicator, the claimant is free to submit the same claim to a second adjudicator, hoping for a better result. Davenport [20] does not explain whether 'adjudicator shopping' is wide spread. However, his reference to a number of legal cases implies that 'adjudicator shopping' is mainly exploited by contractors.

## 3. Impact on Contractors

The most prominent role of contractors under the Act is that of respondents to payment claims made by subcontractors. Both subcontractors and contractors (as claimants) are generally highly successful in adjudication of payment claims. However, contractors (as respondents) are largely unsuccessful at adjudication.

It emerges that claimants of larger payment claims, who presumably are contractors, have been less successful than claimants of smaller claims. The reason for large payment claims being less successful in adjudication than smaller claims is unclear. It may well be that such claims are either more vigorously defended by clients, or that they are inflated or both.

Brand & Uher [3] reported that claimants are assisted by law firms or claim consultants in the preparation of large payment claims. If claimants seek assistance of law firms, it is logical that respondents would do the same. The presence of lawyers or claim consultants in mounting a response to a large payment claim would support the proposition that large payment claims are more vigorously opposed, which could account for their lesser success in adjudication.

## 4. Impact on Clients

At the time of writing, no direct evidence is available to reliably establish the impact (if any) of the Act on client organisations. In addition to being subject to ambush claims and adjudicator shopping in the same way as respondent contractors, it emerges that clients most commonly schedule to pay $ nil in response to payment claims.

The likely reason for this trend is related to contractors' superior knowledge of contract conditions, which enable contractors to make a realistic assessment of subcontractors' entitlement to payment under the contract. Alternatively, since clients will often withhold payment as a result of a dispute with a contractor under the main contract, it is possible that clients employ the same approach even when a payment claim is endorsed as a payment claim under the Act. It may be that clients are not aware that, since the Act is only concerned with payment claim disputes in relation to a construction contract; other disputes between the parties cannot be used as a reason for withholding payment. Finally, it may also be that clients' reason for scheduling to pay $ nil in the payment schedule is their reaction to what they perceive to be an ambit payment claim. In any event, further research is needed to provide an objective explanation of this trend.

## 5. Conclusion

From subcontractors' and contractors' perspective, the impact of the Act has been largely a positive one; subcontractors and contractors (as claimants) have been highly successful at adjudication under the Act, particularly those making smaller payment claims.

For respondent contractors and clients, the impact of the Act has been much less positive. In general terms, respondents to adjudication are largely unsuccessful, although respondents tend to fair better in response to larger claims in terms of the proportion of claimed amount determined to be paid. However, of greater concern for respondent contractors and clients is the emerging practice of subcontractors and contractors (as claimants) submitting 'ambush claims', which arise by virtue of the strict time constraints imposed on the parties by the Act, and the practice of 'adjudicator shopping' by unsatisfied claimants to a previous adjudication. Both of these practices, whilst not illicit under the Act, were not intended to arise, and so considered abuses of the Act.

No direct evidence is available to reliably establish the impact (if any) of the Act on client organisations. In addition to being subject to ambush claims and adjudicator shopping in the same way as respondent contractors, it emerges that clients most commonly schedule to pay $ nil in response to payment claims. Reasons put for this trend are that clients are likely to have superior knowledge of contract conditions and superior knowledge of the Act than contractors. However, further research is needed to firmly establish the reasons for this trend.

## 6. References

Omitted – see full paper, Impact of the 'Security of Payment' Act in New South Wales on clients, contractors and subcontractors in the Proceedings for the corresponding reference information.

# The meaning of the protection of the architects title in European countries

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*The title 'Architect' is legally protected in many countries. Only designers who have successfully completed the required academic education can be registered in the Architects' Register and use the title. The purpose of this regulation is to give some basic quality assurance to consumers when hiring an 'Architect' for their design work. This should also contribute to the general quality of the built environment. In addition, it enables architects to work more easily in other EU countries. However, the requirements for registration as Architect differ considerably in the various countries. In some countries just the academic education is required, in others registration can only follow after a certain period of working in practice, sometimes with a prescribed programme. An extensive survey under young Dutch Architects that took part in a structured practice programme and others that just started in the working at the ordinary way, made clear that some years of experience adds considerably to the competences.*

**Keywords:** Architects, title protection, profession, education

## 1. Introduction

In most countries not everyone that designs buildings is allowed to call himself an Architect. The title is then legally protected. The requirements for registration vary among countries. Sometimes candidates can register with their diploma of the appointed academic courses. In other countries an additional post-academic period is needed in which the candidate architects gain experience in the architects practice and may have to follow some additional courses. The purpose of this regulation is to give some basic quality assurance to consumers and also some basic contribution to quality of the built environment in general. In addition, it also enables architects to work more easily in other EU countries. Since 1985, EU Directive EEC 85/384, also known as the European Architects Directive [1] has regulated the legal position of architects in the European Union. The directive's greatest asset is its provision for the mutual recognition of qualifications in architecture in EU Member States. The purpose of this provision is twofold: to safeguard the freedom of movement of architects within the EU, and to guarantee that architects from the different member states have the same basic skills and competences. Since the requirements for registration varies in the countries, it is useful to examine the value of the post-academic requirements. What is the contribution to the competences and skills of the young architects of some years of practical experience and how should this be structured? These questions arose in discussions about the functioning of the Dutch law to protect the title of Architects. The responsible secretary of state had the intention to abolish his responsibility for the quality of the professions of Architects. He initiated an evaluation [2]. The conclusions were very clear: most of the people in the field were positive about the use of the legal protection, but they also found that the quality requirements of the protected title should be expanded with practical experience and 'life time learning', a professional code of conduct and indemnity insurance. Since then a study was undertaken to get an overview of the regulations in fifteen EU countries. This was followed by a series of discussions by a group of some 15 Dutch top architects to define the required qualifications of young architects to be ready to work as a professional. In 2003 an experimental structure for professional experience of young architects was set up by the State architect. About 40 young architects followed a programme that consisted of working in practise, the mentorship of an experienced architect and a series of workshops. After The Experiment was finished it was evaluated [3]. The opinion of the participants of The Experiment and mentors were compared to those of young architects working in ordinary architects' practice without any specific programme. This paper is build upon the results of the above mentioned studies. The purpose is to present some striking evidence of the use of a structured period of professional practice or internship that is of great value for young architects.

## 2. Professional requirements for architects in member states of the European Union

Although the European Architects Directive provides a common basis for the mutual recognition of diplomas and certificates from certain educational institutions, we encountered wide variations in the requirements regulating the (quality of the) architectural profession in different Member States. (See, Orbasli and Worthington 1995 [4] and Priemus et al 2001 [2]). This section focuses on the how the current European Architects Directive is implemented in the Member States? A comparative overview is given of the similarities and differences between the 15 Member States in this study. More than 350,000 architects are now active in the 15 member states, but their legal position varies greatly. The EU member states can be divided in five groups with regard to the legal position of architects, varying from a wide ranging regulatory system to no legal regulations.

## 3. Experiment with structured internship in the Netherlands

In 2005, a two-year experiment came to an end in the Netherlands in which young architecture graduates were given the chance to gain experience in a structured way in every field of architectural professional practice. It was known as The Experiment. This consisted of a programme of experience on a structural basis for two years, under the guidance of a personal mentor and a series of study meetings. The Experiment was evaluated [3]. This involved questioning the young architects and mentors taking

part, as well as a large comparable group of young architects who entered regular practice without following any specific programme. It is precisely that comparison between participants and non-participants which has provided an insight into whether a period of structured practical experience offers added value. The evidence found in this Dutch Experiment for the added value of various elements of eduction and gaining experience. This can be compared to the results of other international studies, see e.g .Glasser D.E. 2000 [5].

## 4. Conclusion

The answer to the question of whether there should be regulations that deal with the legal position of architects on a European level is 'yes'. The work of architects affects the daily life of many Europeans, a fact that is appreciated by the European Council. The current directive does not require a uniform standard of education and quality for architects. It has flaws with respect to ensuring the quality of architects as well as for the free movement of these professionals. These flaws will become far more important when the new directive on the internal market comes into effect. The aim is to require that an architect working in a country other than his own should comply with the regulations of his country of origin. But the current patchwork of national regulations will make this very difficult, not only for architects, but also for the (quality of) the built environment and for consumers. The recent expansion of the EU will undoubtedly contribute to a more complex (or even unworkable) situation. Therefore, it is important to regulate this professional group with a certain consistency across the continent. The current EU regulatory framework fails to realise this consistency. The directive should focus more on the essential demands on the quality of architects. The educational institutions and their respective degrees that are recognised in the EU member states should be reconsidered. Although the member states have various educational systems, in general the title of architect can be obtained in one of two ways: either through a university course of study or attending a school of (higher) vocational education. On average it will take seven to eight years to become a skilled architect. Not only the educational demands but also the demands on practical experience should be established in the Architects Directive. To guarantee these qualities additional requirements can be made in the directive concerning continued education, a professional code of conduct and indemnity insurance.

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# An American perspective of the suitability of the SOCL's protocols provisions for dealing with concurrency on Australian construction projects

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*Concurrent delays on construction projects have been described as being the most conceptionally challenging aspect of delay analysis. Few of the standard forms of contract commonly used give guidance as to how the issue of concurrency should be addressed or analysed. Two organisations (the UK's Society of Construction Law and the USA's Association for the Advancement of Cost Engineering International) have produced guidance documents in the form of a Protocol and a Recommended Practice respectively, aimed at addressing the issues associated with delay and disruption on construction projects that contains an approach for dealing with concurrency. The aim of this pilot research, which was supported by the Chartered Institute of Building Australasia, was to obtain the opinions of those involved in the production of the USA's recommended practice of the adequacy of the clauses of the standard forms of contract for dealing with concurrency, and the suitability of the Protocol's proposed method for dealing with concurrency, for adoption and use on Australian construction projects*

**Keywords:** Claims, concurrency, delay, extension of time, protocol, recommended practice.

## 1. Introduction

Concurrency is a major issue should delays occur on construction projects. It has implications concerning the awarding of liquidated damages (LD's) and the granting of extensions of time (EOT). When a single event occurs on a construction project that results in delay and/or disruption to the project completion date, one party is normally entitled to compensation typically in the form of an extension of time (EOT), and/or a claim for loss and/or expense due to prolongation, or entitlement to liquidated and ascertained damages (LAD). Entitlement is normally dependant upon establishing who was responsible for the delaying event, determining how the risks have been allocated by the provisions of the contract, and determining an amount of compensation in the form of time (EOT) or money (loss and/or expense/LAD) as appropriate compensation. Typically, if the contractor is responsible for the event, and they have agreed to accept the contractual risk, and provided the contract stipulates, the contractor would incur liquidated damages in accordance with the contractual provisions as a result of any delay to the project completion date (known as an inexcusable [1] or non excusable delay [2]). If the client or owner is responsible for the delaying event, and it is one in which they have agreed to accept the contractual risk, and provided the contract stipulates, the contractor would be entitled to an EOT in accordance with the contractual provisions for a period equivalent to the delay to the project (excusable delay [1]). They may also be entitled to a claim for any loss and/or expense incurred as a result of the prolongation of the project caused by the delaying event (compensable delay [1]). Where the delaying event is the responsibility of neither party (a neutral event), and one where they have both agreed to share the contractual risk allocation, and provided the contract stipulates, the contractor would normally be entitled to an EOT equivalent to any period of delay to the project, but not a claim for any loss and/or expense (excusable delay [1], [2]).

Individual occurrences of such events are normally dealt with in this way.

### 1.1 The concurrent position

Difficulties arise where two or more events occur at exactly the same time or sequentially, that have the effect of delaying and/or disrupting the project completion date. This is known as concurrent delay, and has been defined as "*two or more delays that occur at the same time, either of which had it occurred alone, would have affected the project completion date*" [3], and has been described as "*probably the most conceptually challenging aspect of delay analysis*" [4]. The difficulty is in apportioning responsibility for the combined effects of the events on the construction project in terms of time and money, in accordance with contractual provisions that rarely recognise or address the issue of concurrency sufficiently and adequately. Things are further complicated due to the fact that each of the concurrent events could have a different degree of consequence on the project, making it difficult to quantify and apportion damages (in terms of time and/or money), again with little guidance from the terms of the contract as to the most appropriate method of analysis. The range of techniques that are available for use in quantifying the effects of concurrency adds to the problem. Taken individually, each event could result in a different amount of delay and/or disruption to the project. When combined, the difficulty is in determining what proportion of delay and/or cost should be allocated to each event?

## 2. Protocols and recommended practices

In an attempt to rectify the lack of clarity that exists in standard forms of contracts for dealing with such issues, two organisations (the UK's Society of Construction Law (SOCL) and the USA's Association for the Advancement of Cost Engineering International (AACE)) have produced guidance documents in the form of a Protocol and a Recommended Practice.

### 2.1 The protocols approach

The protocols approach is for the contracting parties to pre-agree:

In terms of concurrent delay, that "where contractor delay to completion occurs concurrently with employer delay to completion, the contractor's concurrent delay should not reduce any extension of time due" [5].

### 2.2 The recommended practice approach

One of the major factors identified by the RP as having a significant impact on the determination of concurrency is contractual definition. The general rules, exceptions and considerations of the RP are applicable to the extent that they do not directly contradict contractual definitions and specifications.

In addition to the contractual variable, the RP lists a further five factors that influence the identification and quantification of concurrency:

- Whether concurrency is determined literally or functionally;
- Whether concurrency is determined on the cause or the effect of delay;
- The frequency, duration and placement of the analysis interval;
- The order of delay insertion or extraction in a stepped implementation;
- Whether the analysis is done using full hindsight or based on knowledge-at-the-time.
- The use of CPM concepts for the reliable identification and quantification of concurrency is stated within the RP as being universally accepted, and as such the RP's approach is heavily influenced by the various CPM techniques available.

The RP also introduces the concept of 'pacing' delay.

## 3. Conclusion

Concurrency is considered to be one of the major issues involved in delay and disruption disputes, but was not seen solely as a protocol issue, but a legal issue governed by caselaw and precedent.

The courts (in the USA) are unlikely to be influenced by documents such as the Protocol and its approach and recommendations concerning concurrency and will continue to develop and follow legal precedent on a case by case basis.

The current clauses of the standard forms of contract rarely address the issue of concurrency adequately.

The protocols approach was considered to be fundamentally correct, and that it has raised the profile of concurrency as an issue in relation to delay and disruption claims, but its content needs to be expanded to suitably address concurrency (and other issues), and include a suitable means of determining concurrency rather than simply defining what it is.

The development of a recognised industry standard approach to concurrency in relation to delay and disruption claims acknowledged and recognised by owners and contractors would be beneficial for the industry.

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# SECTION XIV

## ENVIRONMENTAL MANAGEMENT

# Methodology to manage the sociological interplays of actors in sustainable urban projects

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*We developed a methodological framework allowing us to model the actions carried out collectively and individually by the project group. This methodology takes its origin from the strategic analysis suggested by Crozier and Friedberg. It aims objectively to anticipate convergences or "interplays of co-operation" and divergences or "interplays of conflicts" between the main participants in urban development. The project group, as a sociological system, exists by the interdependence of participants and actions whose objectives can converge or diverge. Individual strategies are analysed to determine the collective actions necessary for success. The municipality can then organize the running of the project in accordance with the participants' inherent stopping points. Our approach places each player within the environmental management of an operation. The tool developed on this methodological basis makes it possible to display several sociograms representing direct influences between participants and the impact of each participant on the objectives of an operation.*

**Keywords:** Environmental management, strategic analysis, sociology of organizations

## 1. General context of the study

Since the launch of the programme "Ecology and Habitat" by the "Construction and Architecture Plan" in 1993, operators in the field of construction have progressively mobilised to promote the environmental quality of buildings.

However, although the operators in the field of construction wish to make a real response to the challenges laid down during the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992, the environmental management of sustainable constructions is no longer in itself sufficient at the level of buildings alone, but must perceive itself in a wider global concept of the " habitat" at urban level. Our "Habitat" may indeed play a decisive role in bringing out new forms of association making it possible, on a daily basis, to reconcile preservation of the environment with economic efficiency and social equity.

The work presented within the framework of "BEAR 2008" forms part of the direct consequences of research developed from the project "ADEQUA " and the expert reports commissioned by a number of municipalities.

## 2. Proposal for a system of management by participants

The proposed methodology aims to place the participants at the heart of our approach before moving on to the technical performance levels that are to be achieved within the framework of this type of operation. We will draw our inspiration from the theory of the strategic player as well as the strategic forecast. The strategic analysis proposed by Crozier and Friedberg allows us in effect to model the actions led collectively and individually by the project group. The system exists through the very interdependence of actions and participants, whose own objectives may converge or diverge. Our method of analysis aims objectively to anticipate the convergences or "interplays of cooperation" and the divergences or "interplays of conflicts" between the principal players in the urban development operation.

This tool makes it possible to display a number of sociograms, schematic representations of the relationships between the players, ie. disputes, alliances, dependences, etc. The results drawn from the matrices of entered data are represented in the form of a matrix of Direct and Indirect Influences (MIDI) summarising the interactions between the participants.

## 3. Case study: the Mérigotte NEIGHBORHOOD in Poitiers

The neighborhood of Mérigotte, figure 1, is situated close to the centre of Poitiers.

The first result that we can draw concerns the influences and dependences between the principal players selected for the study. In Figure 2, we may observe a significant dispersal between the participants. Overall, the role played by the Town of Poitiers within the framework of this operation is highly decisive, more so than that observed on the part of the main or subsidiary developers. The coordination and monitoring of the sustainable development process is therefore wholly incumbent on the municipality. In contrast to other operations in which the developer plays the role of an intersecting player, in this case the Town of Poitiers combines the functions of coordination, steering, negotiation, monitoring, etc., of the process that it plans to carry through itself.

The net balance of direct and indirect influences places the developer in particular outside the other participants, taking into account his potential for influence. The graph of convergences between players, figure 2, also shows the closeness of interests shared by the municipality and the developers. This represents an important guarantee of success in all the objectives linked directly to the "building" level.

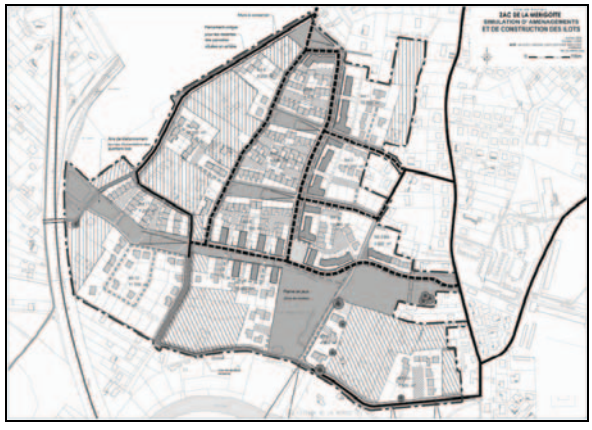

*Figure 1. Development plan produced by AUP in January 2006.*

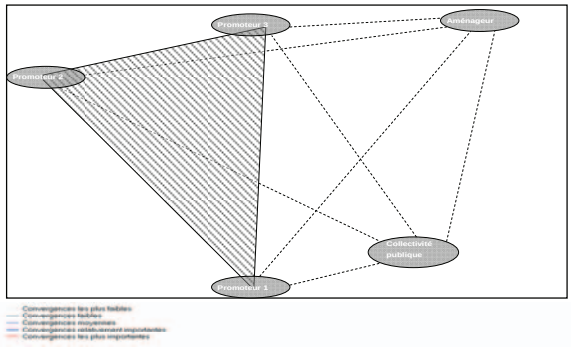


*Figure 2. Graph of convergences*

On the basis of non-directive interviews, we have also been able to draw up a histogram, figure 4, showing the involvement of all the participants in relation to the selected objectives. The favourable results obtained show a very good appropriation of the approach desired by the municipality, above all in matters relating to water and energy. The measured divergences are here also negligible. This would seem to demonstrate a fairly good level of cohesion between the participants with regard to the approach proposed by the municipality.

## 4. Conclusions and prospects

This first application confirms our faith in the feasibility and relevance of our approach. We planned to model various development operations in this way in order to acquire and give structure to knowledge regarding the drawing-up of projects. Our objective is not to rationalise the action being taken. Modelling is not seen here as a predictive model, in other words for putting things in order. The objective is to acquire a better knowledge of the conditions under which the project is put together in order to improve organisation, in the knowledge that each project is unique.

We are seeking to model practices, to understand how decisions are organised and what the rules are governing actions and deliberations. If, within a project, each participant has the right to speak, one may wonder about the value attributed to it according to its origin, about the hierarchical structure and how it is constructed.

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# Construction versus Environment: Their Reciprocal Impact During Different Stages of Construction and Maintenance

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*Is it possible to avoid ecological impacts on built environment instead of battling with the consequences? This paper is focused on mutual impact of environment and building from the viewpoint of selecting the appropriate management strategy. In order to create a built environment harmonizing with the natural world, it is important to manage related information in an adequate way. Systematic approach and methods of simulation modelling enable to assess environmental impacts and establish the balanced interactions between: building and environment; construction process and environment; maintenance and environment etc. The damage of buildings and infrastructure caused by disasters has caught the attention of the world. Even in such geographically calm region as Estonia there have been incidents that compel us to pay more attention to the environmental issues while designing and maintaining buildings. One of the aims of European and Asian Infrastructure Advantage (EURASIA) research project is to find out whether and how the prevention of ecological risks enables to minimize such damage.*

**Keywords:** Built environment, reciprocal environmental impact, environmental risks.

## 1. Introduction

Since the beginning of the society humans have shaped the environment by creating, changing and removing various structures. The aim of the paper is to provide the starting points for future research, enabling to develop the strategy of assessing the environmental impacts at a more detailed level.

## 2. Reciprocal Impacts of Building and Environment

The reciprocal impacts of the building and environment can be identified throughout all the phases of life span. In this paper general aspects and the reciprocal impacts of the building and environment, depending on the life span of the building are differentiated as: the impact of the building on the environment and the impact of environment on the building.

**The building** affects the environment mainly by: placement, time of being located in an environment, the architectural and structural design, building materials used, suitability of the intended use, size and capacity indicators, building technology and intensity of construction, duration of construction period, intensity of usage, preparedness to environmental changes, labour intensity ratio of utilization etc.

**Environment** influences the buildings by the location conditions, duration of stay in the environment, human activity, and cultural, socioeconomic and political aspects of the environment. Out of natural harmful impacts for example the climatic circumstances not corresponding with the qualities of the building can influence it as well as the temperature, precipitation, winds, ground conditions, the groundwater level and its quality, fluctuation of water bodies, tides, seismic activity, harmful gas, UV-radiation etc. In purpose to create a comprehensive picture of the significance of different impacts of the building and to discover the harmful and aggressive impacts at the initial stage of assessment, the rating system has been suggested in the framework of the present research.

## 3. Assessment of Reciprocal Environmental Impacts

In purpose to find information regarding the influence of the intended building on the environment and minimize the risks, most countries have adopted a routine to conduct a mandatory preliminary assessment; which can be done within legal framework and legislation that is usually called the **assessment of environmental impacts (AEI)**. Assessment of environmental impact is generally related to two procedures differing in their content and form:

- applying and issuance of activity licences (building permits, waste permits, pollution permits, water-special usage permits) and
- composing and validation of strategic documentation (plans, strategies, projects).

An outline of basic AEI procedure is shown in Figure 1.

## 4. Planning Strategy and Sustainable Development

Management strategy includes the developed systematic activities, proceeding from a national policy, covering the stages from general to detailed plans, followed by building permit issuance and concluding with deliberate methods at construction, maintenance and utilization of the building in harmony with environmental sustainability. AEI must always precede the planning in accordance with the degree of detail. Various alternative versions from the viewpoint of the most suitable environmental solution should be reckoned over when selecting the architectural and structural design.

The natural factor of the environment is one of the strongest and most valid factors besides the artificial, social and economic components. The natural component of the environment deserves separate regard, as in spite of hidden agents the impact might be unpredicted and destructive, posing a direct hazard to a man as well as to the nature itself. In order to avoid the harmful effects exerted by natural environment the impacts must be gradually mapped, considering the functional and constructive alternatives of the building and searching for mitigating possibilities already before the planning of the structure or in the course of construction process.

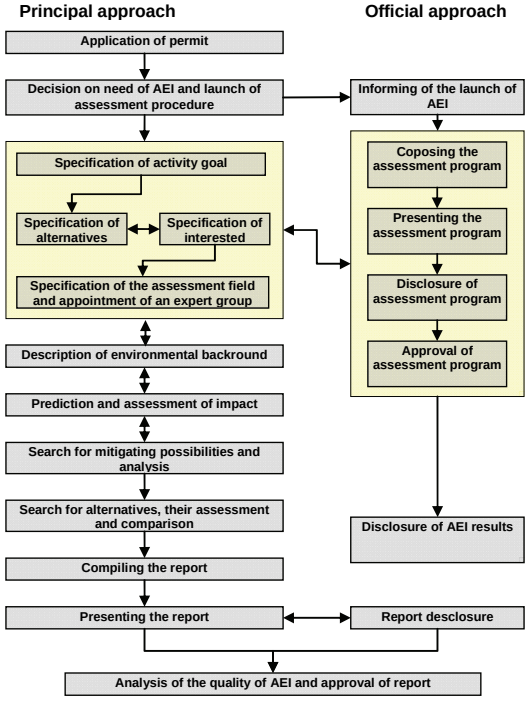


*Figure 1: Procedure of Assessment of Environmental Impact (AEI)*

## 5. Conclusions

The present paper provides a basic overview on the stages of the building life span, reciprocal impacts of the environment and building, their distribution in lifecycle stages, identification of impacts and structure of procedures. It is important to acknowledge that the environmental impacts can be foreseen already on the planning stage of the building. The following gaps in common assessment of environmental impacts are revealed on the basis of current study: as a rule environmental impact assessment involves only the phase of construction process and maintenance, while design and utilization phase of construction life span are almost ignored; while impact of the building is usually accepted the reciprocal impact of environment is considered to be insignificant; the peculiarity of reciprocal environmental impacts by different phases of life span has not earned deserving attention. In purpose to continue this research besides fulfilling the gaps mentioned above a list of the reciprocal environmental impacts should be established and a simulation model reflecting the dependences of the sets of reciprocal impacts created. Knowing the direct and indirect impacts and impact chains it is possible to plan the built environment fitting into nature so that in each planning and building stage reciprocal discords will be minimized.

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# Optimizing Concrete Mixes by Concurrent use of Fly Ash and Quarry Dust

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*The use of fly ash leads to an increase in workability, but a loss in the early strength of concrete. The use of quarry dust leads to an increase in strength, but a reduction of workability in concrete. Therefore, if fly ash and quarry dust are used concurrently, the loss in early strength due to fly ash will be compensated by quarry dust, and the loss in workability by the addition of quarry dust will be compensated by fly ash. By experimentation, it was found that the addition of 45 % quarry dust caused a loss in workability that cannot be fully compensated by the addition of up to 30 % fly ash. Conversely, the loss in early strength due to the addition of 15 % fly ash can be fully compensated by the addition of quarry dust, though the loss in early strength due to the addition of 30% fly ash can only be partially compensated by the addition of up to 45 % quarry dust. The 28-day strength of the concrete is not adversely affected by the addition of 0-30 % fly ash and 0-45% quarry dust in all combinations tested. Thus, both materials can be used concurrently, leading to environmental and financial benefits without resorting to expensive admixtures.*

**Keywords:** Fly Ash, Quarry Dust, Economical, Concrete, Workability

## 1. Introduction

The production of cement requires a great amount of energy. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of securable river sand deposits and a concomitant price increase in the material. Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for cement and river sand that are preferably byproducts. Fly ash (pulverized fuel ash) is used extensively as a partial replacement of cement. More fly ash may be produced worldwide in the future with the establishment of many coal power plants due to the rapid rise in petroleum prices. When examining the qualities of fly ash and quarry dust, it becomes apparent that if both are used together, the loss in early strength due to fly ash [1,2] may be alleviated by the gain in strength due to quarry dust, and the loss of workability due to quarry dust may be partially negated by the improvement in workability caused by the inclusion of fly ash [3]. This paper is generated from a research project designed to determine whether such benefits could be obtained by the use of these two materials together, and to quantify such benefits.

## 2. Research Methodology

Ordinary Portland Cement and gneissic crushed coarse aggregate of maximum size 20 mm was used. River sand was used as the primary fine aggregate, and gneissic quarry dust was used to partially replace it to find the effects of including quarry dust. One mix design was used for the entire research project and it consisted of 362 kg of cement, 210 kg of water, 818 kg of fine aggregate and 985 kg of coarse aggregate. The moisture contents in the stockpiles were 1.83% for river sand and 2.00% for quarry dust, and replacement of river sand with quarry dust was on the basis of dry weights. The fly ash contents examined were 0%, 15%, and 30% replacement of cement and quarry dust contents of 0%, 15%, 30% and 45% replacement of fine aggregate. Strength was obtained at 3-day, 7-day, and 28-day age by obtaining 3 replicates per data point.

## 3. Results and Discussions

The average strengths and slumps obtained from the above tests are shown in Table 1. For ease of comparison and insightful analysis of the effects of replacement, the average strengths of the concrete with replaced materials are reported as ratios of the average strength of the control mix with no river sand and cement replacement. The average strengths of the control mix were 20.21 N/mm$^2$, 25.31 N/mm$^2$, and 33.47 N/mm$^2$ at 3-day, 7-day and 28-day ages respectively.

At 3-day age, when considering all contents of quarry dust, the concrete with 15% fly ash is about 8% lower and concrete with 30% fly ash is about 25% lower in strength than concrete with no fly ash. The loss in strength due to the addition of 30% fly ash has not been negated by the addition of even 45% quarry dust at this age. At 7-day age, when considering all contents of quarry dust, the concrete with 15% fly ash is about 11% lower in strength and concrete with 30% fly ash is about 23% lower in strength than concrete with no fly ash. At this age, the loss in strength due to the addition of 15% fly ash has been reversed by the addition of 30% quarry dust or more, but as at 3-day age, the loss in strength due to the addition of 30% fly ash has not been fully compensated by the addition of even up to 45% quarry dust. At 28-day age, the addition of up to 30 % fly ash has not caused a loss in strength. Considering the slump data, it is apparent that there is a rapid loss of slump with the addition of quarry dust, but the increase of slump with the addition of fly ash is not as significant.

*Table 1: Slump and Strength Data*

| PFA (%) | Quarry dust (%) | Slump (mm) | Age : days | | |
|---|---|---|---|---|---|
| | | | 3 | 7 | 28 |
| | | | Strength ratio | | |
| 0 | 0 | 80 | 1.00 | 1.00 | 1.00 |
| | 15 | 50 | 1.17 | 1.12 | 1.12 |
| | 30 | 35 | 1.20 | 1.13 | 1.13 |
| | 45 | 20 | 1.24 | 1.20 | 1.16 |
| 15 | 0 | 105 | 1.00 | 0.95 | 1.04 |
| | 15 | 58 | 1.05 | 0.99 | 1.09 |
| | 30 | 48 | 1.10 | 1.00 | 1.15 |
| | 45 | 25 | 1.10 | 1.04 | 1.15 |
| 30 | 0 | 88 | 0.85 | 0.86 | 1.05 |
| | 15 | 78 | 0.86 | 0.86 | 1.05 |
| | 30 | 55 | 0.83 | 0.82 | 1.03 |
| | 45 | 30 | 0.92 | 0.90 | 1.10 |

## 4. Conclusions

The loss in early strength due to the addition of 15% fly ash can be negated by the addition of quarry dust, though such loss due to the addition of 30% fly ash cannot by the addition of up to 45% quarry dust. At 28-day age, there is no loss of strength due to the inclusion of 30% fly ash. The addition of 30% or more quarry dust causes a loss in slump that can only be partially ameliorated by the addition of up to 30 % fly ash.

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# Study on advantages of using coir dust in vertical drains for the improvement of soft clay

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*This research project studied the applicability of soft ground improvement with an introduction of coir dust in vertical drains as a filling material with sea sand, as a useful means of reducing and optimising waste. The permeability characteristics of mixed materials and sea sand were analysed and a comparison made of consolidation behaviour of high plasticity clay with vertical drains under two conditions - vertical drains filled with sea sand alone and drains filled with mixed materials. Those without vertical drains were also discussed. The consolidation experimental results showed the introduction of coir dust in vertical drains increases the coefficient of consolidation of high plasticity clay compared to those without vertical drains. The optimum percentage of coir dust to be used in vertical drains with sea sand as filling materials was finally established by considering the permeability and consolidation characteristics with a cost analysis for practical applications.*

**Key words:** Coir dust, Consolidation, Ground improvement, Sand, Vertical drains, Waste reduction.

## 1. Background

Sri Lanka has encountered undesirable ground conditions during major development projects. At the same time, solid waste management has become a major concern. Hence, waste reduction, reuse and recycling have become major issues recently. As a major coconut producing country in the world, Sri Lanka produces annual net waste of coir dust of about 527,800 tons (i.e. 2150 $m^3$) [1]. Sand drains are commonly used in the ground improvement projects. However, at present one cube of river sand costs around Rs. 6000 whereas purified sea sand costs around Rs. 3550, mainly in suburban areas, especially in Colombo [3]. The waste of coir dust is one of the major environmental problems in the coastal zone of Sri Lanka particularly the southern coastline. Therefore, a timely investigation is needed to establish whether coir dust can replace some of the sand used in sand drains.

Sand drains enhance the consolidation process by decreasing the drainage path and often by taking advantage of a higher coefficient of consolidation in the horizontal. It is mainly used in the consolidation of extensive areas of loading over compressible soils to ensure that most of the settlement will occur during and not after the construction. Coir dust influences the maximum rate by which water from surrounding area is absorbed as it drains throughout the mix [2]. Non- woven coir is used in road embankments; rail embankments, river embankments and hillside slopes [4]. One of the special features of coir fibre is its durability, which is unlimited under dry conditions and about 2-5 years under wet conditions and it has a moisture capacity of about 550% (Information from Industrial Development Board, Sri Lanka).

## 2. Materials and methods

Coir dust and sea sand were mixed based on weight and a series of constant head method of permeability tests were carried out to determine the coefficient of permeability. A series of laboratory one dimensional consolidation tests were also carried out to study the consolidation behaviour with vertical drains on settlement of unimproved clay samples. A simple model for the application of vertical drain in a clay sample was prepared with an introduction of a cylindrical hole in the centre of the unimproved clay specimen (Figure 1). As a typical sample, the mixture of 50% of coir dust by weight was tested. The relevant graphs for test specimens are shown in Figure 2. Atterberg limit tests were carried out to classify the clay sample used.

*Figure 1: Introduction of vertical drain*

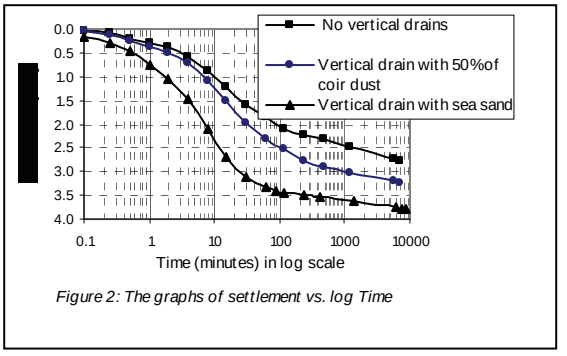


*Figure 2: The graphs of settlement vs. log Time*

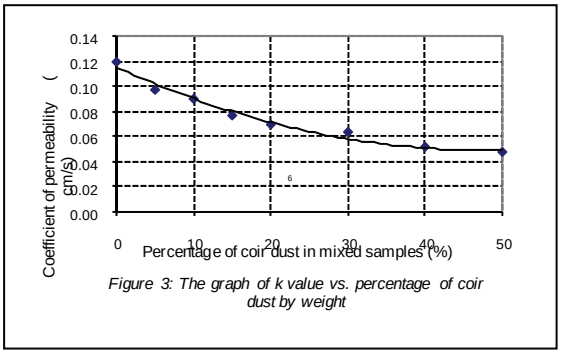


*Figure 3: The graph of k value vs. percentage of coir dust by weight*

## 3. Results and discussions

The permeability tests indicated that the coefficient of permeability of the mixed samples decreased with the increase of coir dust in the mixture up to around 50% of coir dust by weight (Figure 3). However, the coefficient values showed that the introduction of coir dust as a substitution for sea sand did not reduce permeability significantly. Although coefficient of permeability is increased beyond the 50% of coir dust in the mixture, the samples experienced a separation as layers. Due to practical difficulties it is recommended that the maximum coir dust percentage in the mixture applicable as a filling material for vertical drains can be around 80% by volume (50% by weight). The introduction of vertical drains for unimproved clay indicated that the coefficient of consolidation increased significantly (Table 1). The vertical drain filled with sea sand gives a faster rate and the introduction of coir dust in vertical drain reduces the consolidation compared to a vertical drain with sea sand but still gives reasonable higher consolidation. The particle size distribution curve for coir dust indicated that the percentage of coir fibres (more than 2mm) was around 23%. The presence of coir fibres in mixed samples of coir and sea sand increases the durability and strength characteristics of vertical drains. Table 2 shows approximate costs involvements for filling materials. Typical dimensions for vertical drains were assumed as 450mm diameter, 5m spacing and 15m depth. It shows that an introduction of 80% of coir dust by volume instead of river sand reduces the cost more than 90% and reduces the cost by 80% compared to drains filled with sea sand.

*Table 1: The coefficients of consolidation*

| Clay specimen | $c_v$ (mm$^2$/min) |
|---|---|
| Without vertical drain | 1.446 |
| Vertical drain with mixture | 1.973 |
| Vertical drain with sea sand | 3.457 |

*Table 2: Cost comparison for filled materials*

| Cost (Rs.) | Materials | | |
|---|---|---|---|
| | River sand | Sea Sand | Mixed sample (80% coir by volume) |
| Per cube | 6000 | 2000 | 400 |
| Per hectare ('000) | 2014 | 671 | 134 |

## 4. Conclusions

Although the coefficient of permeability value is decreased slightly with increasing coir percentage initially, it is not significant as the coefficient of permeability values are still in the range of $10^{-2}$ (cm/s) which is a typical value for sand drains. Consolidation tests showed a reasonable improvement of ground with vertical drains filled with coir dust and sea sand compared to those without vertical drains. The maximum amount of coir dust in the mixture is recommended to be 80% by volume but the usage of coir nets (or gunnies) in the vertical drains increases the possibility of using a higher amount of coir dust in the vertical drains as it helps to maintain the drain dimensions. In the design stage of vertical drains, the required percentage of coir dust in the mixture can be determined using the graph of coefficient of permeability vs. percentage of coir dust (Figure 3). The steps should be followed as: Calculate the required *k* for the vertical drain design depending on site conditions; Find the appropriate percentage of coir dust in the sample from the graph; Include necessary precautions such as coir net depending on coir percentage used; Mix the coir dust and sea sand properly.

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# Modelling the tsunami wave propagation

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*A computer based numerical model, which can simulate the propagation of the tsunami wave, was developed for the coastal area of Galle city. TUNAMI N2, a computer code developed in Japan (2006) was used as the base model. The model includes bathymetry, fault, and stability sub modules other than the main module. Main module calculates the propagation of the tsunami wave. After inserting the initial wave due to the fault and bathymetry data of the required area, model gives the time series of water surface elevations at given gauge locations and water surface elevations at given time steps as the main outputs. Outputs of the model after applying the parameters of the fault that caused the tsunami in 26 December 2004, were verified with the observations. The model was applied for different tsunamis with different fault origins with different magnitudes. Different propagation patterns were obtained.*

**Keywords:** Tsunami, Earthquake, Propagation, Simulation, Numerical model

## 1. Background

The tsunami has become the largest disaster and which caused the heaviest damages to livelihoods and to properties within last few years. It is important therefore to understand the behaviour of the tsunami wave caused by an earthquake in order to reduce the damage. This paper includes the results of modeling the tsunami wave propagation due to an earthquake.

## 2. Methodology used in developing the model

The prepared model includes bathymetry, fault and stability sub modules in addition to the main module. The bathymetry sub module was developed to store all the bathymetry data of Indian Ocean covering Sri Lanka and possible tsunami generation locations. The bathymetry data was obtained from etopo 2 satellite data. The data was converted into evenly spaced grid files using surfer. Since there are large numbers of values, in order to run the programme faster, a nested grid system was used with four grids. The resolutions of the grids increase from A to D.

The fault sub module generates the initial wave due to the earthquake. Fault parameters were given to this module as the inputs and it then generates the initial disturbance of the water column. This is an input to the main module. Fault parameters of the December 2004 tsunami were used and results were obtained.

The main module is designed to calculate the propagation of the wave and run up. It will undertake the numerical simulation, with linear wave theory in deep sea and shallow water wave theory in shallow sea and on land. A time series of water surface elevations at given gauge locations and at the water surface elevations in the given time steps are given as the main outputs of the model. Mathlab and surfer software were used to convert output data into graphical form that can be easily visualised.

## 3. Verification of the model

The values obtained from the model for arrival times of the waves to shoreline and the way they have arrived were compared with the observed data during recent tsunami in December 2004. The first wave arrival time and the highest wave arrival times exactly match with the model values. The sea level drop due to oncoming tsunami wave was clearly understood within the model. Wave shoaling is always associated with water level reduction at the front side. In Galle, Balapitiya, Hikkaduwa these were the type of waves which arrived before the arrival of tsunami wave. The model also obtained the same type of waves. Table 1 shows the first wave arrival times to specific places in southern coastal area.

*Table 12: First wave arrival times in December 2004 tsunami (Source: Eyewitness record)s*

| Area | Real Values | From Model |
|---|---|---|
| Hambanthota | 9.20 a.m | 9.15 a.m |
| Matara | 9.40 a.m. | 9.45 a.m. |
| Galle | 9.50 a.m. | 9.30 a.m |
| Hikkaduwa | 10.00 a.m. | 10.05 a.m |
| Benthota | 11.05 a.m. | 10.05 a.m |
| Kaluthara | 11.30 a.m. | 10.10 a.m. |

The propagation of the wave within the nested grid system was clearly understood within the model. Observed water surface elevations during the recent tsunami in December 2004 were available only at Colombo and that data was used for model verification. The measured values and the values obtained from the model for the Colombo area were plotted and the shape for

the two values were almost the same. After verification of the model it can applied to anywhere in the world with certain modifications. Since the model gave the most correct values the model could be verified.

## 4. Study different propagation patterns

Tsunami generation and propagation due to earthquakes were studied with different fault parameters. Different propagation patterns were obtained. Figure 1 shows the initial wave due to the earthquake that occurred in December 2004 as given in Table 2. Figure 2 shows the initial wave due to the fault parameters given in Table 3.

*Table 2: Fault parameters of December 2004 earthquake*

| Parameter | Value |
|---|---|
| Origin | 3.30N,95.78E |
| Slip Magnitude (m) | 20 |
| Fault Length (m) | 500000 |
| Fault Width (m) | 150000 |
| Depth of the Fault (m) | 20000 |
| Dip Angle (degrees) | 11 |
| Rake Angle (degrees) | 90 |
| Strike Angle (degrees) | 370 |

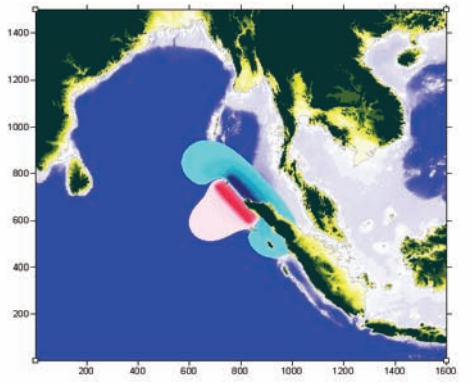


*Figure 11: Initial wave due to December 2004 earthquake*

*Table 3: Fault parameters of an earthquake*

| Parameter | Value |
|---|---|
| Origin | 2.076N,97.025E |
| Slip Magnitude (m) | 15 |
| Fault Length (m) | 200000 |
| Fault Width (m) | 150000 |
| Depth of the Fault (m) | 30000 |
| Dip Angle (degrees) | 13 |
| Rake Angle (degrees) | 90 |
| Strike Angle (degrees) | 300 |

(Source: USGS 2007)

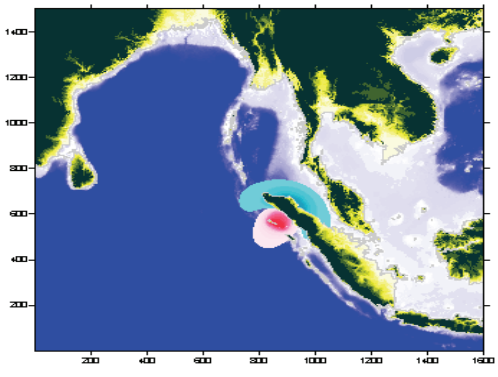

*Figure 2: Initial wave due to earthquake as given in table 3*

## 5. Conclusion

The model successfully simulates the propagation of the tsunami wave due to an earthquake in the selected area. As the large number of bathymetry data was used for the model the nested grid system was used so that the programme ran faster. Although a very coarse grid size was adopted for the numerical simulations, the numerical results match with the field survey data of the arrival of highest waves and the different characteristics of waves fairly accurately along the southern coastlines of Sri Lanka.

By replacing high resolution near shore bathymetry data of Galle area in grid D inundation heights of the area due to the tsunami also can be obtained.

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# The Ecological Restoration of Coastal Terrestrial Ecosystems in Southern Sri Lanka

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*Eighteen months after the devastating 2004 tsunami, Sri Lanka's southern coastal zone has seen the replanting of an array of coastal vegetation ranging from Rhizophora apiculata, to Borassus flabellifer to Cocos nucifera. Centred on the principles of ecological restoration, projects ranged from small and large scale mangrove replanting and sand dune stabilisation, to the re-establishment of home gardens. Local, national and inter-agency partnerships have been established as well as the formulation of local driven collaborative environmental restoration projects involving local communities. In addition to re-establishing nature's protective defences and acting as a natural barrier against possible future natural hazards, efforts are being made to realign the balance of damaged ecosystems by planting a selection of plants, which if utilised and managed sustainably can provide a wealth of socio- economic opportunities to coastal communities.*

**Keywords:** Community, Restoration, Sri Lanka, Sustainable, Tsunami

## 1. Background

On the 26th of December 2004 at 00:59 GMT a 9.0 magnitude earthquake struck off the coast of Sumatra, Indonesia triggering a series of tsunami waves, directly impacting coastal areas of Indonesia, Sri Lanka, Bangladesh, India, Thailand, the Maldives, Kenya, Malaysia and Mauritius. More than 200,000 persons were killed when the waves impacted ashore. The tsunami was the worst natural disaster to have befallen Sri Lanka since historical times, claiming over 35,000 lives, displacing over a million people and destroying homes, offices, hospitals, schools, roads and railways and other infrastructure (USGS 2004).

As a result of the tsunami waves, the Sri Lankan coast suffered devastating ecological damage to more than two thirds of its coastline (MENR 2005). Ecological impacts of the tsunami to the coastal environment varied greatly and were inconsistent from place to place. There were several reasons for this including the differences in on-shore and off-shore coastal geomorphology, the presence/absence of off-shore coral reefs, the presence, maturity and width of mangrove belts and the location of human settlements (IUCN 2005, Yamada et al. 2006). Depending on local land forms, the physical area of the tsunami impact varied from high-tide level to one kilometres inland (Fernando et al. 2006). Areas with estuaries and natural and artificial lagoons acted as channels for the entry of seawater, facilitating damage and leading to the intrusion of saltwater far inland- in several cases, several kilometres inland, leaving the land salinated damaging home gardens and agricultural crops in the process (UNDAC 2005, UNEP-MENR 2005). The tsunami struck ecosystems, already strained by unsustainable practices including habitat destruction, over fishing, and the development and obliteration of mangroves for prawn culture (IUCN 2005). Across Sri Lanka, terrestrial ecosystems suffered significant damage, in particular, managed coastal vegetation such as *Cocos nucifera* and *Borassus flabellifer* and home gardens were severely affected (IUCN 2005(b). Other affected ecosystems include, seagrass beds, coastal sand dunes, salt marshes, mudflats, backwaters, estuaries, lagoons, maritime grasslands, plantations, as well as environmentally sensitive areas including national parks, sanctuaries and Special Area Management sites.

The majority of coastal communities in Southern Sri Lanka rely primarily on highly productive natural terrestrial and marine resources and ecosystems, helping to support the livelihoods of coastal communities and so restoring these ecosystems to their pre tsunami state is vital. In addition, the further loss of coastal vegetation will leave coastal communities even more vulnerable to recurrent extreme weather events, in particular storms and cyclones (IUCN 2005(d), Smithson et al 2002).

## 2. Results

The Sri Lankan government together with the assistance and support of the international community has launched a major restoration and rehabilitation programme in a bid to bring the country to a point of recovery from the devastating effects of the tsunami. Efforts are being made by various agencies including government departments, NGOs, INGOs, and Community Based Organisations (CBOs) in restoring and rehabilitating the vegetation along coastal areas affected by the tsunami (Sunday Observer 2005).

The six projects analysed centred on the principles of ecological restoration- managing and restoring the ecological damage sustained by coastal terrestrial ecosystems to restore the ecosystem to the pre-tsunami state of production activity as well as restoring the ecosystems to a functioning state where they could provide services and goods again to local residents increasing livelihoods and security for people in tsunami hit areas. Projects ranged from small and large scale mangrove replanting, to the reconstruction of sand dunes to the re-establishment and introduction of home gardens. In addition to re-establishing nature's protective defences and providing protection from potential future natural hazards, the coastal reservation green belt offers a wealth of socio-economic opportunities. Efforts are being made to realign the balance of damaged ecosystems by planting a selection of plants, which if utilised and managed sustainably can provide a wealth of economic benefits to coastal communities. A variety of coastal plants including *Cocos nucifera* and *Pandanus tectorius* are being utilised as raw materials for a wide range of indigenous handicrafts- a fast growing cottage industry in itself.

Local communities played an imperative part in the management and development of restored ecosystems having been fully involved in the initial environmental assessments, surveys and site selection as well as the planning and planting stages**.** Traditional, indigenous ecological knowledge of the area was utilised by project co-ordinators as a useful and practical guide regarding the steps to be taken when considering restoration practices. Communities were subsequently assured of financial

benefits, through employment on cash for work basis and as plant nursery entrepreneurs, landscape contractors or as green belt managers (including long-term maintenance). In all projects a regular system for the regular and excusive maintenance and management of the vegetation planted was established with cash incentives and rewards awarded in each project ranging from Rs100 to Rs1250 (approximately £0.50p-6.00).

## 3. Conclusion

It is evident that considerable efforts are being made to restore coastal terrestrial ecosystems in southern Sri Lanka. Local, national and inter-agency partnerships involving all stakeholders have been established and the formulation of local driven collaborative environmental restoration projects have boded well for the progression of the restoration projects. Efforts are being made to realign the balance of damaged ecosystems by planting a selection of plants, which if utilised and managed sustainably can provide a wealth of economic benefits to coastal communities. Good management practices have ensured that the maintenance of the vegetation planted in projects is both meticulous and consistent and it is imperative that these efforts are continually monitored and sustained for the restoration process to achieve its desired effect.

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# Incentive Instruments for Government and Private Sector Partnership to Promote Building Energy Efficiency (BEE): A Comparative Study between mainland China and Some Developed Countries

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*Government plays different roles in promoting Building Energy Efficiency (BEE), among which the role in providing incentives is commonly acknowledged as significant by both professionals and researchers. In this study, two categories of incentive instruments: economic incentives and advocatory incentives have been classified and defined, with related items described according to this classification. Based on this catalogue, investigation and comparative analysis on BEE incentive instruments have been carried out through literature review in four different countries: the UK, Canada, the US and mainland China. Finally, from comparative study of literatures, a list of factors, which are supposed to affect on the BEE incentive policy design, have been identified for future study.*

**Keywords:** Building Energy Efficiency (BEE), Partnership, Incentive Instruments, Policy Design Factors, Comparative Study

## 1. Introduction

This paper aims at contributing to the concept of collaboration between government and private sectors by setting incentive instruments through comparative studies and literature review. The structure of this paper is firstly, two incentive roles played by government on BEE promotion have been briefly reviewed and the operation of these incentive instruments between government-private sectors has been explored. Secondly, according to the two categories drawn above, the authors compare the incentive instruments in different countries, such as the UK, Canada, the US, and mainland China, and understand the different policy instruments used in different governments and their effects. Thirdly, from comparison as well as literature review, a list of factors are identified which will affect the BEE incentive policy design that help to build up partnership between government and private sectors. Finally, discuss what mainland China and some other developing countries can learn from each other on incentive instruments design for improvement.

## 2. Government's incentive roles on BEE

**Economic Incentives —** Government's role is to set incentive policies to enhance the private sectors' interests in order to reduce the cost and increase the demand in energy efficient building market, e.g., setting an feasible price for energy, tax deduction for energy efficient products, subsidy and rebate programs. It also offers financial support to socially and environmentally preferred energy options through investment incentives and low-cost loans, and special funding for BEE programs ([2], [3]).

**Advocatory incentives —** Government's role is to advocate sustainable energy development and consumption through education, training, information publication and through activities such as product rating and labelling, energy audit and government procurement programs [4].

Successful experiences from developed industries show that the BEE incentive instruments are co-designed by government and representatives from private sectors to avoid BEE market barriers. After these incentive policies are brought into effect, private sectors, namely market parties, would send out market signals and these feedbacks received by the government help to adjust their incentive policies on BEE promotion. With the full cycle of re-negotiation and re-design of the policy instruments, the collaboration between government and private sectors is built up and it helps the government promote BEE in a cost-effectiveness way.

## 3. Comparative study & Observations

After clarifying the two incentive instruments that governments adopt to promote on the BEE market, we are able to make a systematic comparison between China and some developed countries through a critical evaluation of the items under the two categories: economic incentives and advocatory incentives. A summary table shows a comparison of different incentive measures and policy instruments related to BEE in four different countries, the US, Canada, the UK and mainland China.

- Economic Incentives--Key common items:
    - All the four compared countries deem incentive motivator to be an important role for government involvement.
    - Tax incentive schemes, subsidy and rebate programs are the common policy tools.

- The US, Canada and the UK governments have all reported satisfactory and cost-effective results through the implementation of incentive tools.
- Government provides loans and funding for BEE promotion.
- Governments in the four countries all prefer to set a R&D funding for new technology.

- Advocatory Incentives--Key common items:
  - All compared governments serve as an advocator to deal with market barrier.
  - Voluntary assessment schemes, voluntary products labelling, education and information publication are the main functions for government's involvement in developed countries.
  - The impact of these government involvements is cost-effective.
  - The US, Canada and the UK governments have their own schemes to serve as advocators to promote BEE, though the purpose of each tool is similar.

Highlights of the special cases in BEE incentive instrucments in different countries are presented.

## 4. Factors affecting government's Incentive Policy Design

In order to develop these incentive instruments, governments have to go through careful design of policy for implementing the incentives. It brings up the need for follow-up studies on factors that affect government's Incentive Policy Design (IPD). In this section, IPD factors are collected and classified into 10 categories and their sub-factors are identified and listed in Table format. It is hoped that with a list of well-structured IPD factors and sub-factors, government would have a better understanding of the process of developing BEE incentive policies.

## 5. Conclusion and Recommendations

Policy study on BEE has already aroused worldwide concern and academic debates, as policy is recognised as a bottleneck to ameliorate problems of climate change, air pollution, and energy security, etc. Among all public interventions, incentive instrument with public-private sectors partnership through appropriate policy design are utmost essential and significant shortcuts to win this BEE promotion campaign. This paper highlights the incentive roles that government plays on BEE promotion by classifying incentives into two categories: economic incentives and advocatory incentives. Through comparative study of four different countries, incentive instruments are identified and collected according to the abovementioned categories. "Key common items" and "special cases" of incentive instruments in these four countries are analyzed, which helps enlighten China and other developing countries to learn from each other. Finally, the importance of careful policy design is brought up and a list of factors and sub-factors, which could affect Incentive Policy Design (IPD), is collected. Further studies are recommended to study the criteria, which could quantify the IPD factors and the way to weigh out different factors that affect government's choice.

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# Extreme wave and water level conditions in the Baltic Sea in January 2005 and their reflection in teaching of coastal engineering

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*Windstorm Gudrun (January 7–9th 2005) was one of the strongest storms in the Nordic Region of Europe during the last decades. Unexpectedly high storm surges occurred along large sections of the coast. Extremely rough seas occurred in the north-eastern region of the Baltic Sea. The estimated maximum significant wave height was about 9.5 m. Such wave conditions are extremely rare in this water body. The lessons learned from this event were used in regular courses for students a few weeks after the events.*

**Keywords:** Coastal hazards, Extreme wave conditions, storm surge, coastal engineering teaching

## 1. Introduction

Windstorm Gudrun, an extratropical cyclone, also known as Erwin in Ireland, the United Kingdom and Central Europe, attacked the northern Europe on 7-9 January 2005. It was one of the strongest storms in Denmark, Scandinavia and Estonia for at least 40 years. It caused widespread property damage and exceptionally high storm surge flooding levels, for example, the highest storm surge in the known history (275 cm above the mean sea level) in Pärnu [1].

The storm caused very rough wave conditions. Unfortunately, the wave sensors were located remote from the maximum of the wave storm (Fig. 1). We bring evidence about the highest storm surges and construct an estimate the roughest wave conditions during this storm based upon available data. The analysis involves a comparison of wave measurements with the output of operational wave models.

*Figure 12: Wave measurement sites, marked by ⊗, in the Northern Baltic Proper (buoy 1), near Helsinki and at the island of Naissaar.*

We also describe how the instructive features of this storm were used in courses in the Department of Hydrography of the Estonian Marine Academy and in the Faculty of Civil Engineering at the Tallinn University of Technology. A short overview of the existing wave data and numerical wave studies in this area is presented to give an impression of extreme wave conditions and related features of the local wave climate in the Baltic Sea.

## 2. Extremes of the water level

The basic driving factors of synoptic Baltic Sea sea level are the wind and air pressure patterns. Sea level variation due to the tidal forces usually does not exceed a few cm. Local storms induce the largest sea level variations and at times extremely hazardous storm surges. The closed eastern end of the Gulf of Finland generally hosts the largest variation of sea water level in the whole Baltic Sea.

The January storm in 2005 set new sea level maxima at many observation sites over large sections of the eastern Baltic coasts. The reason behind is an unfavourable combination of a sequence of events. As a result of strong cyclonic activity the Baltic Sea level was very high (+70 cm above mean sea level) already before the storm 0.

## 3. Wave properties in the Baltic Sea

The wave climate of the Baltic Sea is relatively mild. The overall average of the significant mean wave height $H_S$ is about 1 m and the median wave height is 0.7 m. Seas with $H_S \geq 4$ m occur with a probability of about 0.42 %. The highest

$H_S = 7.83$ m was measured in January 1984 [2]. Since 1978 wave conditions with $H_S \geq 7$ m have only been filed five times. The typical and maximum wave heights are much smaller in the subbasins of the Baltic Sea. For example, in the Gulf of Finland the significant wave heights exceeding 4m are rare and the highest ever measured $H_S = 5.2$ m.

The operational wave models somewhat overestimated the significant wave height during Gudrun. It was forecast to exceed 10 m at buoy 1 and to reach 11–12 m at the entrance of the Gulf of Finland. The relative error of the forecast of the largest significant wave height ranged from 9 % to 19 %. The highest waves were probably excited off Saaremaa and Latvia, about 200 km south-eastwards from buoy 1.

The overall maximum $H_S$ during this storm can be estimated from a comparison of the modelled spatial distributions of wave properties with the modelled and observed wave heights. The resulting estimates of the overall maximum of significant wave height range from 9.4 to 9.6 m [2]. Their relatively small scatter suggests that the overall maximum of $H_S$ most probably was about 9.5 m. The threshold of 10 m apparently was not exceeded; however, the wave conditions were much rougher than expected to happen once in 1000 years.

## 4. Reflections of the windstorm

For historical reasons the teaching of marine matters at the university level in Estonia has been fragmentary after World War II. Since September 2005, the Tallinn University of Technology launched teaching of port and coastal engineering within the curriculum of civil engineering. The content of several new courses was considerably modified to reflect windstorm Gudrun. Elements of the theory and practice of wave and storm surge forecast were included into the course of wave dynamics. A thorough description of measures towards reducing the extent and costs arising from wave-induced coastal processes and of coastal floods as well as problems connected with the effectiveness of disaster management is discussed in the course on coastal processes.

The Indian Ocean Tsunami in December 2004 and windstorm Gudrun raised many questions in Estonian society about their driving factors, potential of devastation, return period, and physics of related phenomena. The Indian Ocean tsunami was used to explain the role of long wave motion (including shallow-water phenomena such as meteorological tsunamis, waves from fast ferries, and general questions of highly nonlinear wave propagation) and related hazards. The unexpectedly high storm surge motivated the discussion of the relative role of its driving factors and statistical and dynamical methods of forecast of future events.

Analysis of more specific features of hydrodynamical processes in the coastal zone (such as wave-induced set-up and set-down) and their potential impact on the local storm surge, and on the accuracy of forecasts, has been included into the course of wave dynamics starting from fall semester 2006.

## 5. Conclusions

The strong reaction of the water surface to windstorm Gudrun both in terms of sea level and high and long waves is the most interesting feature of this event that created substantial hazards both onshore and offshore. The central outcome of the above analysis is that that the overall maximum of $H_S$ most probably was about 9.5 m in the Baltic Sea. Such wave heights were unexpected based on the existing wave statistics. Another interesting feature of windstorm Gudrun is that very long and high waves appeared in areas which generally are sheltered from long waves [2]. The combination of such waves with uncommonly high water level is a probable reason for extensive damage to certain beaches, smaller harbours and jetties. Future storms of the same strength and duration, but corresponding to more favourable wave generation conditions, however, may create even rougher wave conditions in the northern part of the Baltic Sea

The basic features of wave fields during windstorm Gudrun were mostly well captured by operational wave model. The observed properties of the roughest windseas were generally found between the values predicted by different models. Consequently, a sort of consensus forecast based on the comparison of predictions of different models and analysis of their performance in extreme conditions might give a reasonable forecast of hazardous wave conditions for the future storms.

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# Cement and its effect to the environment: A case study in Sri Lanka

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*In Srilanka, the demand for cement is high both in building and infrastructure development. However the environmental impact of cement production process starting from preproduction stages is significant. This study scrutinizes the environmental impact due to cement production process in Srilanka. A case study of Puttalam Cement Company Ltd, (the only cement production facility that encompasses the entire production process) revealed that the production adopted the dry process, which includes supply of raw materials, clinker burning and grinding process. It was found that the major sources of $Co_2$ emissions are from the fuel burning and during the clinker production in kiln, which forms a part of the cement production process itself. The study found that, 0.613 ton of $Co_2$ is emitted when one ton of clinker produce. Further the study showed that, 4-5% dust emission is due to the kiln feed, while the other sources of dust emissions include the crushers, grinding clinker coolers and material handling equipments.*

**Key Words:** Cement, emissions sustainability

## 1. Introduction

In Sri Lanka, cement industry was introduced four decades ago by the state and managed by the state until very recently. Sri Lanka is perhaps the only country in this region, which uses 100% dry process for manufacturing cement (Mohanty, 1997). Today, Puttalam Cement Company Ltd is the only facility provider engaged in cement production consisting of raw material process to cement production process in Sri Lanka. Mainly, there are two types of cement production process; wet process and dry process.

### 1.1 Research aim and methodology

The aim of the research study is to identify the cement production process and its impact to the environment. A case study research approach has been adopted, since this better facilitates to study real life context in depth.

## 2. Cement production Process

A cement production plant consists of the following three processes: Raw material process, clinker burning process and finish grinding process. The raw material process and the clinker burning process are each classified into the wet process and the dry process. The major processes involved in production are excavation of limestone crushing of limestone, preparation of other raw material, grinding of raw materials in the raw mill, storage of raw meal in a raw mill silo, blending of limestone powder to control CaCO3 percentage, burning of raw meal to form clinker, grinding the clinker with gypsum in cement mill and storage of cement in silo packing and distribution of cement.

Minerals of natural origin as well as industrial products can be used for the production of cement. Starting materials for this purpose are mineral compounds containing the main components of cement; lime, silica, alumina, and iron oxide. The two main components are generally limestone and clay. Limestone is of a predominantly fine-grained crystalline structure which influence its colour. The main component of clays is formed by hydrous aluminium silicates. Chalk is sedimentary rock, which was formed during the cretaceous period in geological time. Calcium carbonate ($CaCO_3$) which is wide spread in nature of all geological formations qualifies for the production of cement. The most common forms of Calcium carbonate, most similar to marble, are limestone and chalk.

## 3. Case Study of Puttalm Cement Company Ltd

Puttalam Cement Company Ltd is the manufacturer of cement from the locally available basic raw materials in Srilanka at present. Holcim (Lanka), with its Swiss parent company Holcim Ltd focuses on long-term benefit and bought worldwide experience to the Sri Lankan market through technical and manufacturing excellence, plus a long-term commitment to Sri Lanka. This company produce two types of cement; Portland cement and Masonry cement.

Holcim (Lanka) Ltd continues to promote various environmental performance initiatives in its own facilities viz; reduce dust emission, create a healthy natural environment plantation, and also reduced electricity consumption. It also recognizes the importance of social responsibility as a part of its overall commitment to sustainable development.

The plant consists of several units from limestone crushers to packing plants. There are two lines of process called stage 1 & 2 each having separate processing facilities. The main processing units are crushers unit, raw mill, homogenizing plant, kiln system, cement mill and packing plant. Here, dry production process is used because energy consumption is less and running cost also lower compared to other process. The raw materials used are in the following compositions; limestone 95-97% and laterite 3-5%.

### 3.1 Environmental effect due to cement manufacturing process

Emission to air is the main environmental challenges faced by the cement industry. Main pollutions are such as cement dust (from kiln feed is 4-5%), air pollution, water pollution, solid waste pollution and other environmental pollutions such as: noise pollution, ground vibration, raw material resources depletion and site restoration when using the cement in construction. Fuel gases emitted consist of the components such as CO2, N2, 02, S02, water vapor and micro components i.e. CO (720mg/Nm3) and NOx (287mglNm3) formation. As a result of study, the sulfur dioxides are 300mg/$Nm^3$ stacked through due to fuel combustion. 90% of sulfur dioxide is absorbed in high alkaline condition. However the World Bank standards allows maximum of NOx emissions to 600mg/ Nm3. Green house gases of 0.613 *t/ton* of $CO_2$ is emitted from clinker in PCCL from the cement production which is higher than the amount given by the standards *(0.507t1ton).* By changing to furnace oil, the cost of production could be reduced slightly and the gradual reduction of specific energy consumption is due to the introduction of 4- stages of suspension preheaer at factory. According to Holcim progress report June 2002 consumption of heavy furnace oil rate is 3.095t/h. Findings reveal that, 14-15% of green house gases are emitted into the atmosphere out of total gases emitted from the fuel consumption in PCCL plant. In PCCL, the introduction of new technology of the suspension preheater kiln maintains the optimum level of excess air. Further this study found that, the dust emissions are approximately 52g/Nm3 in kiln stack. But World Bank allows maximum of 50mg/Nm3 for particulates in stack gases under full load conditions.

Aruwakkadu site consists of large open space with forest. Destroying of forest depends on the quarry located. In order to overcome deforestation PCCL has a re-foresting scheme. In quarry site, noise pollution is a problem due to the high noise level caused by blasting.

The comparative study of cement industries in Sri Lanka and WorId Bank group emission guidelines has shown the major gaseous pollution and potential improvements and potential application of energy efficient and environmentally sound technologies.

To further improve the sustainable production the following procedures can be adopted. A comprehensive schedule for maintenance of the plant should be prepared and followed. Dust emissions can be further reduced by proper maintenance of bag house filter. Properly designed and operated ESP can reduce dust emission to as low as 25g/Nm3. The reduction of the intake air leakage and a motor control system of fans will allow a better control of the fuel gas flow.

## 4. Conclusions

Sri Lanka is perhaps the only country in this region which uses 100% dry process for manufacturing of cement. Cement production is one of the main pollution contributors due to its extensive energy consumption green house gas emissions and dust emissions. In PCCL, the use of water is limited because the process is based on dry process. Through observation it was found that waste water does not cause much problem because, the water is used for cooling and dust controlling. Introduction of Greenhouse Energy Management System (GEMS), which is based on the green gas monitoring and evaluation has streamed lined identification of options for reducing greenhouse gas emissions, reduce thermal energy consumption, minimize dust by proper maintenance of bag house filters and ESP, optimizing of electro static precipitators and water sprayer at site and installation of complex pollution control equipment. The industry also can take measures to reduce its green house gases through some kind of plantation in surrounding.

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# Contribution of Commercial Buildings toward GHG Emissions: Sri Lankan Perspective

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*This study aims at investigating the "Contribution of Commercial Buildings towards GHG emissions", as an initial step towards offering GHG arrays through Commercial Buildings. The focus of the study is placed on 20 high rise buildings in the Colombo Metropolitan area as it attracts more investment than other parts of the country and also is the main financial centre of the country. According to statistics, more than 60% of financial transactions take place in financial institutions located in Colombo. The selected sample is a collection of ten office buildings, five hotels and five mixed developments. Monthly energy consumption details of the selected buildings were collected by analyzing electricity bills of Ceylon Electricity Board (CEB) and self generated electricity units consumed. In order to come up with the derived contribution of commercial buildings towards GHG emissions by the demand placed on the grid; existing thermal power plant data and their share of electricity supply on to the national electricity grid was examined. Based on the above data Derived Contribution of Commercial Buildings towards GHG emissions was quantified.*

**Key Words:** GHG Emissions, Energy Consumption, Commercial Buildings

## 1. Background

80% of the anthropogenic emissions of Green house gas (GHGs are said to be directly related to energy consumption activities [1]. Researches have predicted by the year 2025, the developing world will emit more GHG in total than the developed world [2]. As a developing Asian country, Sri Lanka is only responsible for a relatively low content of GHG emissions, both in relation to the absolute as well as per capita terms. Nevertheless there is a high probability of increased GHG emissions from the country, in consequence of various development processes. Therefore it is high time to identify the prospective GHG mitigating projects in the country in various sectors. Commercial buildings sector plays a major role in the Sri Lankan economy, due to their contribution to the GDP via, various hotels, shops, offices, restaurants, etc. The aim of the study reported in this paper is to derive the contribution of commercial buildings towards GHG emissions based on energy consumption trends.

*Table 1: Composition of Building Types*

| TYPE OF BUILDING | NO OF PROJECTS |
|---|---|
| Office | 10 |
| Hotels | 5 |
| Mixed Developments | 5 |

The research is focused on a selected group of high-rise commercial buildings in the Colombo metropolitan region for a quantitative analysis. Table 1 shows the composition of building types chosen for the study.

## 2. Generation of Energy Vs GHG Emissions

The energy demand of Sri Lanka is supplied by a combination of indigenous primary sources of energy, imported primary sources of energy and imported secondary sources of energy [3]. The aggregate supply of primary energy was estimated as 9.1 million Tons of Oil Equivalents (TOE) in 2003 [3]. It has been projected the fossil fuel based electricity production will rise from 7.7% in 1991 and 48% at present to 74% in 2016 [4]. This will lead to consequent increase in the emissions of atmospheric pollutants.

The impact of thermal electricity generation on environment could be primarily due particulate or gaseous emissions. These gaseous emissions could take the form of $CO_2$, $So_x$, $NO_x$, etc., where $CO_2$ and $NO_x$ are identified as primary GHGs by the International Panel for Climate Change (IPCC). When taken as a whole $CO_2$ emission from Thermal Power Plants (TPPs) dominates the others amounting to about 96.5% of the total emissions. Therefore the study is limited to derived $CO_2$ emission as a result of energy consumption in commercial buildings.

## 3. Energy Consumption of Commercial Buildings

When taken as an average these types of buildings seem to consume around 15, 14, and 13 KWh/$m^2$ with regard to CEB, and self energy per month.

*Table 2: A Comparison of Unit Consumptions of Building Types*

| BUILDING TYPE | KWH/M$^2$ | | |
|---|---|---|---|
| | CEB | GENERATOR | TOTAL |
| Hotels | 13 | 2 | 15 |
| Mixed Develop | 10 | 4 | 14 |
| Offices | 9 | 4 | 13 |

It can be concluded that offices are the lowest energy consumers which is understandable considering the function. However the small margin of disparity reveal that they are not geared for energy conservation compared to other two types.

## 4. Possible Contribution of Commercial Buildings towards GHG Emissions

The possible derived emissions from the buildings were quantified and shown in Table 3 as follows.

*Table 3: Summary of Actual Emissions by Different Types of Buildings*

| BUILDING TYPE | $CO_2$ ( KG) | | |
|---|---|---|---|
| | AGGREGATE '000 | PER BUILDING '000 | PER m$^2$ |
| Hotels (5 Nrs) | 3,955.21 | 791.04 | 16.58 |
| Mixed Developments (5 Nrs) | 2,841.44 | 568.28 | 14.14 |
| Offices (10 Nrs) | 2,084.50 | 208.45 | 13.66 |

Taking the extreme situation in to account a hypothetical case is examined, where the whole CEB supply would be based on thermal power as shown in Table 4.

*Table 4: Summary of Hypothetical Emissions by Different Types of Buildings*

| BUILDING TYPE | $CO_2$ ( KG) | | |
|---|---|---|---|
| | AGGREGATE '000 | PER BUILDING '000 | PER M$^2$ |
| Hotels (5 Nrs) | 10,009.88 | 2,001.98 | 41.70 |
| Mixed Developments (5 Nrs) | 6,826.25 | 1,365.25 | 34.63 |
| Offices(10 Nrs) | 4,868.97 | 486.90 | 32.50 |

## 5. Conclusions

The significance of impacts on the natural environment resulting from the increased concentrations of GHGs and the importance placed on addressing these issues by the global community is well known. In terms of the Sri Lankan context, the trend in fossil fuel based electricity production of the country has risen from 7.7% in 1991 and 48% at present, and is expected to increase further up to 74% in 2016. Even though the above indicate that the Hotels as the largest contributor towards GHG emissions, in reality they are already conscious of and are implementing a considerable amount of energy efficient measures by which to become more energy efficient In case of office buildings, despite their low contribution towards the emission of GHGs, they present further potential for emission reduction, by adhering to various energy saving measures. In case of Mixed Developments the energy efficiency mainly depend on the tenants of the apartments. The higher costs of adopting these technologies, lack of access or awareness, together with the associated risks were identified as major barriers for their popularity.

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# SECTION XV

## POST DISASTER RELIEF

# Sanitation during disaster relief and reconstruction; the experiences of Asian Tsunami 2004

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*Sanitation is an issue often neglected in development decision making. This situation becomes more evident under the extreme conditions of a disaster aftermath. Furthermore neglecting the importance of sanitation during disaster rehabilitation may jeopardize the sustainability of entire rebuilding projects. This paper is an attempt to delineate and suggest solutions to the critical problems encountered in providing proper and adequate sanitation during refugee situations and post-disaster rehabilitation projects in tropical developing countries. The author records the experiences gained in several projects carried out as a partnership of Government and NGO sector organizations during the aftermath of the 2004 Tsunami incident in Sri Lanka. The paper also discuss how "proper and adequate sanitation" can be ensured through a proper disaster management framework.*

**Keywords:** Disaster Sanitation, Post-disaster rehabilitation, Social Acceptance, Sustainability

## 1. Background

The technical background to provide proper and adequate sanitation in most geo-climatic regions of the world is already available; further to this it is now universally accepted to consider sanitation as "Basic Human Need" in all development work. Despite all these, sanitation remains a second priority in development decision making in many developing countries. This fact becomes woefully evident during disaster relief and rehabilitation.

Access to "Proper and Adequate Sanitation" is an important concern in all the phases of disaster management. But during many recent disaster situations that occurred in the South / Southeast Asia, many failures were recorded in providing access to sanitation. This paper gives a Birdseye View of how the sanitation issues were handled during the Asian Tsunami aftermath in Sri Lanka reviewing technology, management systems and institutional aspects.

Any disaster management program can be divided into three phases, which are namely: a) Immediate relief b) Intermediate rehabilitation and c) Permanent rehabilitation. Provision of "Access to Proper and Adequate Sanitation" is an important aspect in all three phases, but the methods, technology and tools applicable may vary significantly from phase to phase.

Figure 1: Three Components of Disaster Sanitation

An appropriate technology, proper awareness on sanitation among all the stakeholders and an effective framework for implementation should essentially be brought together for success of any disaster sanitation scheme [3].

## 2. Immediate Relief and Intermediate Rehabilitation

Many weaknesses were observed during the immediate aftermath of the 2004 Tsunami in Sri Lanka in all the three components of Disaster Sanitation (Technology, Awareness and Implementation Framework).The reasons for these failures were: The astronomical number of refugees, Lack of funding allocated for sanitation, Lack of skilled labour, Space constraints, Lack of Sanitation literacy among IDPs and Relief Staff and Physical constraints on conventional sanitation techniques (Pit and trench disaster latrines)

Lack of awareness about the importance of "disaster sanitation" among the institutions involved in disaster management could also be observed generally in all the effected areas. The institutional capacity (i.e. Skills or Resources) to handle the issue of sanitation were either inadequate or non-existent. In certain IDP camps some level of access to sanitation was provided but no attempts were made to assess the appropriateness or adequacy of these facilities.

The disaster sanitation techniques that were in practice prior to the 2004 Tsunami were confined mainly to open pit or trench latrine systems. There were many limitations such as cost, lack of hygiene and inapplicability in water logged areas of these techniques. The author was involved in an intensive program to develop and implement a set of appropriate sanitation techniques for IDP camps in the immediate aftermath of the 2004 Tsunami. The project identified the following points as the essential characteristics of an appropriate disaster latrine technique [1];

1. Technically sound and suitable for site conditions.
2. Hygienic and safe for any category of users.
3. Minimum environmental impacts
4. Low cost of construction and maintenance.

5. Simple technology (both construction and maintenance) & Minimum requirement of technical expertise.
6. Local availability of required construction materials.
7. Quick installation.
8. Social acceptance

Under this project a series of disaster latrine techniques named the" Sri Lankan Disaster Latrine" (SDL) was developed, different versions of these latrines were successfully applied to solve the sanitation problems in several IDP camps[1].

A disaster management act was passed by the parliament of Sri Lanka in October 2005. With this act a new Disaster Management Centre (DMC) was established under the Ministry of Disaster Management. It is commendable that the organizational structure of DMC integrates the government institutions relevant to all aspects of disaster management. But not taking into account the role of NGOs and CBOs whose contribution is immense at ground level implementation of disaster relief, is a notable drawback [1].

## 3. Permanent Rehabilitation

With the gigantic problems encountered in allocating land and construction of Tsunami permanent reconstruction projects, the "Environmental Suitability" naturally became a secondary concern. The author was involved in a study to investigate the potential environmental impacts of proposed permanent housing schemes for Tsunami Affected People. One of the major causes of pollution highlighted in this study was the possibility of ground & surface water contamination due to improper sanitation methods/ techniques used. Out of total number of housing projects investigated under this study approximately about 55% had sanitation related problems. The percentage was as high as 90% in Trincomalee district whereas it was less than 10% in the Gampaha district.

The technology available for permanent sanitation and general sanitation awareness in Sri Lanka is satisfactory [2]. The average sanitation coverage of the country is about 72% percent. The main weaknesses were on the awareness about different sanitation options and poor monitoring by the approval agencies.

## 4. Conclusion

Many weaknesses and drawbacks were observed with regard to ensuring access to Proper and Adequate Sanitation during all three phases of the 2004 Tsunami disaster management process. From the observations made by the author it is clear that the technical resources available for providing disaster and permanent sanitation in Sri Lanka is satisfactory, the weaknesses exist mainly in the awareness and the implementation frame work of the institutions involved in disaster management. Improvement of Sanitation Literacy among general public is also an important requirement. Furthermore it was observed that a direct intervention and implementation approach will be affective in providing access to sanitation during the Immediate Response and Intermediate Rehabilitation stages; whereas a more indirect approach which involves awareness & capacity building should be followed in the permanent rehabilitation stage. Mainstreaming the aspect of sanitation in Disaster Management decision making in the country should be the ultimate objective of this whole process.

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# SHELL – House Steel/Polyurethance Sandwich Systems Ready to Build

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*A shell formed architecture can be quickly obtained by a light steel bearing structure holding insulated polyurethane sandwich panels, shaped in shell form or straight. Lightweight façades could be shaded, in hot climates, with textile extentions and double roofs. Methodology follows very strict design phases which have brought to different systems with different, but a very simple, final shapes. Some prototype has been realized in order to optimize the system and to verify all the theoric calculations about wind loads and earthquake loads (above all the collaboration of the outside curved shell and the bearing structure). Many tests have been carried out to check natural lighting, optimization of spaces, statical loads, dynamic loads, thermal behaviour, etc.*

**Keywords:** Post disaster quick built, Energy saving, Flexibility, Dismountability, Technology transfer.

## 1. Background

### 1.1 Structure Envelope (STREN) Technologies for quick construction

Simple constructive principles and housing systems normally require complex process of analysis that leads to the synthesis of their final form and technology. Industrialized systems of construction, based on sandwich panels or stratified layers supported by a frame structure, seem to offer several advantages in a quick reconstruction situation[2].

### 1.2 Technology: “Shell-House”, ready made industrialized home

A “Shell-House” is based on a simple concept but it is the result of integrated design among architects, engineers, building industry. This helped to achieve different goals: the use of products already available on the market, the weight optimisation and the logistic, transport optimisation, semplicity and speed of assembly, and last but not least important, pleasant architecture. The first “Shell-House”prototype, using curved and linear sandwich steel-polyurethane panels, was designed by Atelier 2 with the industry Metecno. In that first case the unit was designed, totally for free, for the italian NGO Emergency who supports civilian war victims.

*Figure1 Emergency unit in Rumania 2007.*

### 1.3 “L’Armadillo”, ready made industrialized home

“L’Armadillo” is a clever evolution of the “Emergency” unit into a house or other living functions. In this case it has been designed by Atelier2 with the industry Brianzaplastica using their existing roof panel “Elycop” (sandwich with 40 – 80 mm thickness, radius 3.30 m). The bearing structure is based on 3 hinges arches which supports a secondary structure an then the sandwich panel shell.

### 1.4 Prototype and site tests

A prototype has been realized and tested in 2005 in Carate Brianza. Dimensions are 6,60 m x 8,00 m (more than 50 sqm). The structural system has been calculated first with Straus automatic finite elements program both for stress and strains and the prototype has been tested to veryfy the structural calculations. Design and testing on site have been undertaken following specific regulations.

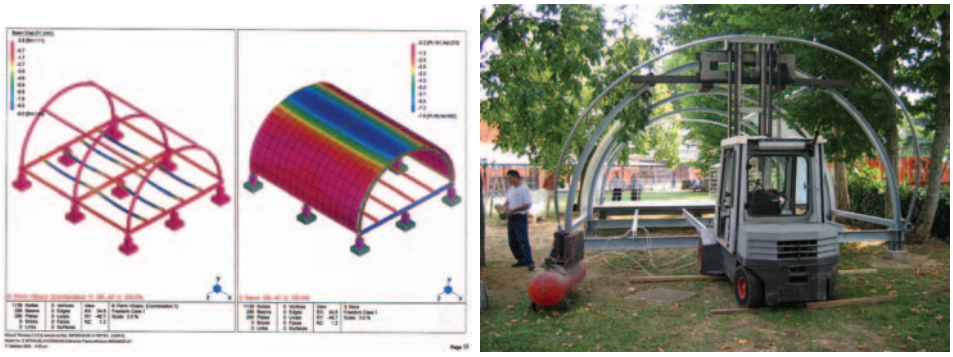

*Figure2 Structural analysis and field tests*

## 2. Temporary Pub “Pian Cafè”

*Figure3 Corten steel high durability shell*

“Pian Cafè” is the direct application of “L’Armadillo” for a different purpose of temporary and dismountable unit conceived to be a Pub in a small town.

## 3. Conclusions

The Shell House realized are modular units designed and built with quality products, present on the market and often used for non-residential purposes. “L’Armadillo” is designed to be shipped in a container, mounted and dismantled, if necessary, through simple, quick procedures. Shell Houses flexibility (both in longitudinal and transversal axis) allow to create common spaces to be used during disaster period but also to reuse units which can be houses during disaster period and, if a reconstruction is done in the time, afterwards can be turned in public spaces (schools, libraries, Pubs, kinder gardens, etc.).

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# Thermal Comfort Tools for Emergency Shelter in Major Disasters

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*Many basic yet effective building environment tools are not used and moreover not included in courses on design and construction. Instead, there is a heavy and increasing reliance on computer based tools and technology though while being attractive belay the levels technology and information available in both developing countries and in disasters. This paper pulls together the climatic tools associated with emergency shelter with the objective of outlining the body of knowledge (and thereby tools) available to humanitarian engineers and technicians in the field.*

**Keywords:** tools, guidelines, climatic design, education

## 1. Background

The basic unit of emergency shelter are tents. Though people in disasters or conflict situations have many options for shelter such as staying with other family, moving out of the area or occupying other buildings tents remain as the "catch net" for emergency shelter. Based on that, this paper then looks at the climatic tools available to designers for making the best of what can be a desperate shelter situation.

## 2. Climate

Climate data is the starting point for such tools and the approaches outlined in the paper. Documents such as the "Climates of the World" published by the Dept of Commerce USA give minimum and maximum temperatures for many cities through the world. It can be down loaded from www.ncdc.noaa.gov/climate/climatedata.html#clim . This site also has the facility to format and down load recent monthly averaged climate data for 1,600 stations outside of the USA. This is a good starting point. Such data is usually not available for the precise site and when data is available from a nearby weather station (such as an airport or city) it usually requires mathematical modified for differences in terrain and topology. The required modification factors can be readily obtained from any structural loading code. Where the topology blocks the climate (rather than modifying it) such an approach of mathematical modified is not appropriate and other methods are required.

### 2.1 Thermal Comfort models

Having established the climate characteristics, how that is then modified and sensed needs to be studied. And in particular, when is thermal comfort achieved. Thermal comfort is a complex and contentious issue. The relationship between the objective measurement and the subjective response is not clear and remains at the centre of an ongoing thermal comfort debate. Field studies of free running or naturally ventilated buildings supported an "adaptive" rather than the "static" approach for essentially "sealed" buildings [1]. People were "adapting" to their environment and for example MacFarlane [2] had found as early as 1958 that Europeans in Singapore preferred temperatures that were some $2^{O}C$ warmer than those in Sydney. Various adaptive models are presented and discussed with a methodology for use in the field proposed.

## 3. Natural ventilation

In warm humid climates natural ventilation is the often the only option for achieving thermal comfort. However, there is presently no guidance in the literature on how this is promoted in emergency situations. Natural ventilation is caused by either wind induced pressures or by solar induced temperature differentials with wind usually being the dominant source. And hence the goal is to maximize the airflow through the tent or shelter. Several practical and commonly encountered spatial situations are presented with a more general theoretical approach also set up.

## 4. Heating

Recent aid following the earthquake in Pakistan have also highlighted that there are issues on the heating side for tents as well as the more usual cooling requirements discussed above. In Pakistan, aid agencies (initially) issued non winterised tents and there were significant issues in the field to resolve this problem before the onset of winter. This came to be known and publicised in the media as "the winter race"[3] and required a significant effort from the technical support teams in devising practical upgrade options. This section draws on the technical lessons learnt from that experience.

The heating requirements for tents are based around the Heat Loss Equation which is as follows:

$Q = UA(T_{in}-T_{out})$,

Q= rate of heat loss

U= "U value" or thermal transmittance or the inverse of the thermal resistance

A= surface area of tent

$T_{in}$= Temperature inside the tent

$T_{out}$= temperature outside the tent.

Thus to reduce heat loss requires one or more of the following:

Lowering of the U value (or conversely increasing the thermal resistance of the sides, roof and ends of the tent). This is achieved by better insulation.

Minimizing the surface area of the tent. This not a real option given the practical constraints on tent dimensions other than digging down into the ground.

Rationalizing (and hence increasing) the outside design temperature $T_{out}$. If tents are in frost areas then an outside temperature of $-2^{O}C$ would be appropriate. Moreover, if the presence of a nearby river means that temperatures would only reach say $0^{O}C$ and this is used instead than a lower heating loss would be achieved.

Lowering the inside temperature $T_{in}$. This should be set by the thermal comfort model discussed earlier.

(It should be noted that there are many "home truths" about how people survive cold that should be analysed careful against the framework as outlined above).

## 5. Conclusion

Much of what has been presented in this paper will seem straightforward and certainly has been known for some time (as can be seen from the reference list below). But it is not used in the field nor is it readily known operationally. And this is because the "Tools of Trade" have never been collected in one place and hence this paper. But the reason for such tools not previous being gathered together is because of the wide range of disciplines involved. Therefore, any training needs to reflect this wide ranging cross discipline approach required to adequately prepare site planners/ engineers and architects involved in emergency shelter.

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# Identifying Value Adding in Humanitarian Programs

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*Earlier work by Kestle had established a management model for design management in remote areas [1]. That model was subsequently tested in the humanitarian aid context of West Darfur in June 2004 and found to be very effective in modeling and understanding the issues related to the provision of humanitarian aid in remote locations [4]. And in this paper, the authors extend the application of that model into identifying where value was added (both perceived and actual) by the Jesuit Refugee Services (JRS), as part of it's Tsunami Relief Program in Aceh, Indonesia. It then suggests ways that this value could be enhanced. This need came about as part of an end of program evaluation of the TRP. The mission statement of JRS is to "accompany, serve and defend" and it was interesting to see how this worked out in the field. Many/most of the JRS field team felt that their added value was linked to it's flat organisational structure and it's bottom up management structure that meant that JRS could respond rapidly to changing circumstances and beneficiary requests. The Kestle Model provided a framework to compare what was seen in the field against what was planned by management. And from that comparison and analysis demonstrate where value was being added.*

**Keywords:** Added value, humanitarian, aid, management, framework

## 1. Background

How do different humanitarian aid organisations add value?

As part of an evaluation of their 2 year tsunami program in Aceh, it became clear that JRS believed that they did have their own particular way of doing things and moreover this was identified by those in the field as being the main way that JRS added value [2]. What was interesting for the evaluation team was that none of this "JRS way" was actually written down and this also appeared to be at difference to the organisation's mission statement. The mission statement of JRS is to "accompany, serve and defend" and it had been doing that in Aceh since July 2001 with a focus on relief, emergency support and accompaniment for refugees (those returning from countries outside Indonesia) and internally displaced persons IDPs (those returning from other parts of Indonesia) to Aceh in North Sumatra [3].

## 2. Methodology

The study used a conceptual design management model developed by Kestle [1][4][5]. The model was originally developed in terms of "reviewing and synthesizing theoretical published 'production principles' and 'sociological factors' associated with design management, and lean design management." And has it's theoretical basis in Just in Time (JIT), Total Quality Management (TQM) and Lean Production theories.

The model uncovers value generation within the design management process and the four areas of the model reflect the many stake holders participating in this value adding process. For example, developing a shared understanding of what is valued on the project and identifying, and then agreeing the objectives for a project with the stakeholders. How this was achieved was critical to the original evaluation but was particular interesting in terms of the usefulness of the model. Much of the lean thinking research falls into the tactical category rather than strategic and theoretical, that is, until the work of researchers Koskela and then Seymour [6][7]. Seymour suggested a proposal for implementing lean construction at an organisational rather than just at the operational level. This work was then followed up two years later by Seymour and Rooke using an ethnomethodological approach in terms of setting up an organisational culture that established how people may perform their site work activities in a visibly orderly manner, by changing their mindset, for instance. Similar findings were published by Howell and Ballard stating that changes of the mental model needed to be made [both are reported in 5]. They further suggested that lean thinking (applied at the beginning, or alternatively applied midway on well run projects) revealed the weaknesses of the current systems by mapping the project value stream. The lean design principle of 'flow' is relevant from a sociological and environmental viewpoint, as it tends to be focussed on a more holistic approach for theoretical and project development work. The thinking and principles associated with lean design management, made a significant contribution in terms of informing the development of the Process Integration factor for the conceptual design management model (for remote sites) [5]. The key factors of design management for remote sites were therefore established as being - 'value generation', 'knowledge integration', 'process integration' and 'timely decision making'.

## 3. Conclusion

So where was the value that JRS added? And to what extent was the sense (as mentioned earlier in this paper) that flexibility and speed of response to beneficiaries needs was the main value added service that JRS provided, was this confirmed by the model?

The TRP had a strong and singular beneficiary focus. That clearly came through in the Value Generation and Knowledge Integration factors. But the flexibility and speed of response were not recognised as value adding. While it could be that both were treated as "givens" being evident in the reliance on feed back, field reports and the informal nature of the knowledge integration identified better value would have been realised by promoting flexibility and response in any future programs.

It is also evident from this analysis that there is the potential for further value adding to beneficiaries by the following:

- Value Generation- More emphasis on flexibility, response and the development of a stronger community of practice (COP) approach.
- Knowledge Integration- Analysis of the responses of beneficiaries
- Process Integration- Development of COP approaches.
- Timely Decision Making- Further decentralisation

This aside, the interesting (and surprising outcome) was the usefulness of the Kestle's framework in analyzing such a situation suggesting that the model was more robust and portable than perhaps originally thought?

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# Flooding in New Orleans, USA and Hull City, UK: Comparing Disaster Management Strategies

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*During the summer of 2007 the United Kingdom experienced some of the worst flooding in its history, with the city of Hull amongst the worst affected. An examination of the government handling of mitigation measures and disaster response in this instance raises comparisons to the 2005 Hurricane Katrina related flooding in New Orleans, USA. These events are especially appropriate for comparison given the vulnerability of each city and general feeling of dissatisfaction among residents. This paper examines each event individually and presents a comparison of the actions and inactions of each government. The result is a call for stronger and more decisive measures to combat climate change and protect vulnerable populations more efficiently against natural disasters.*

**Keywords:** Flooding, Hurricane Katrina, Disaster Management, Disaster Response, Mitigation, Climate Change

## 1. Background

In these times of escalating concern over global warming and its effects on weather patterns, as well as the size and frequency of natural disasters, it seems fitting to analyse and discuss how effectively governments are planning for disasters and whether they are responding to them appropriately. This study compares two recent natural disasters; Hurricane Katrina which devastated the US Gulf Coast in 2005 and the major flooding which wreaked havoc in the UK during the summer of 2007.

Although hardly comparable in scale with regards to death toll or economic loss, these events have raised many parallel issues in government mitigation and response protocol and initiative.

The focus will be on two of the worst affected cities which share many similar issues; New Orleans and Hull City. Each is topographically vulnerable and guarded by a pump system unable to cope with the most severe floods. In addition the residents of each city ultimately felt that they were neglected and let down by the government in terms of the provision of mitigation against flooding and the disaster response effort which took place.

## 2. Flood Events

### 2.1 Hurricane Katrina related flooding

On August 29th 2005, Hurricane Katrina devastated the Louisiana and Mississippi coast. The scale of destruction made Katrina the largest natural disaster in U.S. history and triggered a massive relief and evacuation effort.

In the two years since Katrina struck questions over the adequacy of disaster mitigation measures prior to the storm and the speed and efficiency of response efforts to the crisis have been widely criticised in the world's media and the residents of New Orleans in particular have voiced their ill-feelings as to how the storm was planned for and dealt with.

Firstly consider that nearly every levee in the city breached and caused 80% of the city to flood, along with many areas of neighbouring parishes. 40 years after the Flood Control Act was passed in Congress, it is unacceptable that the protection system for New Orleans was still only 60-90% intact with an estimated completion date of 2015.

In addition, the immediate federal response to Katrina was so incredibly inept it led many to wonder if this lack of support was deliberate and had any political, racial or social motivation. Experts had warned for years that New Orleans was a disaster waiting to happen, yet an effective emergency plan that would include all co-operating levels of government was still not in place [1].

### 2.2 UK flooding summer 2007

In the summer of 2007, the United Kingdom sustained widespread flooding caused mainly by unseasonably low pressure systems during June and July which dumped record amounts of water on certain areas that were simply not equipped to deal with such a volume of water.

Hull was particularly vulnerable to begin with in its low-lying position but in recent years the pumping system had been significantly upgraded and this indeed may have averted a catastrophe. Given the fact that the flooding was a 1 in 150 year event and the city was assessed as a 1 in 30 year flood risk, it is encouraging that key civil infrastructure did not fail. Flooding occurred because the drainage system was full to capacity as were all waterways so effectively there was nowhere to pump to [2].

Problems appeared during the crisis regarding co-operation between multiple agencies in charge of different areas of the drainage system; the Environment Agency, Hull City Council and Yorkshire Water. No agency accepts responsibility for any

elements outside their own terms of reference and this is undoubtedly a problem nationwide. One has to wonder why it took a major disaster before the government would listen to calls for a drainage system overhaul.

In addition there is currently no provision to warn of flooding caused by heavy rainfall. This problem exists at a national level and as such must be addressed by central government.

Local residents and councillors were unhappy at the lack of media coverage afforded Hull given the scale of devastation and were further outraged when it surfaced that the government had been warned months in advance by the Met office that summer flooding was probable because the El Niño phenomenon had weakened, but no action was taken.

## 3. Government mitigation measures and disaster response

Upon examination of the evidence in seems clear that both the US and UK governments were forewarned as to the likeliness of these disasters occurring and should have ensured that appropriate mitigation measures were taken.

In New Orleans, the incomplete levee system should have been finished several decades previously and was not equipped to combat a hurricane of Katrina's magnitude [3]. Meanwhile in Hull, a city in a similarly vulnerable topographical position, the decision was made to protect Hull from a 1 in 30 year flood event when in reality the city was hit by a 1 in 150 year event. Mistakes were made in the build up to each disaster in terms of warnings, evacuations and deployment of supplies and personnel to affected regions.

In each case, a lack of action in the face of scientific warnings that such events were likely has cost dearly in terms of life and economic losses. Meanwhile, the emergency response from both the UK and US governments to these disasters has created a mood of resentment within sections of the affected communities who felt that they were neglected in one way or another. Besides the possibility of political motive and neglect, the lack of co-ordination between agencies has surely emerged as a central problem for each government.

## 4. Conclusion

Many experts warn that due to extreme weather climate change risks are growing [4]. Recent climate model simulations show that a doubling of $CO_2$ may increase the frequency of the most intense cyclones. Equally, the changing weather systems in the Pacific Ocean are likely to alter the magnitude and frequency of extreme events in the UK.

In the face of scientific evidence that climate change is most likely causing an intensification of extreme weather events, governments worldwide must accept that change is necessary in both environmental policy and disaster planning and management.

While it would appear that the mistakes made in the UK were arguably more naïve than in New Orleans, it is simply unacceptable that the US and UK governments have not done all that is necessary to mitigate as far as possible against such disasters. This is particularly true when we consider that these countries are responsible for extensive environmental damage and possess the capability to implement change [5].

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# Targeting Cash Assistance to Vulnerable Families in South Asia's 2005 October 8 Earthquake

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*The October 8, 2005 South Asian earthquake devastated the northern regions of Pakistan, destroying or damaging close to 600,000 homes, leaving more than 73,000 dead, and resulting in displacement of 3.5 million persons. Given the scale of devastation the government relied heavily on outside assistance, either in the form of direct aid or loan. One such grant aimed at rehabilitating livelihoods was the Livelihood Support Cash Grants which provided $50 per month for six months to 260,00 vulnerable families. We evaluate the implementation of this grant, in particular examining whether the grant was given to those families identified as vulnerable and as such focus on leakage and under-coverage of the program. We observe that one in two deserving families received the grant, and that the other family did not fulfil the criteria but was receiving funds. Through a multivariate analysis, we next built a parsimonious model to explain exclusion and false inclusion (leakage). We observe that for exclusions, families reporting a female as head of household was 8.1 (95% C.I. 4.1-15. 9) more likely to be excluded than families with male heads, and families with increasing number of children 2.5 times more likely (OR=2.5, 95% C.I. 2.1-2.9) than those with fewer children. The likelihood of exclusion was also higher with increasing age of family head (OR=1.1, 95% C.I. 1.07-1.2) and if a family resided in Azad Jammu and Kashmir (OR=2.6, 95% C.I. 1.2-5.7). With respect to leakage the model shows that families with younger ages (20-39 years) of family head (OR=4.4, 95% C.I. 1.4-14.1), increasing number of males (OR=2.9, 95% C.I. 1.8-4.6), and families living in Azad Jammu and Kashmir (OR=2.6, 95% C.I. 1.2-5.5) were more likely to be receiving the grant. In evaluating this program, we conclude that the Livelihoods Cash Grant Program was successful in only reaching half the vulnerable population as defined by the criteria..*

**Keywords:** Cash assistance, Disaster mitigation, Social protection, Earthquakes, Pakistan, World Bank, Women

## 1. Introduction

The October 8, 2005 South Asian earthquake with a magnitude of 7.6 on the Richter scale, covering a total area of 30,000 square kilometers of the Northwest Frontier Province and Azad Jammu and Kashmir, took an unprecedented toll on the lives and livelihoods of people living in northern parts of Pakistan. The fault line of destruction extended north to south taking a heavy toll in five districts of North West Frontier Province: Abbottabad, Mansehra, Batagram, Kohistan and Shangla, and four districts of Azad Jammu & Kashmir: Muzaffarabad, Neelum, Bagh & Poonch. An estimated 73,338 persons died, amongst them 18,985 students and 853 teachers were buried under the rubble of school buildings that collapsed in the early hours of that morning [1]. An additional, 69,400 suffered from injuries and 3.5 million persons were displaced from their homes [2]. In addition, an estimated 600,000 houses were partially or completely destroyed in 4,000 villages across nine administrative districts.

Providing immediate assistance to vulnerable populations was a priority so that families could get on with their lives. From the outset, the Government of Pakistan relied heavily on cash assistance to families for reconstruction of homes and livelihoods. One such program was evaluated by Relief Information Systems Earthquake, Pakistan (RISEPAK) based at the Lahore University of Management Sciences (LUMS) in Lahore, Pakistan. We looked at the $85 million Livelihood Cash Grants Program that was part of a $400 million loan from the World Bank Emergency Recovery Credit. In particular, through a survey of 2,612 families of which 2,001 matched with families enumerated as part of the Livelihood Support Cash Grant (LSCG) we evaluated under-coverage and leakage in the program.

## 2. RISEPAK Survey of the Livelihood Support Cash Grant

The Livelihood Support Cash Grant (LSCG) disbursed funds ($300) to over 260,802, and was conceived as central to recovery of vulnerable families. It enrolled nuclear families that could provide a national identification card (CNIC) of the family head and a valid bank account for transfer of funds if selected. Over 750,000 families enrolled in the program from the nine affected district of northern Pakistan, and the LSCG program claims that over 30 percent of families receiving the cash grant are considered as fitting the vulnerability criteria [3], which was defined as families reporting housed damage, with no male members between 18-60 years of age or a male member with a disability, or families with five or more children.

In fall 2006, RISEPAK was contracted by the World Bank to conduct an evaluation of the Livelihood Support Cash Grants (LSCG) Program, with a main focus on determining exclusions (families who were eligible and did not receive the cash grant) and false inclusions (families who were not eligible according to the vulnerability criteria but receiving the cash benefit). To achieve our objectives we designed a field survey at the household level of families living in the earthquake-affected areas. Of the nine affected districts, we included seven (omitted Kohistan and Shangla) for reasons of security.

We conducted a sample survey of 2,612 families and of these 2,001 records matched with the larger LSCG database on the basis of the Computerized National Identification Card (74%) and these cases were the focus of determining exclusions and leakages in the LSCG program. We conducted multivariate analysis to see the independent effect of factors associated with receiving the cash grant and constructed a parsimonious model to explain both under-coverage and leakage.

Our results show that on demographics these 74% of cases were similar. For these cases 30 percent were identified as eligible on the basis of criteria, and of these, half were receiving the cash grant. The other half receiving the cash grant did not fit the criteria as stated. In our multivariate model constructed to assess which factors were most predictive in determining under-coverage and leakage, we adjusted for distance to the program enrolment location, the number of males between ages 18-60 years in the family, and disability. The final adjusted model for under-coverage and leakage are given below.

| **UNDERCOVERAGE** Model | Adjusted Prevalence (OR) | 95% Confidence Interval |
|---|---|---|
| Family Head | | |
| Female | 8.1** | (4.1, 15.9) |
| Male | Ref | |
| Age of Family Head | 1.1** | (1.07, 1.2) |
| No. of children <18 years | 2.5** | (2.1, 2.9) |
| Province | | |
| NWFP | Ref | |
| AJK | 2.6 | (1.2, 5.7) |

**p-value <0.01

| **LEAKAGE** Model | Adjusted Prevalence (OR) | 95% Confidence Interval |
|---|---|---|
| Age of Family Head | | |
| 20-39 years | 4.4* | (1.4. 14.1) |
| 40-59 years | 2.7 | (0.9, 7.6) |
| 60 plus years | Ref | |
| No. of Male Members | 2.9* | (1.07, 1.2) |
| Province | | |
| NWFP | Ref | |
| AJK | 2.6* | (1.2, 5.5) |

*p-value <0.05

## 3. Conclusion

The argument for using cash assistance is two-fold. First, an influx of cash allows for the local market to recover, and second, it gives victims the choice in determining their needs for recovery. However, while the rationale for market recovery and consumer choice may be sound it is unclear whether cash assistance can be accurately targeted to those in greatest need of it after a disaster. We do not know how the selection of beneficiaries was determined but it is clear that one-half of those identified as beneficiaries of the program are not deserving of it. Moreover, it is worth noting that families with females as heads were most likely (8 times more likely than males) to be excluded. In a patriarchal societies where men tend to have access to resources and political power it is very important to determine how the LSCG program determined and conferred beneficiary status. Given that local district level officials were involved and that it was an election year in Azad Jammu and Kashmir, it is possible that funds were misdirected to benefit political interests. Cash transfers in this case missed a substantial number of deserving families and did not serve the purpose for which they were intended.

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# SECTION XVI

## PROCUREMENT

# Managing Projects to Reduce Delivery Schedule Failures

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*In this study, the significance of forty-four sources of project delivery schedule failure were examined based on a survey of 35 construction contractors, 46 quantity surveyors, and 19 designers in Nigeria. The results shows that there is agreement between the three 3 groups of respondents regarding the ranking of the 44 sources of schedule failure. Clients' cash flow problems, contractors' financial difficulties, incomplete drawings, equipment problems, late instructions, poor supervision, material shortages, variation/change orders, planning and scheduling problems and price escalations were among the top significant sources of schedule delivery failure. Simple Linear Regression Analyses of cost data obtained from 43 private sector- and 17 public sector- procured projects show that about 16% percent of project delivery schedule failure can be explained by variations ordered by clients and their consultants while another 16% can be explained by price escalation. Clients and their project management team need give sufficient time for project planning. They need to arrange for sufficient finance prior to project award; and during tendering, consultants should conduct thorough due diligence investigation to ensure that the selected contractor is financial capable and has sufficient financial and management capability. Building capacity in project and procurement management is needed to reduce financial, supervision, planning and decision-making problems. The use of management-led procurement approach could also mitigate coordination problems. Based on anticipated inevitable changes/variations and price escalation during construction, the regression models developed could assist professionals at the pre-contract stage when estimating project cost and time.*

**Keywords:** Schedule, Delays, Project delivery, Contractors, Procurement, Designers, Quantity surveyors, Nigeria

## 1. Background

Project delivery schedule are notorious for their inability to deliver according to plan. Projects in Nigeria overrun their contract duration by between 50 and 420% [1]. Delivery schedule slippage could have significant effect on completion cost of projects [2]. This study seeks to understand how contractors, quantity surveyors, and designers perceive the sources of the project delivery failure. It also quantifies the impact of variation orders and price escalation on project delivery schedule failure. Based on the findings, recommendations on ways of managing projects to reduce delivery schedule failure are proposed.

## 2. Literature Review

Dlakwa and Culpin found that variation orders, design errors, deficiencies in public agency organizations and deficiencies in contractor organizations, price fluctuation and late payment to contractor were among the most cited reasons for delay in public projects in Nigeria [3]. Very few studies have empirically investigated the factors influencing delays based on roles and responsibilities of parties involved in a construction project and few have made us of real life data to understand the contribution of virtuous factors to delivery failure.

## 3. Research Method

A questionnaire survey yielded responses from 35 contracting firms, 46 quantity surveyors and 21 designers in South Western Nigeria. On a 5 point Likert Scale, the respondents provided their views regarding 44 sources of delivery schedule failure. Relative Significance Indices (RSI) was computed to determine the rank of each source. Agreement among the three groups of respondents was determined using Spearman's rank correlation analysis. Further based on data obtained from 47 private sector- and 17 public sector projects, 2 simple linear regression models were set up and estimated to determine the impact of price escalation on schedule delivery failure, and of variation orders on delivery schedule failure.

## 4. Results

There is agreement between the quantity surveyors, contractors and designers regarding the ranking of the 44 sources of delivery schedule failure. Client change orders, client slow decision making, client cash flow problem, material shortages, price escalation, planning problems, designers change orders, planning and scheduling problems, incomplete drawings, late instruction, and contractor financial difficulties are among the top significant sources of the problem. In quantitative terms, 16% of the changes in delivery schedule failure can be explained by variations ordered by clients and their consultants while another 16% can be explained by price escalation. The resulting regression models are as follows:

**For Variation orders**: $Y = 5.139 + 0.414A$

**For Price Escalation:** $Y = 5.324 + 0.410B$

*Where:*

*Y* is project delivery schedule failure (measured by the amount of discrepancy between contract and actual project duration

*A* is Variation or changes ordered by clients and their consultants (measured by variations claims paid to contractor)

*B* is Price Escalation (measured by fluctuation claims paid to the contractor)

## 5. Conclusion and Recommendations

Clients and construction practitioners in Nigeria need to build capability for managing projects and to promote project management culture. Adequate time should be taken to understand and capture client's needs, clarify project objectives in order to reduce variations. Sufficient time should be given to project planning and design of projects to reduce design errors and incomplete drawings. This should also reduce variations to project scope, and lessen disruption on site. To build capability, professional bodies in Nigeria need to mandate project management training and competence as core aspect of continuous professional development and criteria for registration of professionals. Use of ICT is also critical for reducing planning and scheduling problems. To address client's decision-making problem and poor supervision there is need to secure the independence of professionals in public procurement. Clients need to reform their procurement policy to ensure due process, transparency and reduce bureaucracy. Professionals also need to build capability in procurement management and project governance. Besides traditional contracting, there the use of management- and design-led procurement approach should be considered on projects. However, decision-should be based on peculiarities of each projects. Also, project delivery schedule may not deliver according to plan because they are unrealistic and fundamentally flawed from the outset due to their lack of consideration for issues identified in this study such as price escalation, inevitable changes and other contingencies and risks. The role of quantity surveyors and other planning professionals in improving the accuracy of cost and time estimates is essential. Using appropriate risk management and modelling tools is now inevitable as there is now an unprecedented increase in size and complexity in modern projects. Also, in public sector projects, clients' cash flow problems could be reduced by discouraging practices whereby public sector clients' in-house executives and professionals reduce project budget to get their favourite project approved. Such practice could be a major source of cash flow problems resulting from unrealistic and inadequate budget thereby project delivery schedule failure.

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# The contractor–subcontractor relationship: the general contractor's view

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*Subcontractors play a significant role in the Palestinian construction industry. The aim of this paper is to explore the actual working relationship between contractors and subcontractors. This study was based on a questionnaire survey of general contractors in the Gaza Strip. Information was obtained on reason, for subcontracting, communication process, selection criteria, negotiation with subcontractors, commitment, type of contract, and control tools. The results indicate that more than 90 percent of the work is performed by subcontractors. General contractors select subcontractors according to the complexity of the work and previous experience with subcontractors.*

**Keywords:** Contractors, subcontractors, relationship, construction, development.

## 1. Introduction

The contribution of subcontractors to the total construction process can account for 80-90% of the total value of the project [1; 2; 3; 4]. This large involvement of subcontractors can be attributed to the shift from the traditional craft base, to a greater reliance on increasingly sophisticated technology-based products [2]. This has resulted in general contractors concentrating their effort, on managing construction site operations rather than employing direct labor to undertake construction work [3]. Arditi et al [5] has also attributed the increased use of subcontractors to the increased complexity of both the construction of buildings and the organizational relationship.

Subcontractors contribute significantly to the capital risk, resources, managerial effort, and business expertise supporting the largest industry in the country. The trend toward more subcontracted work accelerated as the technical development of building materials and methods escalated the requirement for craft skill and knowledge. Quality control and labor management problems on construction projects became less complicated for general contractors utilizing specialty trade subcontractors in lieu for furnishing all craft labor themselves [6]. Hinze and Tracy [1] have studied the working relationship between subcontractors, and contractors in the United States from the subcontractor's perspective. They put forward a series of recommendations to improve the subcontractor-main contractor relationship. The purpose of this study is to explore the actual working relationship between general contractors and subcontractors in the Gaza Strip for the main contractors' perspective

## 2. Results

The results indicated that the majority of the general contractors' respondents stated that it is a common practice to use subcontractor to execute specific operation in the project. They added that more than 90% of the works are performed by subcontractors. This result is similar to previous researches results in USA, UK, Hong Kong, and Brazil. The main reasons behind using subcontractors were found to be shortages of skilled labor, maximizing profit, reducing overhead costs, and reducing the work pressure on the main contractors. In addition, monitoring and controlling quality control, safety management, and labor management problem, on construction projects become less complicated for general contractors.

Concerning communication process between major contractors and subcontractors, 50% of respondents indicated that informal, face to face communication was the main mean for communication. The results indicated that 33% of respondents communicate with subcontractors by telephone. Only 6% of the respondents have mentioned that they have formal communication (using letters) with subcontractors. This result reflects the informal characteristics relationship between general contractors and subcontractors. This type of relationship (litte documentation) can be a source of problems which may affect the progress and the quality of the work.

The majority of respondents (60%) have stated that they select subcontractors according to the required specific activity and to the nature and complexity of the work. It has been noticed from the results that 13% of general contractors' select subcontractors according to their previous experience with them. Surprisingly, 7% of the respondents select subcontractors based on their reputation. This can be traced to the trend of the major contractors in the local industry in selecting the lowest bid regardless of the safety and quality of work.

It has been found that 70 % of the respondents gave all necessary drawings and bill of quantities to subcontractors in order to estimate their costs for the required operations. It was noticed that only 7% of subcontractors have visited the construction sites during the estimation process. This has led, in many cases, to inaccurate cost estimation which affected the quality of the work as subcontractors are interested to make profit without enough attention to the quality of the work being implemented (this has increased the probability of a conflict and claims after construction work has begin). The general contractor required from subcontractors to submit in addition to bid price, method of execution, past experience in similar works, time schedule, expected obstruction, and any other special conditions.

The majority of general contractors' respondent committed with the selected subcontractors during the tendering stage when they awarded the contract. However, most respondents (87%) practiced negotiation with the subcontractors after winning the contract in order to reduce the agreed costs in the tendering stage. This may be due to the sever competition between

contractors that enforce them to reduce the tender price, and thus asked the subcontractors to reduce their previously estimated cost. Regarding contract type between general contractor and subcontractor, it was noticed that more than 60% of the respondents used contracts similar to the one between owners and contractors. The other respondents used a simplified contract.

Regarding methods of measuring the performance level of the subcontractors, it was noticed that contractors (87%) have used bar chart and s-curve in monitoring the progress of the subcontractors. This reflects the formal procedures and gives a good tool to the management body of the project to correct any defaults that may occure by the subcontractors. Concerning the safety measures of the subcontractors, the majority of general contractors (93%) stated that subcontractors are obliged to adopt the safety measures as specified in the contract between the owner and the general contractor. This is a crucial point in the local construction industry as almost all works are implemented by subcontractors and general contractors. The majority of the respondents have agreed that there is a close cooperation and a good flow of information exchange between general contractors and subcontractors. In general, the main contractors' respondents were satisfied with the performance of subcontractors.

## 3. Conclusion

This study has explored the working relationship between general contractors and subcontractors from the general contractors' perspective. A decision to subcontract part of the process should be a strategic decision, and not one driven solely by resource problems. It may involve long-term strategic views related to the core skills required for the company's future, as well as consideration of the importance of design re-use and internal control of the design and manufacture of the product. The general contractors have stated that, it is a common practice to use subcontractors to execute specific operation in the project.

There are many benefits to be gained from working with subcontractors. It provides skilled labore, reducing overhead costs, and reducing the pressure on the main contractors. Monitoring and controlling, quality control, safety management, and labor management problems on construction projects become less complicated for general contractors. It is apparent from the results that informal communication is practiced between general contractors and subcontractors. General contractors have indicated that they select the subcontractors according to the complexity of the work and previous experience with subcontractors.

Some subcontractors have failed to exercise the proper diligence and care when submitting their bids; even they do not have the time to visit construction sites during the estimating process. General contractors committed to the selected subcontractors during the tendering stage; they negotiate with subcontractors after winning the contract in orders to reduce the agreed costs in the tendering stage. This is due to the sever competition between contractors which enforce them to reduce the tenders price, and thus asked the subcontractors to review and reduce their previously estimated costs. Overall, general contractors indicated that they have good relationship with subcontractors and they satisfied with their performance.

Further in-depth study concerning all aspects of the relationship between general contractors and subcontractors is recommended. It is imperative to improve and develop the subcontractors position towards the general contractor, by upgrading the understanding of all contract terms such as; wording and potential for negotiations of conditions including indemnity, payment and retention terms, warranties and call backs, schedule of work, delays and liquidated damages, lien and bond rights, and of curse scope of work. It is advisable to establish a Palestinian subcontractors union for better networking improves the quality and conditions of work, improving the terms of contracting and place subcontractors in a good position in the local market.

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# Developing relational approaches to contracting: the Sri Lankan context

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*The numerous drawbacks of the traditional procurement systems have been constantly criticised in the past decades for causing poor performance in the industry. The growing need to enhance the efficiencies and performance levels of the industry has created a global shift towards Relational Contracting (RC) practices, which still have not proliferated in the Sri Lankan construction industry. Therefore, the need to explore the potential to develop RC cultures in the Sri Lankan construction industry was identified. A questionnaire survey was conducted among project team members of construction projects within Design-Bid-Build (DBB) and Design and Build (D&B) type procurement arrangements. The purpose was to gather their perceptions in relation to the applicability and validity of factors identified as facilitators and impediments to RC in the Sri Lankan context.*

**Keywords:** Procurement, Relational contracting, Facilitators, Impediments, Sri Lanka

## 1. Background

Most traditional forms of construction procurement rely upon segregated teams, fragmenting the construction process. The numerous drawbacks of this system results in a general atmosphere of poor co-operation, limited trust and ineffective communication in project teams, ultimately resulting in unsatisfactory project performance. Thus, an urgent need for new procurement approaches has been created encouraging better relationships and team working within project teams. This has influenced a global shift towards "relational contracting (RC)" practices, such as partnering, alliancing, joint venturing, etc.

Recent local surveys have shown the dominance of traditional procurement systems in the Sri Lankan construction industry. Although, many countries around the world are quite advanced in the practice of RC approaches, it remains an unexplored area for research in the Sri Lankan context. The aim of this paper is to explore the potential for building a successful relationship-based procurement culture in the Sri Lankan construction industry. Specific objectives have been set to identify the factors: (1) facilitating; (2) impeding the development of a RC culture in the Sri Lankan context; and (3) to assess the capacity to adopt RC practices in the Sri Lankan construction industry.

## 2. Research method and approach

Two samples of ten projects each were selected from projects with traditional Design-Bid-Build (DBB) type and projects with Design and Build (D&B) type procurement arrangements. In each DBB project, a member of the consulting team and a member of the construction team were selected and questionnaires were distributed to them. In the projects with D&B arrangements, the same team (from a single organisation) acted as the design and the construction team. Therefore, in this instance, a single questionnaire was given to a member of the project team.

The questionnaire used a 7-point Likert scale and the respondents were requested to state various levels of agreement/disagreement with respect to 37 factors identified through the literature review. As the data collected was ordinal in nature, median and inter-quartile range were used to carry out descriptive statistics and Mann-Whitney *U* tests were used to identify significant differences in perceptions between groups.

## 3. Data analysis and discussion

### 3.1 Factors facilitating RC in the Sri Lankan context

30 out of the 37 factors considered could be regarded as factors facilitating RC in the current Sri Lankan context. Of these, vertical intra-organisational trust and top management commitment towards developing cooperative relationships between project parties were found to be strong facilitators to RC in the Sri Lankan context. In addition, on average, the respondents agreed that there was open and efficient communication, effective coordination, a team working attitude and mutual trust among parties. These have been found to be the most important facilitators to RC in the works of Cheng and Li [1] and Kumaraswamy et al [2].

### 3.2 Factors impeding RC in the Sri Lankan context

The strongest impediment to RC in the Sri Lankan context was found to be the commercial pressures on organisations and which the respondents agreed was preventing them from working co-operatively with other project parties. This was especially relevant to the contractors, as increased competition, as well as lowest price selections, had forced them to operate in increasingly tight margins. Thus, they are forced to compromise and choose between developing collaboration and better relationships with project parties having conflicting objectives to their own and their own objectives of profit maximisation.

### 3.3 Differences in ratings by consultants and contractors in DBB projects

There were significant differences in perceptions between the two groups with respect to 7 items. The contractors showed greater levels of long-term commitment towards clients and on average believed that all project parties were not held jointly responsible for the project outcome. The latter was indicative of their frustration towards the consultants' ability to escape blame for problems in design and design communication. Altogether, the responses indicate that generally the contractors had a more conducive attitude towards developing collaborative relationships within the project teams.

### 3.4 Differences in ratings by respondents in DBB and D&B projects

Eleven of the 12 factors showed significant differences between the two groups, indicating better facilitators to RC in D&B project cultures. There were noteworthy improvements with regards to equality between project parties, timely responsiveness to problems and trying to reach win-win solutions to problems. However, one surprising result was obtained, where 100% of the respondents from D&B projects agreed that commercial pressures on their organisations were preventing them from working cooperatively with other project parties. On the contrary, the respondents from DBB projects gave a median response of 'disagree' to the statement. This was attributed to the use of rigid lump sum contracts in the D&B projects considered in this research. Overall, the results revealed that D&B projects had stronger facilitating environments to RC than DBB projects. Therefore, the hypothesis, that as relationships between project parties improve through integration of project teams, the project environment seemed more conducive to RC approaches was accepted.

## 4. Conclusion

In general, the results showed that there is a facilitating environment to Relational Contracting in the Sri Lankan construction industry. However, barriers to corporative working created by the traditional procurement environments override the factors facilitating better relationships between parties in the traditional Design-Bid-Build procurement environments. Furthermore, it was revealed that the contractors were more supportive towards developing collaborative project environments than consultants. This showed the frustration of the contractors towards the inferior positions they are constantly given within project teams, as well as an unwillingness on the part of consultants to give up their dominant position. It was also revealed that there were stronger facilitators to RC with increased integration in project teams.

Drawing from the results of this study, it is recommended that initiatives be taken to shift away from the traditional project delivery strategies towards RC. Measures should be taken to promote integrated teams in the project delivery process. The government and other industry related institutions could initiate this movement by promoting integrated project teams and supply chains following the initiative of Construction Industry Review Committee (CIRC 2001) of Hong Kong and the Strategic Forum for Construction in UK. At the same time, clients should be made aware (especially clients of large scale or repetitive construction projects) of these RC practices and the potential benefits that could be obtained through their adaptation.

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# A tool for strategic safety-rating of constructors

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*The construction industry has poor safety records in globally. Improving safety has been an important goal for the WorkCover, Australia. Setting up a rating system for contractors that evaluates them on their safety records and the workplace safety programs in place would be a good strategy towards this goal. This paper proposes a model that serves this purpose. The proposed model can derive a safety index for a contractor, which may be utilised as one of the factors for tender evaluations by clients whereby better-rated contractors may be favoured. It could also be used by insurance companies so that lower insurance premiums for better-rated firms. The implementation of the model in the WorkCover can facilitate accident control in the construction industry.*

**Keywords:** Occupational health and safety, Safety index, Tender evaluation, Insurance, WorkCover, Australia

## 1. Introduction

The construction industry appears to have poor safety performance records globally. The incidence of workplace fatalities in the Australian construction industry was 9.2 fatalities per 100 000 employees in 2002–03 which was three times higher than the national average of 3.1 fatalities per 100 000 employees [1]. Raising safety standards by introducing new laws and frameworks has been a goal for the WorkCover, Australia. It is hypothesised that setting up a new rating system for construction companies that evaluates them on their safety performances would be a good strategy towards this goal. The rating may be utilised as one of the factors for tender evaluations whereby better-rated contractors may be favoured. It could also be used by insurance companies so that lower insurance premiums for better-rated firms. A company that pays lower premium for insurance would be more competitive in bidding. Hence, the aim of this study is to develop an effective tool for safety-rating of construction companies. The specific objectives are:

- Identifying and exploring the factors that need to be assessed for safety-rating of contractors;
- Developing an effective model for safety-rating of contractors; and
- Automating the model as a fuzzy system.

However, due to word limitation this paper discusses only the proposed safety-rating model for contractors.

## 2. Evaluating contractor's safety performance

It was found in the literature that the equal assessment of three key factors is important to evaluate the safety performance of contractors.

1. Dingsdag [1] quoted that evaluating the safety culture in a contractor organisation is a key factor towards safety performance evaluation.
2. Mohamed [2] measuring the safety temperature on site is therefore a key factor for safety performance evaluation.
3. While the previous two factors are pro-active and they are good measures of risk exposure, it is important to monitor how safe work behaviour is practised at both organisational and project levels through an obvious indicator. Every contractor is required to procure workers' compensation insurance to transfer the compensation liability for occupational injury victims as set out by Workers' compensation ACT. Thus, it is likely that contractors will report all the incidents diligently to the insurer to relieve them from financial burden of compensating. Hence, the usage of workers' compensation data to develop a passive indicator would be a reasonable step in this regard.

## 3. Proposed model for contractor safety rating

A new model for safety rating of contractors was developed as depicted in Figure 1.

## 4. Conclusion

Improving safety in the construction industry has been a long felt need of the WorkCover in Australia. One of the strategies towards this goal is to set up a rating system that evaluates contractors on their safety performances. This study developed a model that evaluates contractors' performances analysing three such factors as organisational safety culture, safety climate on site and actual implementation of documented safety management system. The model can be used by the WorkCover, Australia for deriving safety indices for contractors. These indices can give manifest pictures of contractors' safety consciousness which can be a key factor for clients in tender evaluations, and for insurance companies in premium-rating of workers' compensation insurance. Eventually, this would pave the way to an accident-proof construction industry.

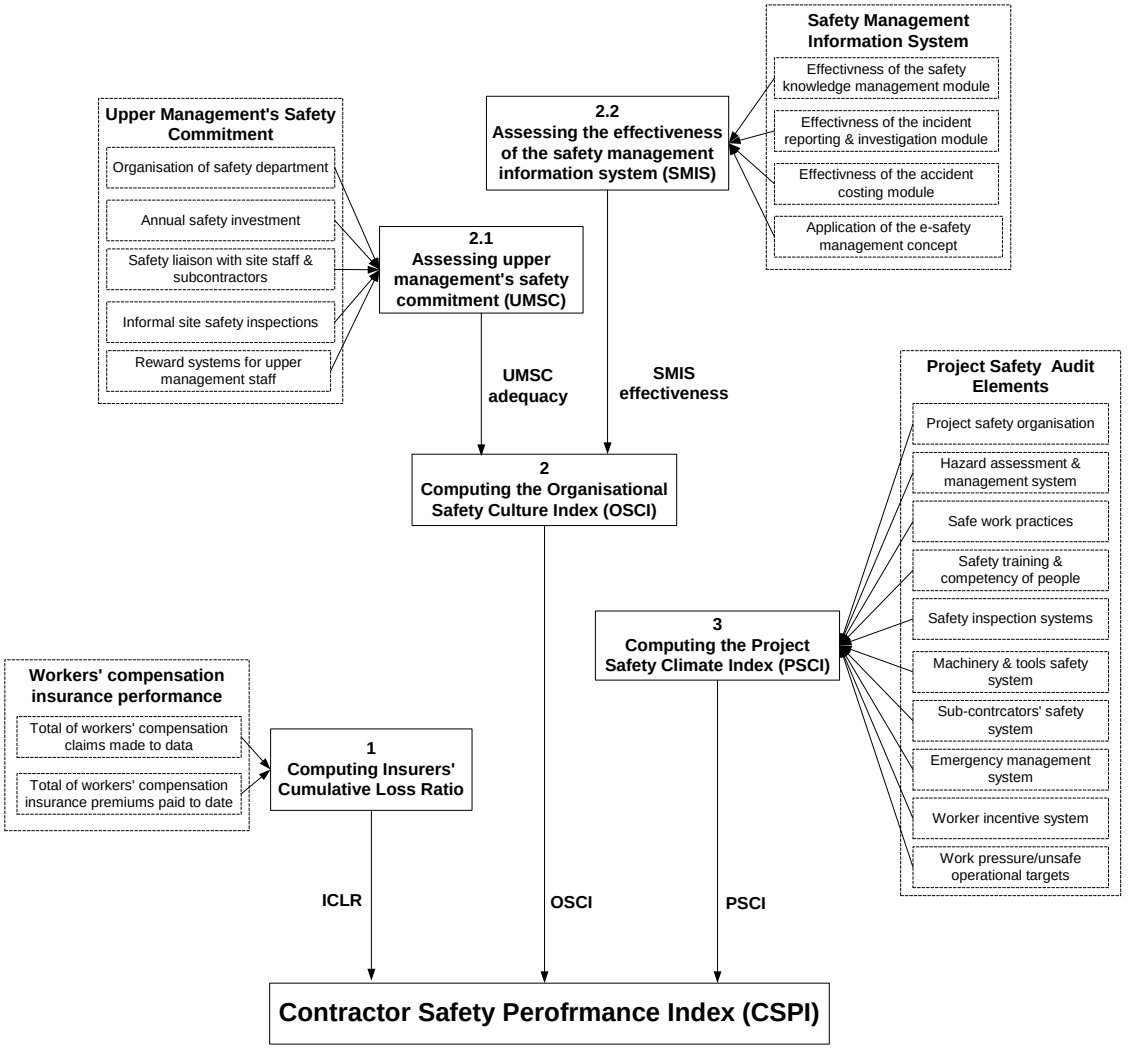


*Figure 1. Proposed model*

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# The Effect of Winner's Curse on Post-Contract Management

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*This study aims to identify whether there is an adverse effect to the client when a project is awarded to a bidder with a large winner's curse. The contractor is likely to run in to cash flow problems when he suffers from a large winner's curse. Therefore it is suspected that this would also have adverse effect to the client. The study is interesting because large winner's curses are found to exist in Sri Lankan construction industry. This urged the need to identify if a contractor with a large winner's curse is an adverse selection. The study finds positive evidence.*

**Keywords:** Disaster Claim attitude index, Post contract management, Winner's curse, Winning bid range, Winning margin

## 1. Introduction

This paper presents a study conducted in Sri Lanka to identify whether there is an adverse effect to the client when a project is awarded to a bidder with a large winner's curse. The study is interesting because large winner's curses are found to exist in Sri Lankan construction industry [5] and the knowledge about their effect is limited.

### 1.1. Background

Awarding the contracts to the most appropriate contractor is one of the critical decisions to be taken by a construction client. This is very important to achieve successful project outcomes. Awarding the contract to the lowest bidder is usually practiced in the public sector particularly because of its greater accountability. Many private clients also award contracts to the lowest bidder for cost reasons [3]. Therefore, the lowest bidder is typically the winner.

Successful bidders tend to obtain returns that (on average) lie below initial projections. This discrepancy between realized and anticipated returns, and the possibility that winning bidders end up making losses, is called the winner's curse [1].

There is evidence that high probability for large winner's curse to exist in the Sri Lankan construction industry [4]. This means that the winning contracts shall either carry losses with below average profits or even negative profits. The contractor is likely to run in to cash flow problems when he suffers from a large winner's curse. Under the circumstance the contractor may try to compensate his poor cash flow by submitting numerous claims. He may also try to make profit by reducing time and quality performance [6]. Either context would lead to post contract management difficulties as the client and consultants would be required to take extra effort for corrective measures.

### 1.2 Detection of the winner's curse

The difference between the lowest and second lowest bids is often referred as "winner's curse." However, the correct quantitative measure of the winner's curse should be the difference between the "right price" of the project and the winning bid [9]. However, the "right price" is literally unknown and thus the measure is not practical.

To represent the winner's curse, winning margin is a useful measure. The term "winning margin" ($W$) is the difference between the second lowest bid and lowest bid. The "percentage-winning margin" ($PW$) is the ratio of the winning margin to the lowest bid and can be used to compare across projects of differing sizes [5].

A recent study has found that the distribution of bid prices was symmetrical and close to the normal distribution. Most of the bids were scattered closely around the average bid [4]. With the conjecture that the majority is correct, the winner's curse measured based on the average bid price would be a better representation of real winner's curse. Therefore to measure the winner's curse "winning bid range" ($B$) can be used and it is the difference between the average bid and the winning bid.

## 2. Research Method and Analysis

The research was design as a correlation research based on an industry survey. The challenge was to measure the project management difficulties. It became necessary to unfold a new measure.

If the contractor runs into the cursed context and tries to rectify it at the expense of client's time and money; the key strategy he would use, is to make numerous claims [7]. This would yield additional paperwork and negotiations for client and his consultants; and also cause adversarial relationships. Therefore the contractor's Claims Attitude Index ($Y$) was identified to measure the level of post contract management difficulties. It was the ratio between the amount claimed for the contractual claims such as variations, fluctuations and cost headings under time extensions by the contractor, and the actual amount approved for payment:

The correlation between variables was tested using the Pearson Correlation Coefficient. Two independent variables: Percentage Winning Margin ($PW$) and Percentage Winning Bid Range ($PB$), were analysed for correlation with dependant variable: Claims Attitude Index ($Y$). The analysis results are presented in Table 1 below.

*Table 1: Pearson correlation analysis*

| Independent variables \ Dependent variable | | Claim Attitude Index (Y) |
|---|---|---|
| Percentage Winning Bid Range (PB) | Pearson correlation coefficient | 0.051 |
| | Confidence level (1- tailed) | 0.584 |
| Percentage Winning Margin (PW) | Pearson correlation coefficient | 0.274 |
| | Confidence level (1- tailed) | 0.856 |

Both independent variables (*PB* and *PW*) showed a positive correlation with the dependent variable (*Y*). However, *PB* showed poor level of correlation and confidence. Percentage Winning Margin (*PW*) showed a better level of correlation and confidence level.

## 3. Conclusions

The Analysis results showed both the winning bid range and the winning margin are correlated positively with the claim attitude. Thus, the relationship between Winner's curse and post contract management difficulties found to be positive. Therefore, awarding a contract to a bidder with a larger winner's curse could be an adverse selection. However, the correlations are not significant enough to statistically theorise this as a fact. But, the results provide clear indication about the relationship.

The Pearson correlation coefficient was 0.051 between winning bid range and claim attitude with poor confidence level; but it was 0.274 between winning margin and claim attitude with confidence level of 85.6%.

Since the winning margin is a measure of perceived winner's curse; it can be now concluded that the perceived winner's curse has larger adverse impact to the post contract management activities than that from the real winner's curse. This is because winning bid range, which is the selected measure for the real winner's curse shows a very weak relationship to the claim attitude. This is pragmatic because, the large perceived winner's curse gives the feeling to the contractor that he losses a significant amount from the contract.

With the conclusions of the research it is advised that a client should not award a contract to a bidder with a large winner's curse, especially when there is a large perceived curse.

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# Impediments to the Development of Design and Build Procurement System in Sri Lanka

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*Design and build has become a popular mode of procuring construction work. It is now regarded by the majority of clients because it offers greater confidence to them. Even through most of the researchers had found that the design and build procurement method is better than the traditional method in most areas, in general, it is not developing as dominant or as a highly practiced procurement method in most countries except France, Greece, Norway and Mexico but only in the private sector. In Sri Lanka, design and build has not increased to the extent it was expected. Therefore, it is worth finding out the reasons behind the drawbacks of the design and build procurement system development. Thus this research is intended to identify the most significant impediments to the development of design and build procurement method in Sri Lanka through two rounds of questionnaire surveys and unstructured interviews.*

**Keywords:** Design and build, Procurement method, Impediments, Sri Lanka

## 1. Background

According to the Royal Institution of Chartered Surveyors (RICS) research, conducted for United Kingdom (UK) construction industry from 1984-2004, D&B has been the single most prevalent alternative procurement method since 1995. This survey reinforces the dominance of D&B as a procurement strategy. D&B has remained steady at just over 40% of total workload value [1]. The D&B procurement method shows an increasing trend, not only in UK construction industry, but also in many other countries such as China, Denmark, Great Britain, Japan and United States of America (USA). In the private sector of the countries like France, Thailand, Norway and Mexico D&B is used as a procurement method more than 50% [2] of the time.

In the Sri Lankan context, according to the research conducted by Rameezdeen and Ratnasabapathy [3], the Measure and Pay method dominates the Sri Lankan construction industry, but has decreased in certain periods paving way for other systems. The majority of public works in Sri Lanka was found to be procured using these methods by considering accountability and transparency. D&B has recorded a usage rate of 20-35% during the period 1977-2003. The growth pattern of D&B was positive up to 1996 and then it began to decline up to year 2000, but there after no significant changes have shown in its growth. The growth of D&B is not up to the expected level in Sri Lanka when compared with the countries mentioned earlier. The traditional procurement system remains widely the procuring method and it seems to be strong. Therefore, it is essential to explore why D&B procurement is not popular in the Sri Lankan context and to identify the barriers preventing its popularity, in order to develop an innovative procurement system in Sri Lanka.

## 2. Methodology

This research is designed as a survey study to identify the most significant impediments to the development of a D&B procurement system in Sri Lanka. The data collection is carried out based on two rounds of structured questionnaire survey. Some unstructured personal interviews were set up for the purpose of study within the local context. The findings of the survey are discussed in the following chapter.

## 3. Impediments to the development of design and build procurement system in Sri Lanka

Impediments can be created externally and internally to the development of a design and build procurement system. According to Rowlinson [4], the external environmental factors comprise: political, economical, technological, financial and social aspects. The internal factors contain: issues imposed on the development of D&B procurement by client, consultant, contractor, government, statutory and regulatory bodies, research and development institutes (R&D) and professional institutes.

The twenty most significant impediments were identified, both internally and externally, that affected the development of D&B procurement system in Sri Lanka. Table 1 shows the identified significant impediments in the rank order.

*Table 1: Impediments identified through the survey*

| | Impediments |
|---|---|
| 1 | Government contribution to promoting D&B in Sri Lanka is very small |
| 2 | Clients' lack of knowledge regarding alternative procurement systems |
| 3 | Little contribution to the development of D&B by D&D institutes in Sri Lanka |
| 4 | Contractors' professionals unfamiliar with D&B procurement system |

| | Impediments |
|---|---|
| 5 | Clients' lack of experience with D&B projects |
| 6 | Little contribution to the development of D&B procurement system, by professional institutes in Sri Lanka |
| 7 | Reflection of consultants' own interest in procurement selection |
| 8 | Government preferences for D&B only by considering time factor |
| 9 | Poor relationships created by client with the consultants |
| 10 | Barriers to enter into D&B market by the construction contractors in terms of: not familiar with D&B projects at earlier stage, and lack of capable contractors |
| 11 | Negative attitudes among consultants' professionals towards D&B procurement system |
| 12 | Inadequate in-house design team in contractors' organisations to compete in the market |
| 13 | Poor project management practices by the D&B contractors |
| 14 | Contractors' professionals inflexible to accept changes when involved in D&B process |
| 15 | Effect of political environment on procurement selection |
| 16 | Barriers to enter into D&B market by construction contractors, due to political environment |
| 17a | Inadequate cover by the 'Standard Conditions of Contract' |
| 17b | Very little contribution given by Ministry of Finance, as a regulatory body of Sri Lanka, to development of D&B procurement system |
| 19 | D&B contractors' profit-making interests rather than thinking of client's requirements |
| 20 | Fewer market strategies used by D&B contractors in order to promote their services |

## 4. Conclusion

It was found that in the Sri Lankan context: very little contribution is given by the government to promote D&B; clients' lack of knowledge regarding alternative procurement systems; little contribution to the development of D&B by Sri Lankan Research and Development, and Professional Institutes; contractors' professionals unfamiliar with the D&B process; clients' lack of experience and knowledge with D&B and reflection of consultants' own interest in procurement selection are the most significant impediments to the development of D&B.

The government's failure to initiate D&B procurement, as one of the major procurement systems, is one reason they are lagging behind. Lack of clients' knowledge related to alternative procurement methods effects the selection of a suitable procurement method for projects. Since, the contribution given by research and development institutes and professional institutes are very small, it is difficult to develop an alternative procurement method as a dominant procurement method within this context, because these institutes play a central role in introducing innovations to the industry. Neglecting procurement selection criteria in project procurement selection, by the consultants, creates a better opportunity for the consultants to select a procurement system based on their own interests. Ultimately, all the above factors highly restrict the development of D&B as a dominant procurement system in Sri Lanka.

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# Exploratory Study of External Environmental Factors Influencing the Procurement Selection in Construction

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*As industry's characterization is determined by the external environment in which it operates, factors from such environment influence the industry in various ways thus determining the procurement use and development. Therefore, examination of such factors influencing the procurement selection in the construction industry is critical for the successful outcome of a project as well as to the development of the industry. In this context, the aim of this paper is to examine the significant factors influencing the selection of procurement systems from external environment. Four rounds of Delphi survey were conducted to investigate the most significant factors from external environment and their level of influence on various construction procurement systems in Sri Lanka. Based on the Delphi survey results, a set of exclusive selection criteria for five factor categories was established. The five factor categories formulated from this study include 'Market condition', 'Economic condition & Fiscal policy', 'Technology', 'Socio cultural suitability' and Regulatory environment'. Further, it was also found that Market conditions have significant influence on procurement selection compared to others factors. Therefore, it can be concluded that beside the commonly considered factors in terms of key selection criteria like client's requirements and project profile, clients should take into account other factors from the operating external environment that influence procurement selection.*

**Keywords:** Construction Procurement, External Environment, Procurement selection, Selection Criteria.

## 1. Background

The construction industry of any country is recognized as an economic regulator which contributes to the national economy in large scale. The construction industry's uniqueness throughout the world is determined by the external environment in which it operates. The external environment consists of several sub-systems such as economical, political, financial, legal and technological [11]. Further, the construction industry is an open system therefore, it is sensitive to change. This changing nature has resulted in the industry to be in a challenging position in addressing the changes forced by the subsystems of the environment in an efficient and effective manner. Consequently, construction project procurement systems practiced in the industry have also been subjected to changes resulting in many newly innovated procurement systems that could be used to meet the clients' contemporary requirements in a dynamic construction environment. Thus, the development & the use of procurement systems are also affected by the factors from external environment. These environmental factors influence the industry in various ways thus determining the procurement shares and trends.

Client's requirements and project characteristics are two major criteria to be considered in selecting a suitable procurement system for any kind of construction projects. The selection process is an open system, which receives information from its environment, transforms and returns as an output to the environment [9]. According to Sheath et al. [12] and Chen [4], clients' requirements will ultimately be influenced by the context in which they operate; and this implies that the choice of procurement selection criteria may also be influenced by the predominant environment. On the other hand, Kumaraswamy and Dissanayake [6] have concluded that the most appropriate procurement system must necessarily depend on the project scenario or project profile that can be derived from contextual conditions such as external factors related to projects. As a result, client's requirements and characteristics of the project that dominate the procurement selection are influenced by the factors from external environment. These factors may have direct or indirect influence on the formulation of selection criteria and thus on the selection of suitable project procurement system.

In this viewpoint, the aim of this paper is to examine such environmental factors which influence the selection of procurement system and their level of influence. It presents a set of exclusive selection criteria formulated based on the influence of external environment in Sri Lankan context.

## 2. Methodology

Delphi technique was adopted as the main research method in this study. Delphi method is a highly formalized method of communication that is designed to extract the maximum amount of unbiased information from a panel of experts [2]. Therefore, it was considered that it would be appropriate to adopt the Delphi technique for formulating a set of exclusive criteria in terms of external environment. Delphi method adopted in this study consisted of four rounds which targeted to derive the expert opinion on factors which affect the procurement selection. At the completion of the fourth round, utility values for significant factors were derived against various types of procurement systems which are commonly used in construction industry. In addition to the Delphi survey, few interviews were conducted with selected industry experts in the view of interpreting the results derived from Delphi survey.

## 3. Results and Analysis

This section summarises the results of four rounds of Delphi survey. The synthesis of the results of all four rounds revealed 14 significant factors grouped under five main criteria using factor analysis. The following Table 1 portrays the summary of the five factor categories and their level of influence on procurement selection.

*Table 13: A summary of the results of round four*

| Factors | CC (W) | Significance |
|---|---|---|
| Market condition | 0.160 | 0.000 |
| Economic condition & the fiscal policy | 0.096 | 0.012 |
| Technology | 0.172 | 0.000 |
| Socio cultural suitability | 0.135 | 0.021 |
| Regulatory environment | 0.147 | 0.000 |
| CC - Concordance of Coefficient | | |

Review of the results obtained from the final round clearly shows that all the factors have significant influence on procurement selection. Relatively, Market condition, Technology and Regulatory environment significantly influence the procurement selection and trends. The mean utility values provided for the five factors were sufficiently consistent at significance level of 0.05 or smaller. Further, correlation between the respondents' view with regards to the external environmental factors was also increased compared to round three. Compared to other related factors, technology is having high level of correlation. Therefore, the underlying relationships between procurement selection and the influence of external environment need to be considered to avoid consequences in decision making and to achieve the client's project specific goals.

## 4. Conclusion

This study has formulated a list of 14 selection factors through four rounds of comprehensive Delphi survey and these factors cover various aspects of the external environment. As some factors are interrelated, attempts were made to consolidate related factors using factor analysis. A five-factor solution for the formulation of procurement selection criteria was derived. These five factor categories include "Market condition" (Factor 1); "Economic condition and the fiscal policy" (Factor 2); "Technology" (Factor 3); "Socio cultural suitability" (Factor 4) and "Regulatory environment" (Factor 5). Further, it was also found that Market conditions have significant influence on procurement selection compared to others factors. Except the factor 5, all other factors include related variables which reflect the influence of various aspects of the external environment. Therefore, it can be concluded that beside the commonly considered factors in terms of key selection criteria like client's requirements and project profile, clients should take into account other factors from the operating external environment that influence procurement selection. The selection criteria established and the utility values derived by this study provides a solid base for clients in initial decision making on the selection of appropriate procurement system for any kind of building projects in the construction industry.

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# An empirical study of the cultural and behavioural challenges in the UK construction partnering

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*Partnering and the related forms of collaboration have been seen as a way of tackling fragmentation and lack of integration that has bedevilled attempts to improve project performance over the years. Despite the amount of interest shown in partnering, actual empirical research is rather thin on the ground and much of the work is notable for its prescriptive tendencies and heavy reliance on anecdotal data with the focus on the experience of the exemplar organisations. This paper looks into construction partnering challenges especially cultural and behavioural challenges in the UK. Empirical data is collected from expert opinion to find out the major partnering challenges and their root causes. Also, this paper stages arguments and discussions regarding the importance of the leadership role, in transforming culture, towards a cooperative and caring environment.*

**Keywords:** Partnering, Cultural and behavioural challenges, Expert opinion, Leadership.

## 1. Background

In the last decade there has been an enormous amount of interest in the use of partnering and to understand the factors leading to an inhibiting successful collaboration amongst construction firms. Partnering and the related forms of collaboration have been seen as a way of tackling fragmentation and lack of integration that have bedevilled attempts to improve project performance over the years. It seeks to re-design relations between actors in projects by promoting the use of collaborative, more open, less managerial and less hierarchical relationships. Many commentators argue that partnering can have a substantial positive impact on project performance, not only with regards to time, cost and quality objectives, but also with regards to more general outcomes such as greater innovation, improved user satisfaction and reduced confrontation between parties, thus enabling an non-adversarial contracting environment [1].

Literature synthesis on partnering shows the significance of cultural and behavioural challenges inhibiting the adoption of partnering arrangements. This paper looks deep into the empirical evidence of cultural and behavioural challenges to arrive at categorised/grouped root causes of these challenges. Furthermore, common to all partnering relationship is the formulation of mutual objectives, trust and an understanding of each other's commitments. However, it is less than clear about the way in which these essential cultural and behavioural characteristics are tackled in construction partnering projects. It is essential to bring about cultural change, encouraging project participants to transgress the conflicting interests and build shared culture. It is certainly not easy to bring about cultural change to adopt a new set of behaviours as a consistent way of working among the people. To get a deeper level of understanding or to predict future behaviour correctly one must attempt to get at its shared basic assumptions and taken for granted perceptions [2]. As such, management has the most significant role to play in the transformation of attitudes.

## 2. Partnering challenges and problematic issues

An absence of mutual trust and scepticism within participants may result in various problematic issues. According to Lendrum a lack of open and honest communication may lead to degradation in the stakeholders' ability to efficiently resolve any problems. Thomas et al. [3] identified the lack of empowerment and technical knowledge from the client's side and usage of competitive tendering, failure to include key suppliers and subcontractors, together with lack of training as some of the main problematic issues in partnering projects. They argued the role of client as the head facilitator of the partnering arrangement should take a leadership role, and ensure full commitment and correct facilitation throughout the entire duration of the projects. It was identified that the majority of problematic issues experienced in project partnering arrangements were related to the commitment provided to the attitudinal change and procedural implementation required in efficient project partnering [3].

Since partnering is seen as changing behaviours and attitudes, cultural transformation cannot be forgotten in the process. Much of the literature tends to presume that cultural alignment is a prerequisite for partnering. However, it is certainly not easy to bring about cultural change to adopt a new set of behaviours as a consistent way of working among the people. Conceptualisation of the relationship between partnering and culture; resistance to change from traditional, adversarial and exploitative ways [4]; lack of cooperation based upon fundamental differences in interests between the parties to contract; profitability and uncertainty issues; unwillingness to commit fully to close, long term relationships together with the construction industry perception of mistrust can be considered as some of the reasons to resist cultural change towards collaborative relationships.

## 3. Research methodology

This study was launched as part of a Doctorial study on 'Rethinking leadership to address cultural and behavioural challenges in construction partnering'. Thirty-nine potential problems were elicited from various partnering research, most of which were

both economically and culturally driven issues. These issues were then integrated based on causality to form the basis for 10 major questions to examine the magnitude and the root causes of the identified cultural and behavioural challenges in construction partnering in the UK. Data was collected by means of self-administered expert interviews with each question containing both a quantitative and an open ended qualitative question. Experience on partnering work of industry experts ranged from 2 years to 10 years while academic experts were selected with a minimum of 3 years of partnering related research experience.

A combination of quantitative and qualitative data analysis was carried-out in this phase to rank the collected data that gave rich details of the challenges and their root causes. Perceived root causes were rearranged with weightings taken from Likert scale to rank the root causes of identified cultural and behavioural challenges. Once again these root causes were integrated/grouped to form specific areas which leadership has to tackle to address cultural and behavioural challenges in partnering projects.

## 4. Results and discussion

Research found that organisational soft issues, wrong partnering practices, lack of understanding of the partnering concept, individual partner's issues and direct top management issues are the major areas of root causes (Table 1). It is essential for leadership to play a very significant role in shaping culture which in turn can bring further benefits by tackling cultural root causes in construction partnering projects. Even though some of these are easy to overcome, it is important to be proactive.

Table 14: *A summary of major cultural and behavioural root causes*

| **Major Root Causes** | **Causations** |
|---|---|
| Organisational soft issues | Mistrust, attitude, culture, fear, resistance to change |
| Wrong partnering practices | Lack of mutual respect, risk avoidance and transfer |
| Lack of understanding of partnering concepts | Lack of commitment, not realising the potential benefits |
| Issues related to individual partners | Misalignment of objectives, negative mind set, inability to learn and unlearn, Heuristics |
| Direct management issues | Lack of negotiation skills and support from top management |

## 5. Conclusion

The literature review shows the growing significance and evolution of partnering which is said to reduce the adversarialism in the industry. Also the synthesis on partnering challenges shows the significance of cultural challenges to be tackled to improve the industry. Most of the identified cultural and behavioural root causes will require cultural change to adopt a new set of behaviours as a consistent way of working among the people. Leadership is originally the source of the beliefs and values that get a group moving with its internal and external problems. Once leader's proposals continue to work, they gradually come to be the shared assumptions of organisational culture. As such, leadership plays a very significant role in shaping culture and it is very important to the change agents to lead the whole process at all times.

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# Failure of applying PFI in Colombo Katunayake Expressway Project

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*Currently the PFI infrastructure projects throughout the world include toll roads, power stations, bridges, ports, water treatment plants etc. It is accepted as best suited for developing countries since infrastructure development is essential for the development of these countries, where the governments cannot afford finance for such huge infrastructure projects. In 1995 the Government of Sri Lanka had proposed constructing the Colombo Katunayake Expressway (CKE) as a highspeed link between the Port of Colombo and Bandaranayke International Airport (BIA) to reduce the traffic volume on the existing Colombo Negombo A3 road. The government had considered PFI for procuring the CKE as the first PFI road project in Sri Lanka, to minimise government expenditure on high grade transportation infrastructure. Fifteen, well established, foreign concession contractors bid for the project but PFI arrangement were terminated after several negotiation sessions. The study revealed ten causes for failure and two root causes for the failure of PFI in the CKE project.*

**Keywords:** Facilitators, Impediments, PFI, Road projects, Root causes, Sri Lanka.

## 1. Background

Private Finance Initiatives (PFI) is an alternative method of procuring services for the public sector. The private sector will design, build and provide funding for the capital projects and operate facilities for the public benefit [2]. Private consortia will receive revenue from operating this service and hence make a profit.

The scale and structure of huge infrastructure requirement, shortage of public sector financing, growing debt crisis and reduction of their external borrowing capacity have compelled many developing countries to shift their focus towards PFI in infrastructure projects [1]. Even though in other countries PFI is successfully used on massive road development projects, giving much more benefits to the government, it was not realised in Sri Lanka. The Government of Sri Lanka (GOSL) had considered PFI for procuring the Colombo Katunayake Expressway (CKE) to minimise government funding but the negotiation sessions were not successful. This results in the question: "Why did the applicability of PFI fail in the CKE project?" - which is also the question of this research.

The single case study research methodology was selectd, with multiple source information, with eleven semi structured interviews with professionals for in-depth discussion and document. Manual code based content analysis was selected as the data analysis method to identify PFI facilitators who were not presented, PFI impediments which were presented and their root causes.

## 2. Research findings

The study revealed five main impediments to implement the project on a PFI basis as: political risk, traffic revenue risk, financial risk, disagreements among upper level politicians and other unfavourable conditions.

Uncertainty in the coming government's political support and government policy changes were the main causes for political risk and it was proposed to mitigate those unfavourable factors by forming a comprehensive legal framework and gaining support of multilateral or bilateral financial institutions. Another significant obstruction for PFI was the traffic revenue risk, which had formed because of: public perception, competition on existing A3 road, increase of tolls and accuracy level of the traffic forecasting. It was proposed to educate people about the benefits of PFI in order to make a better public impression. An inflationary economic environment was the reason for the increase of tolls. It was proposed to implement a straightforward, transparent, fair and binding toll adjustment mechanism to reduce the effect on concessionaires from inflation. The use of refining methodologies, empirical studies and cross checking by independent consultants was advised to improve the accuracy of traffic forecasts. Grounds for the financial risk were the currency risk, uncertainty in policy changes and increases in construction costs. Currency risk occurred due to the inflationary economic environment. Index toll rates to local inflation rates, index toll rates to foreign currency exchange rates, and involving local funding sources were the major currency risk reducing proposals. A comprehensive legal framework was suggested to reduce the uncertainty on government policy changes. An inflationary economic environment caused construction cost to increase and as mitigation, it was proposed to compensate the concessionaires or expand the concession period. Fear of negative public impression, which can influence elections and the inability of handling toll revenue until the end of the concession period were the main sources of disagreement among the upper level politicians on the concessionaire's operation of CKE. As a remedial measure, it was proposed to educate politicians on the benefits of PFI. Other unfavourable conditions were the concessionaires' objection to staying a longer period, by operating the toll road due to terrorist problems and the inability to realise long term plans such as concession contracts for irrigation and power sector projects. The inability to have duty free waves from the GOSL for the imports of the concessionaire also was a negative factor.

Some of the main facilitators, which were discussed in the literature for a successful PFI road projects, were not present in the CKE project. Key facilitators found to be absent included; the unavailability of a local financial market due to high project costs and long payback period; less supportive legal and policy frameworks which could be eliminated by providing flexible

government actions as minimum traffic revenue guarantee, exchange rate guarantee, toll adjustment mechanisms and firm taxation policies; the unavailability of a sound macroeconomic environment due to inflationary economic conditions which could be reduced by providing sound economic policy to compensate concessionaire in highly inflationary situations; and the lack of government involvement through providing guarantees.

Bidders for the CKE project were well established foreign concession contractors. Therefore, they were well equipped with appropriate skills and had in- house capacity. Hence, the impediments mentioned in the literature - as lack of appropriate skills and high project costs, lack of credibility and contacts - were not presented in the CKE project. Conducted negotiations were not too lengthy and completion risk was not with the contractor because the government had already settled all public interferences against the project, environmental clearances, government approvals and land acquisition in the very early stages of the CKE project.

When comparing the facilitators identified in the literature, proper project identification, thorough and realistic cost benefit assessment, high capacity of the concession contractor, attractive financial package, acceptable toll levels, technology solution advantage, transparency in procurement process and reasonable risk allocation were all present in the CKE project.

Through the analysis, two root causes were able to be identified for the existence of the PFI failure factors, as: unfavourable political situation in the country and a conservative society. Therefore what is needed is to educate both the public and politicians on the benefits of having PFI arrangements for infrastructure development of the country, to eliminate the effect from the root causes for the CKE project.

## 3. Conclusion

The analysis of the research exposed that inflationary economic environment in the country, uncertainty regarding the coming government's political support, uncertainty on the government's policy changes, public perception towards tolling, competition from existing A3 road, inaccuracy on traffic forecasting, inability of handling toll revenue by the politicians during the concession period, terrorist problems, inability of realising concessionaires' long term plan to enter into PFI agreements for irrigation and hydropower projects and the inability to have duty waivers from the government for imports of the concessionaire as main reasons for the failure of PFI in CKE. Two root causes were identified by analysing the failure factors as an unfavourable political situation in the country and the conservative nature of the society. Elimination of the identified root causes and failure factors will lead to successful PFI agreements for future road projects within the PFI procurement system.

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# SECTION XVII

## E-LEARNING

# Improving Co-Learner Interactions Through Web-Based Online Assessments Within Distance Learning Settings

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*Distance Learning (DL) is an educational model in which the student and instructor are separated by time and space is currently the fastest growing model of domestic and international education which has come into prominence during the last two decades of the 20th century. One of the major influencing factors for achieving intended learning outcomes in a programmeme is the assessment strategy adopted. Tutors in DL programmemes have adopted various methods of assessments that could broadly be described as formative and summative assessments. A well documented formative and summative feedback for learners, especially early on in a course, will facilitate in their learning and provides opportunities for students to gain insight into their understanding of the course content. Learners often express their need for more empowerment within their modules to enhance their active involvement and interactions within the programmemes. This is the main focus of this ongoing research under the Teaching Learning Quality Improvement Scheme (TLQIS) of the University of Salford. This paper will firstly look into the literature within the area and set out the overall methodology of the paper. Then, through a survey of DL courses within the School of Built Environment (SOBE), University of Salford, it is intended to identify currently used web-based online assessment tools within the DL settings and other issues within the area in improving the co-learner interactions within the DL (e.g. factors and barriers in improving co-learner interactions, gaps and flaws within the available tools, etc). The result and conclusion from this paper will recommend guidelines in improving co-learner interactions within DL settings.*

**Keywords**: Distance Learning (DL), co-learner interactions, web-based online assessments

## 1. Introduction

Advances in information technology (IT) is continually evolving; opening up additional channels for today's higher education (Chen *et al*, 2001), e.g. distance education technologies. Distance education technologies have become more prominent during the last decade of the 20th century (Ingirige *et al*, 2005). Moreover, Chen *et al* (2001) noted that the application of IT have allowed universities to deliver multimedia course contents and enable students to communicate with their instructors and fellow students in both synchronous and asynchronous formats; hence making distance learning (DL) possible. DL, an educational model in which the student and the instructor are separated by time and space, is considered the current fastest growing model of domestic and international education (Poley, 2000).

Distance education had been around for more than a century, which according to Belanger and Jordon (2000, p.6), the history of technology-based DL was correspondence education, which started in Europe and the United States in the mid 19th century. Web-based technologies (WBT) in particular have expanded the interactive capabilities of distance education from solely asynchronous communications with long delays in response to highly interactive class meetings via text, e-mail, video and many more (Murphrey, 2001).

In the domain of higher education (HE) in the construction industry, DL has become a major source by which many HE institutes conduct their courses, particularly at postgraduate level. At the University of Salford, the School of Built Environment (SOBE) itself utilises the distance education technology tools in delivering Masters and PhD programme over the Internet (Ingirige *et al*, 2005). The new developments in technology have impacted the overall delivery process of the DL construction programme. It has been considered that one of the major influencing factors for achieving the intended learning outcomes of these programmes within an overall information and communication technology (ICT) enabled delivery process is the assessment strategy adopted.

Due to the significance of this area, SOBE received funding to conduct a one year study to improve the interactions of co-learners through web-based online assessments tools within DL settings through the Teaching and Learning Quality Improvement Scheme (TLQIS) within the University of Salford. This paper reviews literature within the field area and try to find gaps within the available tools and their capabilities in improving co-learner interactions.

This paper has been designed and structured as follows; first, it will describe the methodology adopted. Then, it will look into research problems and subsequently the literature within the area; e.g. definitions and characteristics of DL and enlisting available web-based assessment tools within the DL settings. Then, through a survey of DL courses within the School of Built Environment, University of Salford, it is intended to identify currently used web-based online assessments tools within the DL settings and other issues within the area in improving the co-learner interactions within the DL. Lastly, this paper concludes by suggesting the way forward.

## 2. Research Problem

Learners often express their need for more empowerment within some of their modules to enhance their active engagement. With all types of learning, including web-based learning, it is useful for students to receive constructive, timely and relevant feedback on their progress even within DL settings. Therefore, a mix of computer marked and tutor marked essays could be adopted for summative assessments. Online marked assessment is sometimes constrained by the medium in which it is operating. Computer marked assessments alone are not appropriate for marking or giving feedback on assignments such as

essays or projects that require more than the mere production of knowledge. With the increase of DL programmes being offered there has been a corresponding increase in both synchronous and asynchronous mechanisms being developed to facilitate these assessments (Dede, 1996; Wilson and Whitelock, 1997).

Despite addressing the needs of the programme in developing a regime of assessment strategies, most learning communities express a feel of isolation. However, barriers in the form of resource constraints, sometimes affect the provision of pedagogic requirements such as maintaining appropriate co-learner interactions within the masters DL programmemes. This paper aims to address issues within the area in improving the co-learner interactions within the DL (e.g. factors and barriers in improving co-learner interactions, gaps and flaws within the available tools, etc) and proposing a way forward.

## 3. Conclusion and Way Forward

The literature review along with the findings from the initial interviews done on DL programmes within the School of Built Environment, University of Salford, UK have provided the methodological basis for this paper.

Most of the DL programmes within SOBE delivers lecture materials in accessible format which comprise text, diagrams and drawings (for which descriptor alternatives are available) and video presentations (for which audio and text captioning are available) through online environments such as the "Horizonwimba". The delivery methods currently used within the programmes are both synchronous and asynchronous. The result from this research identifies that there is a lacking in the implementation of specific web-based assessments tools within the DL settings.

Based on the in depth literature, web-based assessments tools have been found to help improve co-learners interactions within DL settings. Most DL programmes have just gone for the traditional assessment method, which is the written coursework due to lack of emphasis on co-learners interactions when deciding on the method of assessment to be implemented. Co-learners interactions within this method of assessment could be improvised by encouraging learners' interactions and discussions through discussion boards, chat rooms, etc. Written coursework could also be done as a group work instead of individual.

Further interviews will be continued within SOBE for all the other DL Master programmes to enhance the guidelines in improving co-learner interactions within DL settings. The next phase will concentrate on other schools, faculties at University of Salford and finally on other universities in the UK. As part of this research initiative, results obtained will be disseminated and shared.

# Exploring the Effectiveness of an Electronic Classroom Communication Response System

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*The growth in career interests in the built environment and recent changes to the structure and curriculum at Anglia Ruskin University has resulted in increased numbers of students studying the core subjects of building technology and services. Large lecture sizes create difficulties in engaging all students in the learning process, with particular problems of maintaining student attention, promoting discussion and debate, and checking student understanding of the subject matter. Feedback opportunities are also very limited. This paper gives an overview of how electronic classroom communication personal response systems (PRS) can be used to overcome some of these difficulties. This includes a brief description of how the technology works, examples of potential uses and benefits, and an examination of some of the issues to be aware of when using PRS. An outline of a pilot study to explore the effectiveness of the technology is provided and the results are presented at the conference. It is clear that the technology itself does not guarantee success, but, if used appropriately, there is evidence that it can have a positive effect on student learning, particularly when used in large group settings.*

**Keywords:** Lectures, PRS, interactive discussion, student engagement.

## 1. Background

The impact of the new curriculum changes at Anglia Ruskin University, introduced in September 2006, has produced fewer and larger credit modules (an increase in size of modules from 10 and 20 credits to 15 and 30 credits). In the Department of the Built Environment, the importance of Construction Technology and Services on these programmes has been increased, with 30 credits in Stage 1 and 30 credits in Stage 2. A deep understanding of this core area is central to the development of built environment graduates. Both of these changes have resulted in many more students in much larger groups - classes comprise 150 or more students with contact time of three hours per week, consisting of a lecture, workshop and tutorial.

With the move towards mass higher education, there may be an increased risk of student failure in the early parts of course provision. Firstly, with an increased number of mixed ability first year candidates, it is dangerous to assume that all students can be treated as mature adults who are well motivated to undertake their own learning. Secondly, the increase in class sizes counteracts substantial educational research that stresses the necessity of engaging the student with the subject matter in order to foster deep and lasting learning

It can be very difficult to stimulate, encourage and manage useful dialogue or debate in a large class setting. Question and answer techniques can be effective, but sometimes are just limited to a sub-set of the group responding, rather than all students. Additionally, students at the back of the lecture may have difficulty hearing student comments at the front. In some lectures the flow of information is largely one-way, so lecturers will have difficulty in assessing if students are experiencing problems. There is often little opportunity to obtain quick feedback that would assist in changing teaching approaches to meet the needs of students, particularly in the identification of those students who may require extra help and attention. This can facilitate the desire of the less able student to feel securely hidden within the large cohort. A very simple model of learning modified from Race's work (2001) is "Doing + Feedback = Successful learning: One of the best ways of learning is to get on and do it, have a go and not be too worried about the risk of failure. Indeed, failure often has more of an impact and usually results in a change in behaviour reducing the risk of further failure. This failure however must take place before the final evaluation. Rust (2002) argues that we need to "build in regular tasks" to help students pace their learning. For this to be achieved however, students need regular feedback on what is going well and what is not

## 2. Electronic classroom personal response systems

In order to address some of these weaknesses, the Department of the Built Environment at Anglia Ruskin University is considering new ways of motivating and stimulating students in the subject matter in large lecture and tutorial settings. One possible solution is to implement an electronic classroom communication personal response system (PRS). Most people's experience of this type of technology is in popular television programmes, such as "Who wants to be a millionaire?" where the participant can ask the audience to assist in the response to difficult questions. This technology is increasingly being used within the higher education sector, as it enables the lecturer to interactively engage with a large number of students at the same time.

## 3. The potential benefits of using PRS

The main advantage of this technology is that it enables the active involvement of large numbers of students, not just one or two individuals - a major weakness of conventional lecture teaching. As Draper et al (2002a) states, the equipment requires "each learner independently to generate an answer whereas otherwise only the handful who put hands up really do this". As such the lecturer receives responses from all students, rather a small section of the group. A common approach, based on Mazur's (1997) "peer instruction" method, is to pose a question that students have to answer without thinking about it for too long. Without revealing the answer, the lecturer asks them to discuss it with their neighbour, which involves having to provide

explanations and reasons for their choice. A common problem in conventional class settings is the provision of suitable feedback to students about their performance. Often students have to wait until assignments are marked and returned before they receive any indication of how they are doing. With a PRS, answers are marked electronically and automatically, so feedback on performance can be given almost immediately. One way to foster student confidence at the beginning of a class with new students is to use the system for icebreaker activities. Through informal questions that elicit some background information about the group (such as age, gender, interests, etc.) and displaying the responses, mutual awareness is raised which may contribute to the feeling of belonging to a group (Draper et al, 2002a). The use of a PRS to display collective responses to the whole class can also be a reassuring experience for many students because they can see that other class members are thinking along similar lines.

## 4. Research Pilot Study

The main objectives of this current project are (1) to review the added value of electronic classroom communication systems in large class settings, and (2) to ascertain whether the technology can help to address the issues of student engagement and motivation in the teaching of Built Environment students. The results of this work carried out in Semester 1 September 2007 to December 2008 are presented at the conference as well as a demonstration of its use with delegate participation using the handsets.

## 5. Conclusion

This paper has outlined some of the problems and issues that can be encountered when teaching large lecture classes. It has explained the nature of one possible solution to overcoming some of these difficulties, in the form of PRS. Through a review of the literature about PRS, this paper has discussed some of the potential merits of using the technology, as well as some of the possible pitfalls.

The pilot study being conducted during the academic year 2007/08 will assess the added value of PRS (what can this technology provide that conventional class settings cannot?) and appraise how appropriate use of the technology can assist in increasing student participation and engagement with the subject matter in large class settings.

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# An e-learning approach to quantity surveying measurement

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*Quantity surveying measurement adopts prescriptive processes which are underpinned by an understanding of construction technology. The rules for measuring are complex, and are designed for experienced practitioners. Some students struggle to acquire the mix of skills and knowledge within the timeframe allowed. At Newcastle University (Australia) we are preparing high quality teaching and learning materials for both on-campus and on-line distance learning students. We are collaborating with the Department of Civil and Building Engineering at Loughborough University (UK) to develop e-learning measurement packages utilising 3D images. This paper describes and discusses some of the merits and challenges of the approaches we have adopted.*

**Keywords:** e-learning, measurement, quantity surveying.

## 1. The Context

Quantity surveyors need to measure what goes into a building before they are able to assess costs. The Australian Institute of Quantity Surveying [1] considers measurement / quantification as a basic quantity surveying ability.

Quantity surveying students embarking on their studies come from a wide variety of backgrounds. Many are of mature age and already have a construction background. Few are female. Many are highly computer literate and expect to engage with their studies using computer systems. An increasing number bring with them financial imperatives of having to work to support their tuition. Students require flexible alternatives that respond not only to their pecuniary requirements, but to different ways of learning that many of them engage in.

To be able to measure, students need to be able to 'read' construction drawings. They need an amalgam of skills, knowledge and understanding: they need knowledge and understanding of construction materials and construction technology; they need to be able to visualise how various components fit together; and they need to have an understanding of construction plant and equipment, occupational health and safety issues, relevant legislation and so on. Measurement might be seen as a 'basic' quantity surveying skill, but it needs to be underpinned in a multitude of different ways.

The approaches to teaching quantity surveying measurement described in this paper are those adopted in the Bachelor of Construction Management (BCM) program in the University of Newcastle, Australia. We have responded to some of the abovementioned challenges by: offering our BCM program in face-to-face as well as on-line modes; delivering our courses using problem-based learning approaches; and by developing several on-line measurement tutorials in collaboration with the Department of Civil and Building Engineering at Loughborough University (UK).

This paper briefly describes the skills involved in quantity surveying measurement, illustrates the materials we have developed and then describes how they have been used. Indicative student evaluation data are also presented as well as brief plans we have for future developments.

## 2. Measurement skills

We acknowledge traditional measurement skills, but question the relevance of traditional modes of delivery for modern generations of students.

A significant challenge for those teaching measurement is to ensure students have sufficient knowledge and understanding of construction technology to enable them to measure. Taking-off requires students to follow a prescriptive set of rules provided by published standard methods of measurement. These publications do not explain the taking-off process. They are designed to provide experienced quantity surveyors with rules for taking-off in a standardised manner and rely heavily on readers understanding the 'technology'.

From a teacher's perspective the challenge lies in teaching SMM based taking-off processes to students who have just enough knowledge of construction technology to comprehend the measurement rules. This needs to be done without losing focus on demonstrating taking-off. Traditional lecture based approaches deal with taking-off and technology as two separate topics. Students learning taking-off have to continually refer to technology texts which are generally not compiled in the same order as SMMs. This is clearly frustrating for students and must hinder their learning. We have adopted a different approach. By judicious use of image capture software and 3D modelling we have blended the necessary construction technology with the teaching of the measurement process as will be seen in the following sections.

## 3. Description of the QS materials

The materials comprise: **video presentations** which describe relevant measurement procedures and incorporate relevant documents such as selections from the Australian SMM [2], dimension paper, construction drawings, site layout plans and site photographs; and **supporting documentation** including drawings and specifications.

## 4. Development of the QS materials

The QS materials were developed using two software packages, Camtasia Studio [3] and Google SketchUp [4]. Camtasia is a fourth generation screen capture program that provides a timeline which accepts video, images and audio. Video and images are arranged on a timeline and finally a voice-over is added. Camtasia provides output in several formats including AVI, Flash, WMV, QuickTime, RealMedia, iPod video and mp3 audio. The Flash format has significant advantages; it streams particularly well without dedicated streaming software and allows interactivity via hot spots (which, when invoked, take users to another image, video or URL).

## 5. Used of our QS materials

The digital measurement materials may used in a number of different ways including lectures, as parts of Lectopia lectures (which deliver on-campus lectures to distance learners via the Internet), on CD, as self-paced teaching materials delivered through BlackBoard, iPod and /or Windows PDA, and as and as tutorials.

## 6. Student evaluation

A representative sample of students (37%) responded to an on-line survey. They were split almost evenly between on-campus and distance learners ensuring that the views of both cohorts were represented. The majority (76%) used the measurement materials on-line from home (two students used iPods and two used PDAs), while 12% accessed the Internet from work and a similar percentage gained access from University. Only three students experienced minor technical difficulties using the materials. Our intention was to keep the materials short and 80% of students said that the length of the tutorials was about the right length of time. The remaining 20% felt that the materials were too short. We also anticipated that students would access the materials several times. This was indeed the case, with 64% of respondents saying that they had accessed each tutorial 2 to 4 times. Virtually all students found the materials easy to use. When asked whether they thought the materials would help them with their assignments, 88% of students said yes, and a similar percentage said that they would like to see more tutorials prepared in this way.

Whilst the above views are acknowledged to be those of a small sample of students, they support our hopes and expectations, and encourage us to continue our developments.

## 7. What improvements / changes will we implement?

Many software packages are available to help students overcome the limitations of 2D drawings. We have trialled 3D models developed using Google SketchUp [4] and have been encouraged by the ease with which these have been created, and by the verbal feedback students have provided.

## 8. Concluding comments

We have demonstrated what can be done on a relatively small budget with mature software and imagination. The scope for future development is constrained only by the foresight and imagination of developers. These tools are not intended as a replacement for traditional course delivery. They complement conventional approaches by providing students with convenient access to repositories of knowledge and procedures.

## 9. References

[1] Australian Institute of Quantity Surveyors, National Competency Standards for Quantity Surveyors – construction economists, 7th edition 2003

[2] Australian Institute of Quantity Surveying (2002), Australian Standard Method of Measurement of Building Works, 5th edition, ISBN 0959964150

[3] Camtasia Studio (2007), viewed on 18 Apr, 2007 at http://www.softwarecasa.com/pprod/212402dd.htm?gclid=CN7S-5fyyosCFRqfYAodfAjGBg

[4] Google Sketchup, viewed on 13 April 2007 at http://sketchup.google.com/

# Practical Application and Improvement of VEBER Online Questionnaire within VGTU e-Learning Environment

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*Lately, distance studies, which are attempting at the best possible education for students and satisfaction of as many of their study needs as possible, are gaining wider popularity. Online questionnaires are increasingly used to get detailed opinions of distance learning students on various issues of studies. During the project EurAsia, it was identified that VEBER online questionnaire can be a useful tool for VGTU beyond the scope of the project EurAsia. An online questionnaire has been developed to facilitate the process of surveying related to implementation of the project EurAsia. The assessments helped to recognise that this tool helps VGTU to enhance its institutional system related to e-learning. Having identified the potential of this tool outside the scope of the EurAsia project, further experiments have been carried out to assess how this tool can be further developed to accommodate the requirements of the project EurAsia other institutional systems. The research showed that distance learning students not only want to express their opinion about the study process but to be active participants in shaping of strategic alternatives of the study process by electronic means, as well. In order to implement this idea, the authors proposed the Web-based Model of Multiple Criteria Ethical Decision-Making for Ethical Behaviour of Students and used as a basis to develop the Ethical Web-Based Decision Support System (E-DS). Using the features of the VEBER online questionnaire, the developed Model and the E-DS System the process of distance learning can be additionally humanized and adjusted to ethical norms, which would have a positive effect on the whole distance learning process. Thus the institutions participating in the project EurAsia or offering distance learning studies could use the features of VEBER online questionnaire, the developed Model and the E-DS System in their activities. It would stimulate more efficient application of moral norms in the distance learning process.*

**Keywords:** Distance Learning, EurAsia project, Ethical Decision-Making Models, VEBER Online Questionnaire, Decision Support System.

The VEBER online questionnaire has been used within VGTU distance learning environment to administer student feedback questionnaires and surveys. With the success of the VEBER online questionnaire being used in VGTU, the intention of join institutional systems development process within the EUARSIA project is to share the experience and the technology across all the partners and beyond. The practical application of VEBER Online Questionnaire (ethical behaviour of distance learning students at VGTU) within VGTU e-learning environment and proposals for join institutional systems development process within the EUARSIA project are briefly analyzed in the paper on the basis of ethical questions. The authors have developed the Web-based Model of Multiple Criteria Ethical Decision-Making for Ethical Behaviour of Students and the Ethical Web-Based Decision Support (E-DS) System, which are briefly analysed further in the article. The ten stages of Model are as follows.

**Stage 1.** Obtaining as much objective and subjective information about ethical behaviour of students (historical information, institutional, administration, legal, societal expectations and limitations, ethical principles involved, identified conflicts, etc.) as possible.

**Stage 2.** Analysis of university stakeholders (students, student community, lecturers, professors, deans, the Rector's Office, etc.). The university stakeholders are identified as the interested parties who are directly or indirectly influenced by the decision that is to be made. For a better understanding of the current situation, discussions among the various interested parties are often necessary. Also, some ethical dilemmas can be prevented through dialogue between university stakeholders. University stakeholders have to act as a team in an effort to come to some commonly suitable decisions. All university stakeholders should accept some responsibility for the existing ethical behaviour of students and have to be a part of any proposed decision. The personal values, theoretical orientation, experience and other stakeholder features play a part in achieving ethical decisions. University stakeholders have to analyze their own value judgments, moral codes, experience with similar ethical behaviour of students, and decide how to avoid injecting personal biases into decisions. Also, the decision maker must examine the values of others university stakeholders. Compromises that may diminish harmful consequences should be analyzed. On the ground of the Model offered, decisions may be made from the viewpoint of one, several or all the interested groups.

**Stage 3.** Definition of the problem (conflicting ethical principles, value conflicts) and determination of the nature of the dilemma of ethical behaviour of students. Conflict between values of the different university stakeholders leads to an ethical dilemma where there is no easy solution and no right or wrong answer to ethical behaviour of students.

**Stage 4.** Determination of the philosophy theories (e.g., utilitarianism, deontology, justice, etc.) according to which the ethical alternatives will be evaluated and the decision made. Determination of the ethical ideal is made in concrete circumstances.

**Stage 5.** Search for the description of analogous typical situations of ethical behaviour of students in the available literature and a development of the best practice database.

**Stage 6.** Development of comparative tables of ethical behaviour of students. The aim at this stage is to build options for the decision, in preparation for making the ethical decision and arguing for the choice. Results of the generation of all possible

courses of action have been submitted in the table. By submission, such a display, of the multiple criteria comparisons can become more effectively supported.

**Stage 7.** Evaluation of ethical ethical alternatives of ethical behaviour of students. A decision maker must examine a large number of ethical alternatives, each of which is surrounded by a considerable amount of information. Ethical alternatives are analyzed along with the involved ethical principles and philosophical theories. The expectations and obligations of different university stakeholders are then considered. Ethical alternative solutions are compared in terms of the possible outcomes and according to the selected philosophical theories. Following on from gathering this information, the priority and utility degree of the ethical alternatives is then calculated. The Ethical Web-Based Decision Support System (EDSS) developed on the basis of this model enables the analysis of ethical alternatives from the viewpoint of different interested groups. However, there is seldom an ideal decision to an ethical dilemma.

**Stage 8.** Implementation of a course of action.

**Stage 9.** Monitoring of the action and its outcome.

**Stage 10.** Rehabilitation of the external and ethically advantageous environment in order to avoid potentially conflicting ethical behaviour of students or to diminish their negative impact. On the grounds of cumulative experiences it is suggested that there be changes under these possibilities of the surrounding environment in order to decrease the possibility of a conflict situation arising in ethical behaviour of students or to diminish their negative impact. Developing an ethical environment also provides a background for ethical questioning, significant exchange, informed decision-making, and human consensus, in which all university stakeholders are satisfied.

The above-described Model can provide decision-makers with quite a secure means of making difficult ethical decisions. This model can also help university stakeholders to make the best feasible decision in certain given circumstances. The proposed Model does not make ethical decisions, but explains the process for investigating an ethical behaviour of students. Based on the proposed Model of Multiple Criteria Ethical Decision-making an Ethical Multiple Criteria Decision Support Web-Based System (http://dss.vgtu.lt/ethic/index_eng.htm) was developed by the authors. In order to demonstrate practical application of the Model, a survey was carried out in Vilnius Gediminas Technical University (VGTU). The survey gives a more detailed explanation of Stages 1 and 2 of the Model.

In order to humanize VGTU distance studies and to strengthen their ethical nature, the VEBER online questionnaire was implemented and the Web-based Model of Multiple Criteria Ethical Decision-Making for Ethical Behaviour of Students developed within the project EurAsia; the latter was used as a basis for the development of E-DS System.

# Biometrics Technologies, Intelligent Library and Tutoring System within the EURASIA Project

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*The aim of this research project is to study what contribution the new technologies (Search Engine Rankings, Multivariant Optional Module Design and Multiple Criteria Analysis; Voice Stress analysis, IRIS recognition) can bring to Intelligent Tutoring Systems. Also the project aims at the development of the Intelligent Library and Tutoring System within the EUARSIA project (ILT-EAP system) for e-teaching master degree and PhD students of construction and real estate sector according to EUARSIA project objectives. The practical application of Intelligent Library and Tutoring System within the EUARSIA project is briefly analyzed in the paper.*

**Keywords:** EUARSIA project, Intelligent Library and Tutoring System, Voice Stress analysis, IRIS recognition.

## 1. Background

The EURASIA (EURopean and ASIan Infrastructure Advantage) aims to enhance the capacity of the partner institutions for training, teaching and research activities required for the creation and long-term management of public and commercial facilities and infrastructure. One of the main activities includes development of a professionally accredited postgraduate curriculum, design and delivery of training courses. In order to increase the efficiency and quality of delivery of above training, teaching and research activities, an Intelligent Library and Tutoring System within the EUARSIA project (ILT-EAP system) was developed. The functionalities of ILT-EAP system include the search and find useful material, carry out multivariant optional module designs, multiple criteria analysis and select the most rational study material alternatives according to students' requirements.

## 2. Intelligent Library and Tutoring System for EURASIA project

Nowadays intelligent libraries [1-7] with search engine rankings cannot select chapters (sections, paragraphs) of a specific text which are the most relevant to a student, cannot integrate them into learner-specific alternatives of teaching material and cannot select the most rational alternative, i.e. cannot develop alternatives of training materials, perform multiple criteria analysis and select the most effective variant automatically. However, an Intelligent Library and Tutoring System within the EUARSIA project (ILT-EAP system) can perform the aforementioned functions.

The ILT-EAP system consists of seven subsystems: Domain Model, Student Model, Tutor and Testing Model, Voice Stress Analyser Subsystem, Iris Recognition Analysis Subsystem, Subsystem of Multivariant Optional Module Design and Multiple Criteria Analysis, Database of Computer Learning Systems, Decision Support Subsystem and Graphic Interface. The Domain Model, Student Model, Tutor and Testing Model, Database of Computer Learning Systems and Graphic Interface are quite similar to existing Intelligent Tutoring Systems. The Voice Stress Analyser (VSA) Subsystem, Iris Recognition Analysis Subsystem and Multivariant Optional Module Design and Multiple Criteria Analysis Subsystem are innovative Intelligent Tutoring Systems solutions. VSA and Iris Recognition Analysis Subsystems are briefly analysed below.

## 3. Voice Stress Analyser Subsystem

The muscles of a human throat vibrate in a range of 8-12 Hz and this range is called a micro-tremor. When a person is emotional or stressed the vibration shifts from 8-9 Hz to 11-12 Hz and the more intensive the stress the higher the frequency of such vibrations. The Voice Stress Analyser Subsystem (VSA) measures stress in a human voice. The research aim was to compare data received during an examination with ILT-EAP (information on correct and incorrect answers, time periods for each question, and the number of times a student changed an answer to each question of a test) with similar data received from the Voice Stress Analyser (VSA) Subsystem, to make practical conclusions and to plan future research. This research helped to determine changes of students' psychophysical conditions during examination. During an e-test, students were asked to select one correct answer from the provided alternatives and to say the answer aloud. The sound record of each answer was then saved into a PC memory with an identification code for listening and further analysis. The higher frequency of voice vibrations was determined when analysing voice answers to "unknown/difficult" questions. It was found that the emotional stress of a student was higher when answering "unknown/difficult" questions.

The reliability of the results was assessed by making a correlation analysis of emotional stress and of evaluations of correct/incorrect answers to test questions. The analysis showed that a correlation exists between emotional stress and the correctness of an answer. During the experiment, a total of 4,000 voice records in four student groups were examined and analysed. The research helped to determine whether questions can be classified (in respect to students) as "known/simple", "unknown/difficult" and remaining questions in-between these two groups. The "unknown/difficult" experienced higher than average emotional stress, and zero or minor emotional stress when answering "known/simple" questions. On analysis of the whole set of answers, a direct relationship was noticed between emotional stress and correct/incorrect answers to an e-test, i.e. answers to "unknown/difficult" questions scored less than answers to "known/simple" questions. During the research, the average microtremor was calculated for each question.

In the future there will be a possibility to assess students' knowledge automatically by using VSA Subsystem on the basis of accumulated historic data and determined regression equation. For example, the VSA Subsystem will automatically assess a student's knowledge during an examination according to the student's spoken/oral answers, i.e. the VSA Subsystem will convert student's answers into Hz and show a mark according to the amount of Hz. solutions.

## 4. Iris Recognition Analysis Subsystem

Students, sitting at a computer during the exam, were invited to answer 20 questions. Several possible answers were provided. Recently, the research is in progress, and the interdependence between the changes in the eye iris diameter and the emotional state of a person is being investigated. During the research, a micro video camera, which records the changes in the diameter of a student's eye iris and transfers the data to the computer, is mounted opposite to face a student.

During the exam, the changes in the eye pupil were recorded by a video camera fixed on the head. Thus, a pupil diameter is determined, which corresponds to a particular question, e.g. if a student, before answering the question No. 1, was thinking for 1 min, then all 20 photos are taken (as the eye was photographed every 3 seconds), and the average of measurements is deduced. All the 20 pupil diameters corresponding to 20 questions were determined by such a sequence. According to them, it was possible to determine the student's reaction to each provided question. The changes in the eye pupil of some students were very clear and obvious (the pupil diameter might have changed by up to 20–30 mm); in others, the changes were insignificant – just by several millimetres (2 to 4 mm). We may draw a conclusion that those students, whose pupil diameter underwent minute changes, were better prepared for the exam, they worried less and questions did not seem so complicated to them. The complexity of other questions had a greater influence on the answers; this was also reflected in the exam results.

The research helped to find out, if the interdependence actually exists between the complexity of questions and the changes in a pupil diameter. Accomplished research highlight the dependence of a pupil diameter on the complexity of questions. In case a student answers correctly all the questions, he/she may collect maximum 20 points. Also two correlational curves obtained during the research that indicate direct dependence of a mark on the changes in a pupil diameter. For example, the bigger the change in a pupil diameter, the worse a mark is, and vice versa. The higher pressure a person experiences (uncertain of his/her knowledge, or faces the question for the first time), the wider a pupil of his/her eye becomes and its diameter increases.

Supposedly, in the future, taking into consideration the obtained data and determined interdependences, student's knowledge will be evaluated automatically. For example, a lecturer puts several questions to a student about the level of preparation to the exam, and the Iris Recognition Analysis Subsystem, with regard to the changes in the average of the student's eye iris, and taking into consideration the obtained data as well as determined interdependency, will be able to perform an automatic evaluation of his/her knowledge.

## 5. Conclusion

The future of this research is to study how implement the new e-learning technologies (Search Engine Rankings, Multivariant Optional Module Design and Multiple Criteria Analysis; Voice Stress analysis, IRIS recognition) for e-teaching master degree and PhD students of construction and real estate sector according to EurAsia project objectives.

# Mixed-mode delivery of construction management degree programs

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*The profile of students reading for construction management degrees is changing. In Australia, a buoyant construction industry is currently fuelling high student expectations. Job opportunities for students (as part-time employees) and for graduates are attractive. Students embarking on their studies come from a wide variety of backgrounds with a profile that is significantly different from the early 1990's when the Bachelor of Construction Management (Building) program started at Newcastle University (Australia). This degree was conceived to meet the needs of the local building industry. It embraced problem-based learning as its main tenet and was developed to be delivered to on-campus as well as to distance learners. Reviews by the Australian Institute of Building and the Australian Institute of Quantity Surveying as well as the University have highlighted the need to respond to market requirements and student expectations. Over the past two and a half years the degree has been redeveloped to embrace mixed-mode delivery of courses to on-campus as well as to distance learning students. This paper describes how the degree has evolved and the manner in which e-learning has been harnessed to deliver an innovative problem-based learning curriculum in mixed-mode.*

**Keywords:** e-learning, problem based learning, distance learning, mixed-mode learning, blended delivery.

## 1. Background

Opportunities for would-be construction managers are considerable. A recent KPMG survey (2007) notes that the demand for construction is expected to increase significantly over the next five years. The report observes that the "single overwhelming conclusion that can be drawn from our study is that the shortage of qualified contractors is without doubt the biggest challenge to new construction projects in the future. Furthermore, with market demand expected to increase significantly over the next five years, this issue looks set to intensify as the pool of qualified contractors able to bid for projects is reduced and the wider shortage of skilled labour contractors impacts the ability of teams to deliver on projects."

There are clearly good job opportunities in the construction industry, and these are reflected by buoyant recruitment to tertiary level construction programs. Students embarking on their studies at the University of Newcastle come from a wide variety of backgrounds. Many are of mature age and already have a construction background. Few are female. Many are highly computer literate and expect to engage with their studies using computer systems. This profile is significantly different from the early 1990's when the Bachelor of Construction Management (Building) program started at Newcastle University (Australia). Then the degree was conceived to meet the needs of the local building industry, and focused largely on domestic and commercial opportunities in the region. It embraced problem-based learning as its main tenet and was developed to be delivered to on-campus as well as to distance learners.

In addition to the changed profile of our current intake of students, an increasing number of them bring with them financial necessities of having to work to support their tuition. Students require flexible alternatives that respond not only to their pecuniary realities, but to different ways of learning that many of them engage in.

## 2. Current developments in the BCM program

Degree programs at our University are subject to scrutiny from accrediting bodies as well as from the University itself. In 2004, our Bachelor of Construction Management [BCM] degree was reviewed as part of our own internal quality assurance procedures, and by the Australian Institute of Building and the Australian Institute of Quantity Surveying. Several recommendations were made and we have responded in various ways. In the context of these recommendations the BCM program was re-conceptualised to address the changing needs of our stakeholders. This paper discusses how the new BCM program has addressed these issues.

## 3. IT to facilitate flexible learning

Our program employs range of IT and online tools to create flexible and effective learning environments for students. We use the Blackboard learning management system, Lectopia on-line lecture system, Audio recording systems, online tutorials and tele-tutorials to facilitate student learning.

# 4. Program rationalisation and re-conceptualision of our teaching philosophy

The changes to the BCM degree are significant, and extensive resources and effort have been directed to developing and delivering what is effectively a new curriculum. Delivery of the redeveloped courses to on-campus BCM students commenced at the start of 2006. This approach allows efficient use of cross disciple skills for student learning.

## 4.1 Problem-based learning

The BCM program is based on a Problem Based (PBL) curriculum. Traditionally, in universities, PBL is expressed in terms of the content that is taught and the sequencing of this content, embodied in courses. It is argued that a PBL curriculum consists of the:

- application of concepts and theories to practice/real world situations,
- concepts and theories that inform practice of the discipline
- processes of the discipline
- processes of learning

The question of choice for the implementation of a PBL curriculum is based on the characteristic of PBL to facilitate a fully integrated curriculum. This is defined in the goals of PBL programs, and includes an ability to (a) develop high professional competency (b) reason critically and creatively (c) make reasoned decisions in unfamiliar situations (d) adapt to and participate in change (e) appreciate another person's point of view (f) make self evaluations, identify own strengths and weaknesses and undertake appropriate remediation (g) work productively as a team member.

## 4.2 Reflective practice

Central to PBL is the idea that students develop as reflective practitioners, requiring them to develop the ability to "think-in-action", to develop an awareness of "knowing how they think", which progressively translates into managing their own thinking, increasing their problem-solving skills, ultimately developing as a life-long learner (Fonteyn, 1998).

# 5. Quality Assurance: Continuous Improvements

## 5.1 Aligning and mapping student learning

The PBL curriculum is aligned with the development of students' graduate attributes. The proficiencies of graduates then become the basis for the development of course objectives. The University of Newcastle identifies three broad domains of graduate attributes as important outcomes of a university undergraduate degree: professionalism, community responsiveness and scholarship. The domains of attributes are generic to all undergraduate programs and reflect the University's scholarly values in relation to teaching and research, the employability of graduates and partnerships with the community.

## 5.2 Student evaluation

The Discipline of Building engages in a constant process of improvement in the BCM program. This is only possible because it undertakes frequent evaluation of courses, teaching, and the program itself, using techniques that provide multiple perspectives. The combination of evaluative techniques invariably results in a program that continuously evolves and improves in order to meet the needs of the students.

# 6. Concluding comments

Like other disciplines, construction management and education needs to adapt to widespread changes. The problem based learning BCM degree program that has been successfully implemented at the University of Newcastle has been revised over the past three years. It is now delivered in mixed-mode, providing on and off-campus students with innovative and flexible education. This structure is continually evolving, and it is inevitable that the curriculum currently being delivered at our institution will be different to that of the future.

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# Technology Enabled Learning – Lessons Learned from Irish Initiatives

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*The presentation of lifelong learning opportunities for construction professionals in an effective yet flexible manner presents a number of challenges for educational institutions. The changing profile of full-time undergraduates highlights they encounter similar challenges. This paper outlines an EU project that addresses these challenges and describes the methodology adopted in developing a portal for continuing professional development (CPD). Features of the portal are outlined in addition to a methodology to evaluate its continued development and maintenance. The paper concludes with an analysis of a module delivered through Technology Enhanced Learning (TEL) and how the lessons learned from this exercise assist refining the CPD portal towards its full-scale implementation.*

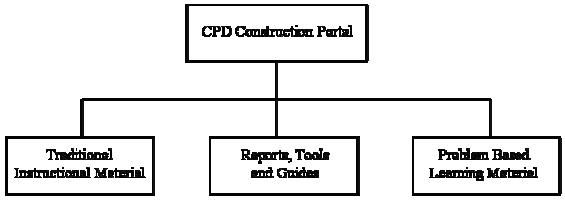
**Keywords:** blended learning, lifelong learning, portal, technology enhanced learning. Introduction

One of the most significant changes in education has been the increased availability of information and communication technologies (ICT) at work, school and in the home (Condie and Livingston, 2006). Given the increasing evidence that ICT and the Internet are transforming the way in which society accesses information, there is growing support for Garrison and Kanuka's (2004) observations that these tools will be a significant transformative innovation for higher education in the 21st century.

## 1. Designing a CPD model for Construction Management Professionals

As a part of the project, manuals and good practice guides, based on the interim and final evaluations have been formulated and are available for download by the subscriber. Figure 1 summarises the components that constitute the CPD Portal.

*Figure 1 CPD Construction Portal*




## 2. Portal Functionality

The Home page for the Portal for Continuing Professional Development is (www.cpd-construction.com). There is an open access area contained under the Main Menu page. Included on the homepage is a description about the project, a description about the project partners, research papers presented as part of the project work, guides for both participants and teachers, a contact details page and a link to a framework for deploying CPD based on research carried out on the project. There is also a course categories section and a login section. These are controlled access areas within the portal.

## 3. Case History: Pilot TEL Survey Using an Undergraduate Cohort

The time demands placed on full time undergraduate students is fast approaching that of the professional practitioners. The full-time student now seeks greater flexibility and autonomy in the way they receive and advance their education. To this end, the second case study looks at the delivery of an introductory module on geology and soil mechanics using TEL.

The opportunity to assess the experience garnered from this approach along with learner feedback provides an interesting pilot exercise that is used to troubleshoot the efficiency of the professional CPD portal. These tools contribute to learning throughout and module and provide prompt feedback on performance; a welcome addition to closing the 'learning circle' for the student.

## 4. Longer Term Sustainability of CPD Construction Portal

The potential access to the outputs of this project is unlimited. The principal beneficiaries from this project's outputs are; construction management professionals across a wide range of disciplines that will profit from the collaborative development, lecturing staff from the institutions participating in the project, teaching staff at higher level institutes outside of participation institutions and researchers in the construction management field. Professional bodies charged as part of their charter to ensure that CPD opportunities are available, taken by members can also be encouraged to be involved, and can benefit from the project.

## 5. Discussion

The facilities and capabilities offered by e-learning and technology in the delivery of training are considerable. Bruce (*2003; p 24)* notes "*today's students think of the Internet the way their parents and their grandparents…viewed electricity: ubiquitous and only noticeable when not available."* For undergraduates' integrating technology into the process of learning is not a significant challenge. This may not be the case for more mature construction professionals accessing lifelong learning opportunities, where ICT presents a significant challenge.

Based on the research carried out as part of the EU programme, there is potential for such a portal and an opportunity for more collaboration to take place between the professional bodies, industry and higher education in the delivery of CPD using technology. If CPD becomes an obligatory requirement for continued professional recognition, this will have knock on effects for the professional bodies in terms of resource requirements to manage and police the content of the material delivered.

## 6. Conclusion

The rational behind the first case study is to create an innovative international learning resource that is widely accessible to construction management professionals thereby facilitating improved knowledge and skills within the industry. It is well recognised that the integration of e-learning and blended learning into programmes is led by motivated and enthusiastic individuals with little extrinsic rewards structures to encourage these initiatives.

To date the major output of the project has been the development of a framework that will host a series of on-line training modules, a reference bank of materials, web-based services such as discussion groups and bulletin boards to act as a forum for the exchange of information and ideas between educational institutions, industrial and professional bodies. However, unless a strategic approach is adopted, resources deployed, and an appropriate support infrastructure is put in place, the longer-term sustainability of this initiative will be jeopardised.

The undergraduate case study presented highlights many of the benefits of delivering course material using TEL. In general, there was unanimous recognition that TEL improved the learners' experience, particularly the easy access to module documentation and the frequent assessment of course material using the 'tests and quizzes' option. These tools have contributed to learning throughout and module while prompt feedback on performance is a welcome addition towards closing the 'learning circle.'

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# The use of online asynchronous discussion forums in the development of deep learning among postgraduate real estate students

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*The role of learning management systems in real property education is examined in this paper with particular emphasis on the use of asynchronous discussion boards. The research shows that students readily respond to the use of online tools for communication and as an administrative tool discussion boards have a significant role in reducing the level of one to one communication required. They also enable student engagement with their peers in providing feedback. The use of discussion boards to achieve reflective writing and deep learning among students is demonstrated with a significant number of students participating at this deep learning level. The research clearly supports the use of these tools in enhancing learning in postgraduate courses and demonstrate that students are strategic in their approach to learning and will only fully engage with learning tasks where they are assessable and thus contribute to their objective of passing the course.*

**Keywords:** real estate education, learning management systems, discussion forums, reflective writing, assessment.

## 1. Background

### 1.1 A Developing technologies

Higher education is experiencing an explosion in online teaching tools. It is little more than ten years since anyone had heard of learning management systems but now everyone asks do you use WebCT or Blackboard. Hardly a semester goes by without a new building block being added to the range of online tools available to academics to 'enhance their teaching'. There is limited research however, as to the added value these systems bring to increased educational outcomes for students. Educational research has struggled to keep pace with the developing technologies. This has led to some criticism that it is the technology that is dictating the approach to teaching rather than sound pedagogy adopting the technology as an enhancement over traditional methods of course delivery.

### 1.2 Discussion forums in education

Discussion forums in which instructors and students post to a threaded asynchronous discussion provide a convenient mode of communication, but do they add to the education of students? Do they 'change the way in which people understand the world around them, rather than as an accretion of facts and figures' and thus lead to learning? (Ramsden 2003;79)

Discussion has long been a part of traditional class interaction. Online discussion forums, however, provide a very different format in that students are required to write their responses and post them for all to see. The process of writing in itself causes the student to engage in reflection: 'Writing is the manifestation of thought. It is guided by and grounded in knowledge and experience. It is self-generated, constantly reviewed, questioned and revised' (Redmon & Burger 2004;158). Thus the very act of writing is a learning activity that contributes to knowledge (Knowlton 2005;165; Pena-Shaff, Altman & Stephenson 2005). There are other benefits attributed to the written approach to discussion in that it is less prone to be dominated by a single participant and allows students not interacting in their first language to be able to spend time constructing their contribution (Havard, Du & Olinzock 2005). The asynchronous nature of the discussion is seen by Redmon & Burger (2004;158) to be a distinct advantage as it is 'less bounded by convention' and as such it can become a more effective medium for reflection. It would seem that there are strong positive outcomes for teaching and learning in adopting this written form of online interaction.

## 2. A survey of student attitudes to asynchronous online discussion and an analysis of learning in online environments

This paper will explore the pedagogical rationale for the use of online tools in the delivery of postgraduate real estate courses. It reports on a survey of students utilise discussion forums within the learning management system.

### 2.1 Methodology

In order to evaluate the use of asynchronous online discussion forums in real estate education, Student perception questionnaires were used, each containing both open and closed questions. In addition student discussion board postings were analysed.

The principal research method comprised a questionnaire which was developed to determine student's perceptions of the online teaching environment and the use of discussion boards as teaching enhancement tools.

## 3. Data analysis and results

The student survey of three separate cohorts at both undergraduate and postgraduate level provides a rich data source from which to derive an understanding of real property students' attitudes towards the use of online technology to augment traditional teaching practices.

## 4. Conclusions

This research paper has attempted to link the literature on the benefits of reflective writing in engendering deep learning among students with the use of asynchronous online discussions.

The research has clearly shown that at both undergraduate and postgraduate levels there is a widespread acceptance of the learning content management software, Students readily interact with the online system and welcome its use in teaching and as a primary means of communication It also demonstrates that most students are active users of the systems and if not active participants they are certainly monitoring postings. The results in terms of the use of discussion forums for administrative uses is certainly positive, showing that the majority of students are prepared to use open, asynchronous communication to ask and receive feedback on course related queries. It also provides a forum in which students are able to assist peers and to work as a group in providing assistance and feedback.

The other and more pedagogically important aspect of the use of online discussion is in its use as a teaching tool that seeks to achieve an increase in students learning and understanding of the subject. The results of this project clearly show that postgraduate real estate students strongly favour the assessment of discussions. This is reinforced by the clear indication that if it were not assessable then discussions would not receive the same level of attention. Indeed experience from previous years and using the same discussion format support this finding. It is a fact of life that postgraduate students with their heavy work, study and home commitments are strategic in their approaches to education and will 'cherry-pick' those elements within a course that contribute directly to passing the subject. That said a proportion of students are driven to achieve high grades and have a passion for understanding the issues, and, as such, will seek within a discussion to go beyond the base requirement with more detailed and a greater number of postings. The evidence from this study shows that while an assessed discussion many will still seek to undertake the minimum requirement in terms of postings and do not engage in any deep reflection of fellow students points. A significant number of students do however use the discussion as intended, and research and critically assess postings of others. Analysis of contributions has also shown that these students are engaged in deep reflective learning of the course materials and, as such the use of asynchronous discussion forums in real property courses has proved a pedagogically sound approach to enhancing learning in real estate students.

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# The use of an e-Support system to enhance student guidance in an Eco-House design project

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*This paper describes the development of a web based support environment for students undertaking the Eco-House design project with the Environmental Building Programme University of Plymouth in the UK. This e-Support environment provides students with a flexible and extendable search structure that allows them to obtain deeper information on specific systems they apply in their designs, or on fundamental issues that get raised. The environment links into websites of manufacturers, product data as well as serious academic papers. It will be developing over future years, providing an expanding source of information and inspiration for subsequent generations of students doing the Eco-House project. The paper describes how the e-Support environment was developed using an action research cycle, using critical reflection and feedback from different stakeholders. It presents the current form of the environment, an estimate of the impact on the Eco-House design projects, and areas identified for further development and improvements.*

**Keywords:** Web based resources, studio teaching, support, Eco-House

## 1. Introduction

The Eco-House project is the main element of coursework on the Domestic Construction Technology module ENBS 111, taught to first-year students working towards accredited degrees in Building Surveying and the Environment, Environmental Construction Surveying and Construction Management and the Environment at the University of Plymouth. The project is carried out as group work in a studio teaching setting. Some deeper background on the Eco-House project is provided by de Wilde and Pilkington [1]. An end product of the 2006-2007 academic year is shown in figure 1. On a more general level, the project is embedded in the Environmental Building Programme which aims to support students through a variety of mechanisms, which include formal lecturing, close tutorship relations, and self-learning, see for instance Murray et al. [2].

*Figure 1: Eco-House design, May 2007*

While the Eco-House project in general is viewed as an invaluable element of the course, previous experience indicates that there is insufficient time during design surgeries for the lecturer to address very specific systems, materials and other issues that might arise for students undertaking the project. This problem is inherent to the nature of studio design – students are asked to come up with different ideas and approaches, which cannot all be covered in contact time. In order to partly address this issue, an e-Support environment has been developed, providing students with a search structure that allows them to obtain deeper information on specific systems they may apply in their designs, or on fundamental issues that get raised.

## 2. e-Support Development

The e-Support environment has been designed to link into websites of manufacturers, product data as well as serious academic papers and will be developed further in future years to provide an expanding source of information and inspiration for subsequent generations of students doing the Eco-House project. Its overarching aim is to provide flexible opportunities for students to deepen their knowledge of key aspects of domestic eco-construction.

Development of the e-Support system has been based on action research, incorporating the following elements:

- Student feedback from the 2005/6 Eco-House project, plus directed suggestions from students who undertook the project in that year (collected by means of a brainstorm session) have been used to set directions for the development.
- This year's students have been encouraged to explore and use a prototype. They were asked for feedback both in a very informal way, inquiring about findings during design surgery sessions, and formally by means of an anonymous, structured questionnaire upon completion of the project.
- Specific in-depth feedback has been asked from colleagues on the Programme, on both the set-up as well as the contents

The initial development of the e-Support environment has been based on the notion that it is generally recognized that one of the prime ways of promoting access to the internet is to develop a clear and organized page ("hub"), with a clear and simple style [3]. It was decided to keep to this hub theory without adding additional features. One could easily make a more complex e-Support system that includes for instance technologies like a blackboard messaging system, virtual meeting facilities, project data repositories and RSS feeds; however, such aspects might distract from the basic information gateway that was envisioned. Furthermore including these in the Student Portal facility at the University of Plymouth might come with practical issues that are beyond the scope of a one term effort.

The basic layout of the hub has been designed based on access from a starting page on the portal. This starting page has been used to set the context for a prototype support system, and to carry basic instruction for users. From the start page, a link is provided to the actual hub. This allows a quick overview and access to the main categories of information included in the prototype version. Categories of information provided are based on the suggestion of last years students to include links to UK-based case studies, and categories defined by the lecturer: case studies, design principles, design tools, planning & regulations, energy systems, water systems, and construction materials.

Each of these categories has its own separate page, where a collection of links is provided, together with a short description of what information is accessed by following this link. This additional information is useful as it allows the lecturer to make students aware of commercial context, slightly opinioned subpages, etcetera.

## 3. Evaluation

Overall feedback on the structure of the e-Support was very positive. There does not seem to be a need to change the basics, only further development with more links, and may-be a few more commenting words on selected topics. The information linked to by the e-Support has been deemed very useful and interesting, and might be of use outside the scope of the ENBS 11 module. For instance, it has been suggested that the resource might be made available to students on the Master Programme.

However, it has been observed that getting students to actually use the systems has been rather hard. This has a parallel with a module where students were supplied with module books as a baseline reading resource, but failed to use this. From here it can be said that students should be actively encouraged to make use of such resources, for instance by requiring the underpinning of their designs by referencing to such information as provided in the e-Support system. This suggests the development of an active link between the project assignment and resources provided (text books and e-Support) for the next academic year.

## 4. Concluding Remarks

The new academic year will see the modification of the Project Assignment, to encourage students to engage with the resource by means of specific tasks, making some basic use compulsory.

In the future other options will be investigated. Topics to be pursued are the options to position the e-Support environment in such a way as to support continuing professional development (CPD), and including a part of the website to support online collaboration and lecturer input. In the long run the environment might even come to include web-based project presentations and assessments.

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# SECTION XVIII

## SKILL DEVELOPMENT

# Women's career advancement and training & development in the construction industry: The research strategy

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*The UK construction industry has a particularly low participation rate of women, both for those employed in the industry and for those engaged in training. The statistical analyses reveal that women are earning a greater number of professional degrees and entering the labour force; however, these women are not reaching the top corporate management tiers. It has been identified that lack of training has helped to prevent entry of women into the management ranks in many organisations and keep women at the lower levels within management. In this context, this paper highlights those aspects which will be addressed when designing a feasible research methodology for the study under consideration. The paper illustrates the use of case studies as the suitable research strategy and selection of Individual as a case in this particular research.*

**Keywords:** Case Study, Research Philosophy, Research Strategy, Training and Development, Women's Career

## 1. Background

The UK construction industry is one of the most male dominated industries, which thus presents challenges relating to equal opportunities [1]. It is assumed that a greater number of women will be a clear sign of increased equal opportunities policies working and reduce the skills gap and labour shortage in industry [2]. Hence, a logical solution to increase the number of women in the industrial professions is attracting more women to the industry initially, and then subsequently increasing the retention of them [3]. Numerous research studies have been conducted into how to attract women into construction [4]. However, the desired effect has yet to be seen thus far in the industry due to women leaving industry, before they have reached higher management positions and they are remaining in junior positions longer than their male peers. Structural barriers exist to exclude women from the sector, such as facilities, training, career progression, education, lack of promotion prospects, industry culture, and flexible working hours [5][4]. Additionally, [6] identified lack of training has helped to prevent the entry of women into management ranks in many organisations and kept women at lower levels within the management hierarchy. Therefore, this study intends to address the gap in construction T&D and women's career advancement in the construction industry. Accordingly, the aim of the study is to explore the impact of T&D towards women's career advancement in the construction industry.

## 2. Designing a research methodology

The study is focused on women, who are working within the professional capacity in UK construction organisations. The boundary of this study is considered as an environment, where women's career advancement is carried out. For this purpose, the hierarchical model of research methodology by [7] is used. This model consists of research philosophy, approaches, strategies, choices, time horizon and technique. Each philosophy, approach, strategies and techniques are guides and energises the inner research strategies and techniques. Interpretivism can be identified as the most appropriate research philosophy for this study. In terms of the research strategies, case study approach was selected based on the philosophical stance, research approach, contemporary nature, and by considering the added benefits.

### 2.1 Research strategy

Each research strategy can be used for exploratory, explanatory and descriptive research [8]. [7] are guided by philosophical underpinning and focuses the appropriate methods of research strategy. Since this research takes the interpretivism and subjectivism with regard to the philosophical stances, use of experiments and surveys are unjustifiable. Experiments and surveys are conducted under controlled environments where in the former situation the phenomenon and the context are separated and in the latter situation investigating the context is difficult due to the limited number of variables set out [8]. Since this research falls under the interpretivism and subjectivism stances, the researcher has to make a choice between ethnography, action research, or case studies. The research under consideration does not intend to influence or change the attitudes or procedures of the participants or the environment. Further, it does not intend to study behavioural patterns or physiology of the participants as in the case of ethnographical studies. Hence, the use of case studies is preferred over action research and ethnography. Case study approach is therefore, suitable for this research to explore the women's careers within the context of the construction industry and T&D aspects within the case study. The case study approach also provides the opportunity of carrying out an in depth study about the links between women's career advancement and construction T&D.

In order to select choices between the holistic or embedded case study, the unit of analysis is a vital fact to be considered in the research. The unit of analysis of the research is women's careers. Further, the research is consistent with a single unit of analysis, thus research is towards the holistic case study. The use of single case studies is preferred when the study represents a critical case, extreme or a unique case, representative or typical case, revelatory case or a longitudinal case [8]. The research in question does not fall under these categories, thus multiple case studies are preferred over a single case study. However, it is

intended to claim literal replication by comparing the findings from the multiple case studies. Women's careers will be the focal point of the research. Therefore, Individual woman is a case when considering the unit of analysis in the research. Consequently, collection of data from more than one woman will be the multiple case studies in this research and replication logic is used in order to justify the reliability of the collected data. The approach to case studies in this research involves theory building and verification.

In this research, semi-structured interviews will be conducted among professional women in different career phases in the different organisations, to understand the context of women's careers in the construction industry and the applicability of T&D towards their career enhancement.

During the data collection stage, it is expected to use case study protocol which consist of interview procedures and general rules that will be followed during the case studies. In addition to that, consistent interview guidelines are expected to be used. The use of a case study database, case study protocol and consistent interview guidelines will increase the "reliability" of the research.

## 3. Conclusions

This paper identified the investigation of women's career advancement in the construction industry concept within T&D; the most suitable research strategy is the case study and individual as a case in this research. Selection of individual as a case in this study is more suitable than the stakeholders in the case study. Selection of individual women in different career phases will assist to investigate in-depth their career advancement on T&D. It can also be concluded that the proper understanding of the philosophical issues followed by a clear definition and design of research strategy are essential elements in developing successful research.

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# Role of women leaders in the UK construction industry and their career barriers

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*The issue regarding lack of women leaders in construction has been a prominent concern for many years because women in mainstream management reduce potential managerial skills shortage in the industry and increase women's interest for construction related occupations. A literature review has been carried out followed by four case studies that were developed around four female leaders in the industry in order to identify their role and the barriers confronting their careers. Results of this study reveal that the role of women leaders in the industry is yet to be improved in terms of number but the majority of women leaders do not find problems in their leadership ability. Further the study reveals that women leaders in construction face career barriers such as balancing family and work commitments, childcare problems and old boys networks which prevent them from advancing towards leadership positions.*

**Keywords:** Barriers, Construction industry, Leadership, Women

## 1. Introduction

This paper is based on a study, which aimed to identify the role of women leaders in the UK construction industry and the barriers confronting their careers. The role of women leaders was examined through the duties and the job satisfaction of female leaders, their leadership styles, characteristics and ability and, the significance of their leadership in terms of number of women leaders in the industry, the extent of contribution and their positions in the organisations. Further the study explored the experiences of female leaders in order to identify the barriers confronting their career in leadership positions since examination of barriers is an important step for developing women leaders.

## 2. Background

A survey carried out in the UK construction industry shows that the ratio between male and female management staff is 6%:94% [1]. Increased access of minorities has been identified as an effective way of changing the existing culture of the construction industry, in order to overcome its various problems including lack of women, as acknowledged by many construction professionals [1]. It has been found that female leadership tends towards a style defined as 'interactive leadership' and women adopt more democratic and participative leadership styles [2]. However, the unique characteristics of the construction industry such as project characteristics, contractual arrangements, project life cycle and environmental factors can have an impact on leadership styles in construction [3].

Literature identifies that women have progressed slowely and have confronted a greater number of barriers in their development than their male counterparts. Most importantly, the industry has failed to consider the issues associated with women's commitments towards job and family life [4]. Furthermore, women find it difficult to fit into the atmosphere of the industry and the prevalence of gender stereotyping and the incidence of sexual harassment remain as major threats to women especially for their career development into senior managerial positions.

## 3. Methodology

Four case studies, which were developed around four female leaders representing different disciplines of the construction industry (Table 1), were carried out in order to achieve the aims of this study. The unit of analysis of the case studies was decided as the individual leaders because on them only the conclusions were drawn at the end of the study.

A detailed study was carried out on each female leader's career, career progression, leadership style and ability and, barriers faced during career progression. Views regarding the selected female leaders' leadership and her career difficulties were obtained from superiors, peers and subordinates to gain an overall perspective. Semi-structured interviews, Personal Attribute Questionnaire (developed by J.T. Spence, R. Helmreich and J. Stapp in 1975) and organisational documents such as organisational charts, employment records and other relevant documents of the respondents' organisations were used in order to collect data.

The data collected through the semi-structured interviews was analysed using a three step process of data reduction, data display, and conclusion drawing. The questionnaires were analysed by adding the scores on each items of a particular set (masculine, feminine and androgyny) together and deriving the averages.

*Table 15: Case Studies*

| | *Description* |
|---|---|
| *Case A* | *She is the Assistant Director of Estates and Facilities Division of a public body, which is attached to a university hospital in England.* |
| *Case B* | *She is the Financial Director of the UK's northern wing of an internationally wide construction company.* |
| *Case C* | *She is an Associate Architect in a well established architectural design firm in the North of England.* |
| *Case D* | *She works as a Site Quantity Surveyor on a construction site and her employer is an internationally reputed large construction company.* |

## 4. Findings and discussion

The leaders of cases A, B and C, who were in higher positions and whose work was not based on construction sites, were confident about their leadership ability and believed that they receive the recognition and acceptance from their working environments. The superiors, peers and subordinates irrespective of their gender were extremely positive about these three leaders' leadership abilities. In contrast, the case D leader possessed a negative attitude about her leadership ability and the acceptance and the recognition she receives from her site working environment. Further, a close relationship between the self-perceived personal attributes and the nature of the leaders' careers could be seen through the questionnaire findings.

The difficulty in balancing the family and work commitments was a more frequently quoted barrier within the study. Childcare facilities were identified as a major hindering factor to women's careers. In addition the old boy network was found to be another common barrier in construction since it is a male dominated industry. Further, respondents felt that lack of inhospitable culture within the construction organisations is a major obstacle to their career except the case B leader who comes from a different discipline hadn't felt any difference with regard to the culture in her work division though she is from a construction company. Case D leader, who worked on a construction site emphasised the industry wide practice of working long hours as a barrier to her career. Further, both case B and D leaders had admitted that the facilities which encourage women's careers are minimal in construction organisations compared to other sectors. In contrast to leaders' perspectives, most of the co-workers said that their female leaders do not face any difficulties.

## 5. Conclusions

Literature reveals there is a significant under-representation of women in mainstream management of the construction industry. However, according to the case study findings, the leadership of women was highly appreciated in the organisations. Apropos, the study illustrated that women leaders in construction make a significant contribution to the industry. On the other hand, female leaders perceive themselves to be more democratic leaders.

The results reflected that the difficulty in balancing family and work commitments, childcare problems and old boys networks are the most common mentioned barriers encountered by women in leadership positions in the construction industry. However, women leaders on construction sites find more difficulties in their career than those who work in an office environment.

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# The construction supply chain and supervisory skills for housing regeneration

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*In the housing market renewal programme the specification for and the management of the regeneration of the existing housing stock is a prime concern. Achieving quality and customer satisfaction in existing homes and new build designs, using locally sourced contractors, workforce and supply chain, presents key challenges in meeting the decent homes agenda and in achieving best value through a framework procurement process. The series of market intelligence reports produced by Construction Skills have identified critical skills gaps in the national and regional market place. This research paper explores the recommendations of this data, linking to demand led initiatives, which are now operating regionally. The issues arising from this work relating to supervisory and management shortfalls are explored. The research was initially conducted with regional and local construction contractors, to gauge the extent to which such higher level skills are developed. From this study, it was evident that deficiencies are apparent and that a proactive process of development of local and accessible education and training provision is required. A focus group study was conducted to validate the survey outcomes and develop a practical development plan to progress the initiative in order to bridge the gap between skills and people. The study progresses to make recommendations regarding professional skills needs, supply chain development and seeks to define options for the development of a sustainable local industry base.*

**Keywords:** Construction management, skills gaps, regeneration

## 1. Background

Forecasted figures for the national and regional construction industry indicate an existing demand for skills at all levels from the construction crafts to management (Construction Skills, 2006). Within East Lancashire, the Elevate East Lancashire Housing Market Renewal pathfinder focuses on wards within five local authorities that are subject to the extremes of housing market failure and societal collapse. Elevate are progressing a programme of new housing development and repair using a combination of best value procurement and local supply chain development. Unfortunately, this aspiration is currently not fully realised due to capability and capacity issues.

## 2. Literature review

The issue of supervisory skills within the construction sector in East Lancashire is not a purely a local one, indeed the issue of skills within the sector as a whole is an area of some concern as the construction industry moves towards the target of a fully qualified workforce (Turner 2004).

The complete skills range required to achieve successful project management is quite extensive, if the effects are to last and sustainable regeneration is to take root. Both the English Partnerships Report (2004) and the Egan Review (2002), both identified the need for the creation of a skills structure to increase the performance and enhance delivery by regeneration teams. Of the skills most lacking in publicly funded but privately delivered projects, partnership working where a shared set of values is important gives the biggest cause for concern. The lack of higher end skills such as Quantity Surveyors, Planners and Project Managers within the region, means that they have to be sourced outside the region, which often drives up the salary base (Turner & Townsend 2005).

## 3. Methodology

In order to scope the study, an initial telephone survey was carried out with a sample of 24 local companies were selected from the East Lancashire post code area and who employed more than five people. Importantly they were asked to rate in order of importance key elements soft project delivery. The second phase of the study comprised a series of innovation circles conducted with attendees at a series of best practice events hosted in the sub-region.

## 4. Study findings

From the first phase of the study involving the telephone survey, the companies tended to rate the attainment of formal skills as more rather than less important, with the exception of "ensuring the handover of engineering products". This was because many companies felt that this was not an area in which they had any or much experience. The most important area is felt to be "monitoring quality, regulations and health, safety and welfare". The next two most important areas are "confirming and monitoring the dimensional control of construction and installation projects" and "monitoring contract progress, quantities and certification". These are clearly supervisory type duties and were recognised as such, as was the importance of being qualified in them. When asked if such skills should be provided locally to meet the needs of the local working population, an overwhelming majority of 96% (23) of the companies asked cited that they would like to access a local provision.

In the second phase of the study, it was apparent from the focus group outcomes that nearly all of the 20 companies claimed to have training plans in place. The respondents claimed to be coping adequately in terms of acquiring the necessary supervisory skills, mostly via the Construction Skills 5 day Site Managers' Safety Training Scheme (SMSTS). They were however aware that acquiring more senior managerial qualifications, when the time was right, would pose its own problems. It was reported that development needs were met in a variety of ways, mostly using external training providers from the private sector, on an ad-hoc basis and to meet specific project requirements.

## 5. Conclusions

The development of construction skills and the supply of professional trained candidates is a prime focus for development in the North West region. There are however unique aspects of the construction industry that make the acquisition and retention of skills somewhat problematic. Unfortunately, the local availability of appropriate educational provision is difficult. In an effort to resolve the educational provision, Elevate, in conjunction with three Further Education Institutions in East Lancashire have attempted to achieve a common approach to this issue and raise development funds to provide a workable solution. If one looks at demand, there is evidence of employer led demand for level 3, 4 & 5 educational provision. However, if the environment is to meet this demand then further development and support is still required.

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# Developing Cost Effective Mid-Career Learning Support for Construction

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*This paper compares and contrasts the experience of developing a balanced learning approach for construction Small Medium Enterprises (SME's) in the UK, Brazil and South Africa, as they strive to learn creative and innovative skills for wealth creation. In effect this was an international benchmark of balanced learning as a relevant combination of facilitated Action Learning, traditional e-Coaching and eLearning materials developed specifically for small contractors. A critical aim of the work has been to understand the contribution more relevant skills development can have to construction modernisation and improvements of the construction industry in terms of process productivity, product quality and human work conditions in particular. Our studies revealed the main barriers for effective innovation and how these might be overcome by processes such as Action Learning and eCoaching. It also showed that the Action Learning (AL) component of the learning, with SETS of 'construction partners in adversity' finding "common ground" for useful discussions led to innovation for wealth creation.*

**Keywords:** Mid Career Professional Education, Action Learning, Business Bridge, Effective Blended Learning

## 1. Background

For many years research in construction at Salford University and at the Universidade Federal do Rio Grande do Sul has been particularly directed to contributing to the development of construction solutions and service support based on a systemic approach. As such, its research considers all aspects that influence the construction of building environments, as well as the performance of the construction industry as a whole. In a systemic approach the construction process is considered in very broad terms from conception, through design, materials production and execution, to use and maintenance. The approach is an integrative one, taking account of all interactions between these diverse construction phases.

Much of our theoretical research in both these university construction departments has been to contribute to construction modernization and the improvement of the industry performance in terms of process productivity, product quality, and human work conditions. From this firm theoretical base we have then moved on to develop better learning approaches, to turn theory into practice, which is the subject of the present paper. Our hope in doing this is that improved learning approaches will improve the fast and effective transfer of new and useful managerial concepts into the practical context and their full uptake to enable better working on building sites and for the industry as a whole.

## 2. The Project

The present author was keen to develop a demand driven approach for mid-career construction learning which would recognise the real needs/demands of construction SME owner-managers, help them understand how to learn from themselves how to cope and indeed flourish by developing new ways of working suitable for themselves, and enabling them to respond quickly and effectively to new opportunities. The focus of the work concerned busy mid career professionals who are action oriented and much of their learning, therefore, is context-dependent and experientially based.

So the project, formally known as "Networking North West" was funded by the NWUA so that a Mid Career Construction Professorial Learning Research Team could undertake a comprehensive R&D study into the learner needs of small to medium sized enterprises. Using a full action learning approach, the learner needs and learning processes of about 40 owner managers of SME construction companies, working in 7 AL SETs, were elicited using a portfolio of methodologies including: case study explorations, ethno-methodology, thematic interviews, empirical observations and full learner reports of all action learning meetings. All the material was content analysed and, using a grounded theory approach, a new model of mid career professorial learning was developed known as "Consilient Leadership". The funding from this research led to further formative evaluation and to the development of a "balanced and open learning portfolio" of materials suitable for SMEs. Finally a summative evaluation was also undertaken. 'Research' in this project relates to the original investigations of the learning needs of SMEs.

## 3. Action Learning

Action Learning is a process where groups of 5 to 7 professionals (a SET) come together to tackle real problems and issues from their working lives, develop solutions and reflect upon the success and failure of their resulting actions – thus learning from self and other reflective processes. SET meetings, facilitated by an Advisor, are characterised by certain accepted 'soft' rules and benign structures designed to encourage being 'authentically present' in someone else's issues – a truly empathetic response where a 'reciprocity of perspectives' enables both the questioner and the questioned to learn new ways of learning in context.

Action Learning was developed as a method of enabling managers to work on real tasks and learn from their experiences. Our previous work confirmed the importance, in Action Learning, of SETs creating the right context for real change and improvement. These SETs are small, mutually supportive groups of people prepared to band together to solve real problems or difficulties which cannot be solved by current best practice. Members of a SET bring to it, issues or failures from their own

work in an attempt to understand them and then try to improve one recognisable quality at a time as they observe their own, and others' problems, solutions or weakness during their attempted process of change (Powell, 2001).

## 4. Summary Findings

The present study clearly shows it is possible to engage and empower small construction businesses in a cost effective way by developing a blended learning approach, with action learning at its core which: answered the SME's, 'what's in it for me' question; fitted their normal ways of working, but also set them realistic and fund earning challenges; and finally used a real world language and 'just-in time' learning approach. Such an approach worked by sharing the responsibility for the development of educational materials and the delivery in a broad university partnership with the construction SMEs themselves.

In general the only limitation to the Action Learning (AL) process relates to the time limits of the meetings themselves. This was on the basis that the 'learning space' provided for the managers had the right balance between deep reflection to give confidence and deeper understanding on the one hand and learning from creative and innovative actions at work. To achieve success AL SET Advisors always tried to provide compelling advice to encourage action for change with respect to the most difficult skill to learn from at the beginning of the SET. If not handled sensitively and correctly, through good SET support, the real benefits of Action Learning - to improve work and actual processes at work - may well not be followed through with action and hence the real benefit maybe reduced. All SET members, who sustained their involvement in the SET to its completion, clearly enjoyed the process and gained a great deal concerning their own self-awareness especially with respect to valuable personal ('therapeutic help as they called it) lessons. Nevertheless, *most of the volunteer action learners were prepared to spend more than 30 hours contact time working in their action learning SETs; this is a considerable commitment from busy construction professionals who often loathe giving up even the most minimal time for training and education*. All participants grew in confidence and every participant had a different learning outcome; see table below for just some of the many examples of successful delivery, outputs and outcomes.

Fourteen other more specific learning points are mentioned in the full paper which also gives reference to doctoral theses and other reports holding the detail. Two critical examples of these are:

- It is important to have AL facilitators for construction SMEs who have: an empathy with, and personal professional expertise to share with their SMEs; be capable of coaching, rather than advising their SMEs; and willing to be supportive in difficult areas of their enterprise development.
- Even fairly inexperienced SET Advice can lead to best practice in SME learner development by sticking to the basic principles of Action Learning as espoused by Professor Reg Revans.

## 5. Conclusion

This case study provides a powerful benchmark revealing the value of an "action learning type" approach to engaging and empowering construction SMEs, with a whole range of capabilities and levels of knowledge, to learn from each other, and their supply chain corporates, for mutual benefit. The similarities of the underlying learning process between the UK, Brazil and South Africa in implementing such an approach is clear and reinforces other evaluations of its overwhelming success in engaging busy managers to learn how to participate in many new ways both tactically and strategically. Their new skills developed include learning how to question others in a penetrating and useful way, to actively listen to peers, bosses and subordinates equally and act with understanding as a result and to learn from all their actions, now seem to have been embedded in useful ways to the benefit of their mainstream working. Interesting other detailed learning points have arisen when comparing the more proactive, professional disciplinary and advisory role of facilitators. These learning points have been fed into the learning packs developed for the training of future coach facilitators for "education micro networking" in the North West and beyond; these packs are available from the author.

# Assessment of Demand & Supply Of Quantity Surveying Professionals To The Sri Lankan Construction Industry

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*Quantity Surveyors are the cost consultants in construction. They possess expert knowledge in construction costs, material usage, and labour norms. Quantity Surveyors have their expertise in project finance, project cash flows, contractual procedures and legal aspects pertaining to construction. This research is focused on analyzing the demand and supply of Quantity Surveyors to the Sri Lankan construction industry. As per the evaluation and forecast of demand and supply , supply of graduate and non graduate Quantity Surveyors is insufficient to cater the present and future demand. Therefore, supply sources are to be stimulated to meet the demand of the industry.*

**Key words:** Quantity Surveying, Demand, Supply, Graduates, Non-Graduates

## 1. Background

### 1.1 Introduction

Historically, the construction industry has played an important part in meeting the social, economic and technological demands of developing civilization. The role of the Quantity surveyor can therefore be defined as being the management of resources in the development, production, maintenance and disposal of capital assets [1].Since the construction industry becomes more significant in the economy and it has created more employment opportunities to the nation [3].

The market forces regulate demand and supply for the labour which decides the price of the labour which has a greater impact on the business, government policies, general education and the technical and vocational education. Demand for labour is the number of employment opportunities available in the public and private sector institutions within the country and overseas as well. Supply of the labour represent the number of workers enter into the world of work from schools, universities, and technical and vocational training institutions. The visible changes and growth of Sri Lankan construction industry have forced the Sri Lankan Quantity Surveying profession to evaluate its demand and supply.

### 1.2 The Quantity Surveying Profession in Sri Lanka

The origin of Quantity Surveying in Sri Lanka can be traced back to the British era. British Quantity Surveyors were employed during colonial period in the Public Works Department of Sri Lanka. During World War II these Quantity Surveyors left the country. Later, Sri Lankans who had the opportunity of obtaining foreign education returned and practiced as Quantity Surveyors [2]. As per Miskin 1993 [1], in the past the only course available in Quantity Surveying was the Builders' Quantities course at Ceylon technical college. Today, there are number of Quantity Surveying programmes, in Sri Lanka such as a four year BSc honors degree course in Quantity Surveying at University of Moratuwa ( started in 1985), a three year part time National Certificate of Technology course conducted by technical colleges throughout the country and other courses conducted by private sector organizations.

### 1.3 Aim

The ultimate aim was the assessment of demand and supply of Quantity Surveying professionals to the Sri Lankan construction industry.

### 1.4 Research Methodology

In order to identify the factors that are being demanded by industry, news paper survey was done by referring weekend papers from January 2002 to December 2006. Convenience sampling method was used since this research is under exploratory category. Forecasting was done using Time Series Analysis. The supply analysis was mainly done to establish the number of Quantity Surveyors passed out from relevant institutions from January 2002 to December 2006.

## 2. Research Findings and Analysis

In the study Quantity Surveying vacancies appeared in weekend news papers for years 2003-2006 were considered. A forecast was done for year 2007 using time series analysis. It can be stated that still graduate Quantity Surveyors have increasing trend in their graph while non graduates are proceeding with small variations (refer figure 1). In between 2005 and 2006 the rate of increase has changed significantly.

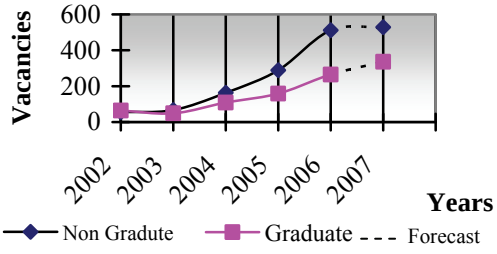


*Figure 1 -Graduate & Non Graduate Demand forecast*

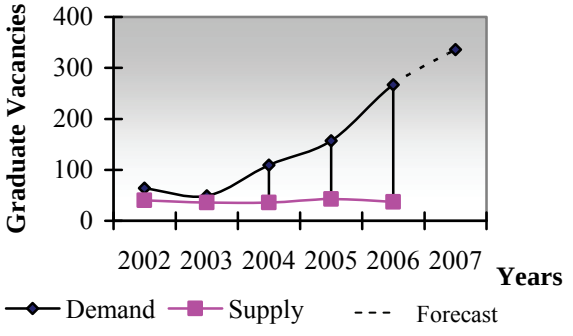


*Figure 2 - Graduate Demand and Supply Forecast*

When demand and supply for Quantity Surveyors are compared, the supply is not keeping with demand (refer figure 2and 3). According to the figure 2, the gap between the two graphs is increasing. Even though supply is not up to satisfactory level still demand has been continuing to increase. Figure 2 has been presented using all passed out graduate students from University of Moratuwa. However the average supply of graduates to the Srilankan market is still lower than shown in the graph since most of the graduates are leaving the country after about six months time from their graduation.

Even though supply for non graduates, had started with high position than demand in year 2002/3, the trend has reversed since 2004 and the gap between demand curve and supply curve are increasing similar to the graduate graph.

## 3. Conclusion

The profession of Quantity surveying also has to meet demands of the market as all other professions. According to the study, Quantity surveyors who have experience in civil and building construction are highly demanded. The graduates who have minimum two years experience and non graduates with more than four years of experience are the most attractive range for employers. Further for the period under review the market share of 60% has been filled by non graduates due to the non availability of graduates in the domestic market. As per the study it can be recommended to significantly increase the supply of graduate and non-graduates and further to acquire experience in civil and building fields. This would definitely enhance the quality of Quantity Surveying practice in Sri Lanka as well as reap higher financial benefits to the individuals with both civil and building experiences.

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# Contribution of women managers towards construction industry development: Methodological perspectives

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*This paper endeavours to explain the methodology for researching the contribution of women managers towards the construction industry development. The research is concerned with the gender segregation in the construction industry and its impact on the skills shortages. It further identifies how an increased number of women managers in the construction industry will help to change the gender segregation pattern and how this may contribute to the development of the industry by resolving the problems within it. With that background this paper mainly focuses on the research methodology that has been adopted in this research. Justifications are made for the most appropriate choice of methodology in terms of its philosophy, strategy and techniques. This paper further elaborates the chosen methodology, by explaining the data collection and analysis techniques, the research design and the design tests.*

**Keywords:** research philosophy, research strategy, research techniques, research design, research tactics

## 1. Background

UK Construction industry faces severe skills shortages at technical and managerial level [1]. Its gender segregation pattern is one of the factors that contributes to skills shortages in the industry. The majority of women hold administrative and secretarial positions in construction. A radical change in the gender segregation pattern will help to tackle the skills shortages, by attracting diverse skills. This could be achieved by increasing the number of women managers in construction. Having more women managers will provide much inspiration for young girls interested in construction careers by increasing the number of role models. It is also one of the most effective ways of ensuring women's participation in decision making. In this context, this research intends to investigate the ways women managers can contribute to the construction industry's development.

## 2. Aim of the research

Leadership is selected as the primary area to be studied. Organisations have paid attention to the leadership styles of the people who occupy managerial positions, holding the belief that leadership is an important factor in achieving business success. A very recent article proposed a leader-manager model as the effective one for construction [2]. Therefore, the contribution of managers can hardly be studied without considering the leadership component. Accordingly, the aim of this research is to explore and investigate the ways in which the leadership styles of women managers may contribute to the UK construction industry's development.

## 3. Research methodology

Research methodology refers to the overall approach to a problem that could be put into practice in a research process, from the theoretical underpinning to the collection and analysis of data [3, 4]. The two contrasting views on how a research should be conducted can be labeled as positivism and phenomenology [5, 3, 4]. The key idea of positivism is that the social world exists externally and that its properties should be measured through objective methods, rather than being inferred subjectively through sensation, reflection or intuition [5]. Unlike the positivism, the phenomenological paradigm assumes that the reality is not objective but is socially constructed and given meaning by people [5]. This research intends to explore and investigate the ways in which leadership styles of women managers may contribute to the UK's construction industry development. Leadership characteristics and styles mean different things to different people and the extent of women's contribution to the industry development is highly subjective. In this context, it could be argued that this research takes the overall phenomenological stance.

A research strategy may be thought of as providing the overall direction of the research including the process by which the research is conducted [4]. The commonly used research strategies in business and management research are experiment, survey, case study, action research and ethnography [6, 4, 5]. Among these the case study has been chosen as the most suitable strategy, the justification for which is given below.

Experiments are generally governed by positivist epistemological undertakings and an ontological assumption tilted towards objectivism. Ontological assumption of strong 'pre-existing reality' in experiments, require a high extent of control over the environment by which the investigator directly, precisely and systematically manipulates the reality [7]. These can basically be conducted in a highly controlled environment like a laboratory. The leadership styles cannot be manipulated in a real life context. Therefore, this strategy is not compatible with this research. In action research, the researcher tries to solve the problem by becoming a part within the problem environment, with the goal to change the status quo of the participants. The action research operates in a partly controlled environment and the aim of the research may be to have a direct and immediate impact, and hence it attempts to change the environment. Ethnography is defined as the study of people in naturally occurring settings, by means of methods which capture the social meaning and ordinary activities, involving the researcher participating

directly in the setting in order to collect data in a systematic manner. According to the aim of this research, an immediate change does not need to be incorporated into the research process as it merely intends to explore and investigate the contribution of leadership styles of women managers. Further, both these approaches need high participative observation from the researcher. As this research does not take these qualities, it disqualifies action research and ethnography from being an appropriate strategy.

This leaves both survey and case study strategies as the suitable choice for this research. The survey requires little control over the environment and is designed to address the 'what' type of exploratory questions and they can be applied in social science research [7]. However since this research requires an in-depth analysis of the construction industry, the case study is more appropriate compared to survey.

Research techniques refer to the specific methods used to collect and analyse the data. Semi-structured interviews, expert interviews, Multiple Leadership Questionnaire (MLQ) and Personal Attribute Questionnaire (PAQ) surveys are the data collection methods adopted for this research. The data collected through interviews will be analysed using content analysis whereas quantitative analytical techniques associated with MLQ and PAQ will be used to analyse the questionnaires. Multiple sources of evidence, pattern matching and replication logic in multiple case studies will satisfy the construct, internal and external validities respectively. The case study protocol and a case study database will be developed in order to ensure the reliability of the research. In summary, this paper will be a supportive resource to any reader interested in defining a methodology for a specified research study.

## 4. Conclusion

This paper explains the methodology for researching the contribution of women managers to the construction industry development. It introduces the subject area in which the researcher intends to undertake a study. It justifies the selection of the appropriate methodology. The topic to be researched and the research questions are the primary drivers in the choice of methodology. The researcher's knowledge, availability of time and other resources, and accessibility of information sources are also to be considered. Based on these factors an exploratory, multiple, holistic case study has been chosen as the most appropriate research strategy.

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# Employability of women managers in higher education sector: a study on their leadership qualities

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*The teaching profession both in this country and internationally is, with few exceptions, dominated by women as it has traditionally been seen as a 'suitable' job for women. However, statistics reveals that despite the large numbers of women in the profession, they are greatly under-represented in positions of management in higher education. Thus their under-representation in positions of senior management continues to be a matter of some concern. The background of this paper identifies the status of women managers within the higher education sector. The leadership styles typically adopted by them are then discussed. These styles are taken into further analysis in order to find out whether such styles are of use in terms of filling the leadership gaps in higher education. In this context this paper examines the literature relating to gender, leadership styles and higher education in order to explore the employability of women managers within the higher education sector.*

**Keywords:** Higher education sector, Leadership, Women managers

## 1. Background

Research in the recent past revealed that the number of women entering into higher education in UK has continued to increase over recent years. However, the participation rate of women at senior management level in higher education is relatively low. The senior management level, in this paper, refers to the academics professionals such as professors, senior lecturers and senior researchers in higher education institutions.

The major reason for this under-representation is the barrier women face to progress their career in educational leadership. Socialisation and stereotyping are the major barriers for women seeking a senior position in education. Some internal barriers such as a lack of confidence, lack of competitiveness and fear of failure have also been identified for the entry of women into leadership position.

In this context, this paper reviews the employability of women in senior management positions in the higher education sector. There is a growing trend in the UK to attribute a greater significance to leadership as a way of solving organisational problems not only within the private sector, but also within the public sector – generally across education, health and local government organisations [1]. Accordingly this paper first identifies the leadership gaps in higher education and then the leadership styles typically exhibited by women managers. These finding will lead to the discussions on the employability of women managers within higher education sector.

## 2. Leadership in higher education

Educational leadership refers to leadership influence through the generation and dissemination of educational knowledge and instructional information, the development of teaching programmes and supervision of teaching performance [2]. During the last 5-10 years UK Higher Education Institutions (HEI) have been developing and implementing significant levels of structural change, influenced by both internal and external policy and environmental developments [3]. The senior management structure of many institutions is being conceptually restructured. As a result the balance of power between groups at different levels is changing and identifying the focus of power and influence within senior management has become more difficult and complex [3]. Consequently it may affect the effective functioning of senior management in higher education.

Interventions from leaders should be limited in order to allow the self-correcting mechanisms of the HEI to operate effectively. Therefore, the traditional form of leadership may sometimes be more significant for the problems it can foster, than for its benefits. This suggests that a key issue in higher education is not so much about what leaders should do, but what they should avoid doing. The identified characteristics of the managers who are good developers of their staff could closely be linked to that of a leader in the centre of the organisation and not at the top. Based on the competencies identified for effective leadership in higher education, the attitudes and behaviours of leaders tend more towards people-oriented than task-oriented. Thus leadership in today's academia must take into account the needs and demands of various stakeholders and include these major stakeholders in the change process [4].

## 3. Leadership styles of women managers

The growing numbers of women in managerial positions have created interest in the role of women as a leader. Female leaders are more likely than men to use transformational leadership, which motivates others by transforming their individual self-interest into the goals of the group. The characteristics of transformational leadership relate to female values developed through socialisation processes that include building relationships, communication, consensus building, power as influence and working together for a common purpose. The notion of male and female gender qualities facilitates the argument that male gender qualities are oriented towards the more impersonal, task oriented or transactional approach to leadership, while female

gender qualities tend towards more nurturing, relationships oriented style of leadership that underlies the transformational leadership approach [5]. The empowering, collaborative and democratic style of leadership associated with women is compared with the more directive and authoritarian style traditionally associated with male leaders.

Apart from these leadership styles women are said to be better than men in terms of multi-tasking. Women's central involvement in managing households, raising children, juggling careers gives them a capacity for prioritising in a leadership role that men typically do not possess.

## 4. Conclusions

The higher education management structure has become more difficult and complex. More than the activities involved, it is the people who are to be motivated and trained in order to promote them into a state of self-correction. Therefore the higher education institutions should be more friendly and accommodative for the employees and the gaps between the people at different levels should be minimal to achieve this. Thus maintaining a personal relationship is vital in higher education. This cannot simply be achieved by placing the whole responsibility on the shoulders of one single leader. Leadership in higher education is therefore more complex as the people in these positions should have the ability to motivate employees to excel beyond what is expected through the use of individual consideration. This could closely be linked with the typical characteristics of women managers such as empowering employees, caring for others, listening to others, establishment of priorities, coordination, communication, multi-tasking and developing personal relationships. These qualities largely fall under transformational approach of leadership.

However, leadership based purely on transformational style may not be sufficient. There could be instances where the leader has to use a transactional style, for example, when motivating people to perform in exchange of specific rewards. Similarly, when there is a situation where a job is required as a matter of urgency, the leader may have to use an authoritative style. Considering these, it cannot be concluded that higher education is effective merely with the transformational style of leadership. Managers, therefore, should be able to switch from one style to another depending on the situation. Nevertheless, the authors intend to say that the transformational leadership, which is largely used by women managers, could positively contribute to improve the higher education sector. Through this paper it could be concluded that women have a greater potential to be employed in managerial positions within the higher education sector.

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# Grounded theory as an appropriate methodology for leadership research in construction

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*Leadership research in the construction industry has been dominated by positivist methodologies resulting in a much larger proportion of quantitative studies than qualitative approaches. Thus, the richer interpretations which could be possible through the latter are not realised. With growing research focus on leadership in construction, it is pertinent for studies to utilize the grounded theory approach to uncover the basic social processes that drive the leadership phenomenon in construction. A case is presented here to advocate the strengths of grounded theory and the potential benefits it can offer to research on leadership in the construction industry.*

**Keywords:** Leadership research, Grounded theory methodology, Construction industry

## 1. Background

Research on leadership in construction has been restricted to the use of positivist or quantitative methodologies. Very few studies have utilized qualitative methods to analyze the nature of leadership in the industry. Since leadership is a social process [2] and construction is a social system [3], it is essential to use of analyses that are suitable to uncover the complex details of the social processes that take place among people in construction projects. This paper underlines the need for the application of more qualitative methodologies to study leadership in the construction industry. It focuses on three issues: (i) the current methodological trends in leadership research; (ii) why qualitative methodologies are more useful for leadership; and (iii) how the grounded theory framework can help to capture the basic social processes of leadership in construction.

## 2. Which research method?

Choosing a research methodology is not an easy task. In this process, researchers should address the paradigmatic question, the ontological question, and the methodological question to adequately discover the basic social processes. Issues which play an important role in the choice of research methodology such as: aims of research, epistemological concerns, and norms of practice of the researcher who is also influenced by organizational, historical, political, ethical, evidential, and personal factors. According to Buchanan and Bryman [4], the researcher must encompass the ability to address, systematically and coherently, the organizational, historical, political, ethical, evidential, and personal influences on the choice of research methods.

## 3. Research approaches to study of leadership

Bryman [1] criticizes that leadership research has been dominated by a single kind of data gathering instrument—the self-administered questionnaire. In their review of leadership studies in construction, Toor and Ofori [6] note that most of the works utilized quantitative methodologies, using survey questionnaires to collect information. They join the critiques on quantitative research and assert that surveys and questionnaires mostly measure attitudes towards behaviors and not the actual behaviors due to social desirability. Such surveys are also not useful as they mostly measure the static situations and do not explain the processes behind them. Such descriptions of leadership fail to help us understand the deeper structures and dynamism of leadership phenomena and are mostly unable to draw effective links across the multiple levels to explain leadership events and outcomes. Quantitative approaches do not explain the subjective and ever-shifting realities of the leadership process and are criticized as pseudo-scientific, inflexible, myopic, mechanistic, and limited to realm of testing existing theories.

Whereas, qualitative methodologies are strong in those areas that have been identified as potential weaknesses within the quantitative approach. Qualitative approaches may be intensive, complex, expensive and time consuming but they provide a deep, rather than broad, set of knowledge about a particular phenomenon. Researchers have also suggested combining the quantitative and qualitative approaches to achieve triangulation of data and to examine how far the results from both methods are similar. Bryman [1] suggests that qualitative research on leadership can serve the area better by engaging much more with quantitative research in terms of its findings and literature.

## 4. Leadership as social process

Leadership is primarily about influencing others and regarded as the collective incremental influence of leaders in and around the system. It is a function of the social resources that are embedded in relationships, the environment, structure and technology of organizations. Also, leadership is not a linear or mono-directional phenomenon; it is rather multi-directional, involving formal leaders, informal leaders, and followers. Leadership is a social process [1] in which leaders interact and communicate with, and influence others. Thus, Parry [5] argues that leadership research should focus on the social processes that go on between people and which have a leadership impact. This is because irrespective what behaviors people employ in leadership roles, many other variables influence the impact which these leadership behaviors have upon followers and upon the context of work. The nature of leadership as a process which takes place within a social system—comprising groups, organizations, and

so on—is further strengthened when it takes places in the construction industry, a social system in which people are the principal actors [3].

## 5. Grounded theory as a potential research method

Supported and used by several researchers, grounded theory [7] has been advocated by many scholars as a method well suited to enhancing the development of knowledge on leadership. Parry [5] suggests that as leadership is a process of social influence, this makes grounded theory a relevant method of analysis as it emphasizes theory development rather than testing an existing theory. In the opinion of Hunt and Ropo [2], grounded theory discovers the underlying social processes and forces that result in a particular activity or phenomenon. The key argument here is that leadership is a basic social process [5] with a number of intervening variables which makes it dynamic and complex. This, therefore calls for more grounded qualitative approaches that can dig deep into social realities and can uncover the intervening variables and forces that influence leadership. It can also be used to examine leadership incidents in various organizational contexts. The grounded theory approach will also be helpful to refresh and considerably compliment the existing works on leadership [8].

## 6. Conclusion

Leadership research in the mainstream social sciences as well as in construction continues to utilize positivist methodologies. However, there is evidence that qualitative or interpretivist methodologies have the potential to take leadership research in a new direction and to a high level by discovering the basic social process that drives the dynamics among leaders and followers under given circumstances. The grounded theory approach can be useful in helping to uncover the social processes that are fundamental to leadership. While mainstream researchers have already recognized the significance of grounded theory for leadership research, its use remains scarce in construction research, making it is a timely for scholars to use grounded theory methodology to develop richer interpretations, frameworks, and theories of leadership in construction.

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# SECTION XIX

## CURRICULUM DEVELOPMENT

# The changing role of universities and flexible course re-development

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*This paper reflects upon the development of a suite of new courses in the Faculty of Built Environment and Engineering at the Queensland University of Technology in Australia. It describes the theoretical framework upon which these courses are founded and the broader pedagogical and structural implications and opportunities. It relates a model of transformative learning to the large scale issues of course design and contemporary course relevance. The paper illustrates such a relationship with a suite of courses in which the student takes a greater lead in the shaping of his or her own education. Notions of change and transition are presented as opportunities for continued renewal of course offerings, and as the catalyst for transformative learning wherein students become more active members in the teaching and learning process. What we find is that good pedagogical course design can actually align with the changing role of universities in contemporary society.*

**Keywords:** Cross-disciplinary, Curriculum, Design, Education, Multi-disciplinary

## 1. Introduction

"Universities are products of the late 19th and early 20th centuries… The question is how do you break them up in some way… How do you make them free to do something new and different?" Everett Hughes [1].

This paper explores and illustrates how university undergraduate courses can be designed and developed in direct response to the changing role of universities within the broader social context. Further to that, it illustrates how a model of transformative learning [2] can be used to inform such course design and development. Universities must prepare students for the real-world demands of professional practice, and the classroom knowledge is increasingly seen as only a part of the knowledge needed to operate in practice [3]. New courses need to adapt and embrace a broader more flexible approach to what constitutes scholarly knowledge.

## 2. The changing role of universities

"Current changes in Western universities which are attributed to global and other international economic, social and cultural developments are variously referred to in a number of different ways including new managerialism, academic capitalism and academic entrepreneurialism" [4].

The basic reason for the existence of higher education is changing. That is to say that the role or purpose of universities within society has changed. One of the significant issues about this is that different people/stakeholders still have different perceptions of that changing role. For example, university is no longer seen as being as elitist as it used to be, it is much more 'normal' to attend university with an increasing percentage of the population now studying at tertiary level. Higher education is now seen as an expected part of the process of getting a job or developing a career. This has not only affected the types of courses that we run, but more significantly the way in which we run or deliver our courses. There is also increasing influence from industry and professional bodies with respect to student graduate attributes (employability skills), and within the disciplines of design, engineering and built environment, many courses are externally accredited by such professional bodies, which has an increasing affect on curriculum development.

Many professions in the design, engineering and urban development industries still require a period of formalised workplace training, either during or after university study, before being eligible to apply for organisational (Government sanctioned) registration. This arrangement sees three significant stakeholders involved in, and influencing, education in these fields [5]:

- Governments who are responsible for registering professionals, and administering registration examinations, and who control higher education policy and funding
- The professional industry bodies, who increasingly lobby governments and have their own education policies
- The higher education sector itself, responsible for curriculum development and delivery, often within guidelines provided by government and industry

This complex arrangement is fraught with all of the expected conflict between academia and industry and the ongoing differing visions of the role of professional education [6].

## 3. Building a new course model

Closing the gap between outdated learning experiences and the changing societal expectations of the professions, and the changing role of universities, requires a shift from an educational model based on persuasion to one based on dialogue [7]. Where in the past, education has been seen as a process of doing it to them, to turn them into practitioners, it must now be

about enabling them to become professional life-long learners by their own processes. This notion of 'becoming' suggests a transformative pedagogy as exemplified in the work of Jack Mezirow [8] [9].

Mezirow's ideas of dialogically based learning environments can actually be up-scaled from a class room context to a whole of course context. What the Faculty of Built environment and Engineering has attempted, is to conduct that dialogue at a course scale, wherein course structures are not imposed upon students but rather developed individually by students, through their own self-selected choices; choices such that students can respond to changes in society, the professions, the higher education context in general, and changes in the role of universities.

## 4. Course structures for dialogue

With a coming together of these Faculty goals, and ideas of transformative learning, it was possible to develop a common course structure (model) that would still allow for the individuality of the disciplines to prevail, while also providing, and indeed encouraging, transdiciplinary activity. These two notions of discipline focus and flexibility/choice exist as shared possibilities that promote self-constructed, divergent learning. The courses would provide the students with:

- Opportunities for self-construction and divergence
- Opportunities for integrated transdisciplinary study
- Opportunities to learn through and in practice (work place learning)
- Opportunities for articulation
- Opportunities to engage in discovery (research) and application (external and community service) activities through a thematic approach to faculty activities

## 5. Conclusions

The courses described here can be seen as a direct response to the changing role of universities, while implementing sound practices of transformative and dialogical learning environments. These courses offer students the opportunity to develop into different *types* of graduates, appropriate to changing professional and social context. "Adults do not learn for the sake of learning; they learn to perform a task, solve a problem, or live a more satisfying way" [10]. These courses seek to provide educational possibilities for the broadest range of tasks, problems, and ways of living.

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# Shifting the Engineering Education Paradigm - Challenges and Experience in Curriculum Development and Delivery

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*It is being recognised around the world that educating future professionals as building practitioners requires a fresh approach. In this fast moving and globally competitive environment, the industry recognises that what has been perceived as "know-how" can become stale in a much short time than the time required to acquire and preserve it. Forward thinking building education thus bears the challenge of training a new breed of practitioners who are robust self learners relentlessly in pursuit of skill transformation within short life cycles. This paper presents the teaching and learning paradigm which is aligned to the above school of thought.*

**Keywords:** Engineering education, WIL, PBL, Co-rational design, PBL, Curriculum development

## 1. Background

The Engineers Australia manual for the accreditation of professional engineering programs [1], issued in 1999, called for a major shift in the way universities train engineering graduates. This demanded the inclusion of generic graduate attributes in all programs, driven by capability agenda which was linked to re-accreditation in 2004. In a way, this was the first formal acknowledgement of the widening gap between engineering education and industry expectations mentioned above in Australia and the strategy adopted to address the issue. In response to this and also as a part of the general quality assurance process, the faculty of engineering at RMIT University issued, in 2002, a project plan titled: 'Renewal of the Bachelor of Engineering 2002-2004' [2], encouraging project based learning methods in teaching practices at RMIT. The paper discusses the challenges faced and the experiences gained transforming a prescriptive type teaching and learning paradigm in the field of civil engineering design stream aligning to a capability agenda. The curriculum development and the delivery presented here evolved over five years (2002-2007), and the first batch of engineering students benefited from this undertaking is graduating at the end of 2007.

### 1.1 Need for shifting the paradigm

The modern practice of building and construction engineering is evidence-based critical decision making achieved through team networks. However, engineering was traditionally taught in a content intensive, compartmentalized and prescriptive manner, focusing on numerically deductive reasoning. That approach had little focus on generic graduate attributes expected of the future engineering practitioner. There is an increasing trend to suggest that the professional and the tertiary education institutions are jointly addressing the concerns of this widening gap [1].

## 2. Work integrated learning and audit readiness

Unlike a couple of decades ago, the current marketplace demands work ready graduates. Therefore the key focus of educational institutions in our view, striving for quality value added delivery, is to ensure students' readiness to work at different stages of their growth, even before they complete their degree. Work Integrated Learning (WIL) basically refers to the institutions' ability to simulate or mimic workplace process mechanisms and emotional/behavioural intelligence within the constraints of the "class room" or learning environment. Audit readiness here refers to students' ability to be competitive in seeking a placement as early as possible in their undergraduate program. These two objectives require a significant departure from training graduates through text books, tutorials and exams. Audit readiness is a concept we introduced to encourage our students to be confident and upfront in sharing and discussing their work in progress. To put this succinctly, our endeavour is to transform "student hours" to "engineering hours" as early as practically feasible within the degree program so that our students are highly sought after within the workplace.

## 3. Teachers' role

Obviously, re-defining teachers' roles and teachers' mindsets is fundamental to shifting an education paradigm, especially in creating student centeredness. In this regard the teacher's role would shift from being the knowledge provider to a facilitator's role in knowledge management. Although the volume of information available and the speed of accessing it have reached phenomenal levels of efficiency, the obsoleteness and the lack of credibility of the knowledge that is within reach are also on the rise. As a result, the teacher's role as the sole guardian of knowledge and the ability to police students' leaning is going out of fashion. In the new paradigm shift, the teacher can command respect only if she/he possesses great motivational skills, vision, reach, can interpret information in a speedy manner and is capable of real time responses to students' enquiries regarding various sources of information. In other words, building education is moving from having a pseudo-static status to a dynamic mode.

## 4. Curriculum, learning outcomes and performance indicators

In this endeavour work integrated learning (WIL) environments were created in a scaffold-like manner by a vertically integrated stream of engineering design and analysis courses offered from second year through to final year. By immersing students in realistic and team oriented integrated learning activities, analysis and problem solving skills were simultaneously developed with teamwork and communication skills (our core graduate capabilities). As demonstrated here through a sample of project outcomes, the author managed to arouse enough curiosity and enthusiasm in them to foster independent learning which, in our view, would encourage them to become reflective practitioners later in their careers. A brief sampling of curricula and learning outcomes is presented to support the conceptual model illustrated in Figure 1. They are discussed under three key performance indicators which are of great importance to future engineers and highly valued by the Australian building industry. Namely, gaining skills in co-rational decision making, skills in virtual mobility and work ethics are all required to succeed in inter-discipline and intra-discipline engineering services.

## 5. Conclusions

The tertiary education paradigm is currently being revived in many forward thinking universities around the world which are aligning to a capability agenda. The need to create Work Integrated Learning environments in professional education is gaining recognition and Project Based Learning is regarded as the best form of delivery of a capability driven agenda. However, it must be emphasised that the intension is not to undermine basic and fundamental discipline specific skills but to enhance its application by creating exciting learning environments simulating the real work place. In other words, content is taught within the context of processes, emotional and behavioural patterns of the real workplace, providing students the opportunity to experience first hand.

The skills needed by the quality educators and the future graduates for success are changing rapidly and can no longer be regarded as pseudo-static.

Knowledge is widely and freely accessible. Training opportunities and experiencing first hand how to apply know-how in the working life are the reasons for students attending educational institutions. This can be achieved while safeguarding and nurturing tertiary institutions' traditional position as the institutions of scholarly learning.of engineering design and analysis courses offered from second year through to final year. By immersing students in realistic and team oriented

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# The perspective of students on research methodology learning and teaching in the UK

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*Dissertations are used in many disciplines as the flag ship document for honours graduates. The skills developed help in completing work in other modules and are valued by potential employers. Bespoke research methods modules are used in some degree programmes to foster improvements. It could be argued that built environment dissertations still lack rigorous analysis. Students who have a dislike of mathematics will avoid quantitative techniques that involve statistics. Students who take a qualitative approach rarely do little more than content analysis. The methodology for the study is a literature review and survey of students in two segments (i) those who have completed a research methods module and about to embark upon dissertations (level two students), and (ii) those who have completed their dissertations (level three students). There were 50 replies. The survey measures 'student perception of success of learning outcomes' in research methods and dissertation modules. Overall mean scores were 68.4% for level two students and 72.1% for level three students, indicating 'good to very good' achievement in learning outcomes. The study finds that a research module is highly valued by most students. There are several areas where students need to improve, including analytical skills, time management, citing techniques, and the use of hypotheses and variables. It was found that tutors sometimes give contradictory advice about research methodology.*

**Keywords:** Research methods, dissertations, analysis, teaching

## 1. Introduction

In the early 1990s, there was concern in the built environment that student dissertations were not of the appropriate quality. Holt [1], Fellows and Liu [2], and Naoum [3] published their first editions of research methodology texts for construction students in the late 1990s. Consequently, dissertations improved, and consensus was established about structure and content. Historically, students have not used robust analytical techniques, and academics did not agree on what constituted a 'good' dissertation. Some degree programmes prepare students for dissertations with formal teaching in the dissertation module itself, whilst others prefer to nurture research skills in all modules. It is unlikely that students will have the resource to take-on both quantitative and qualitative analytic methods within their work. Consequently as Strauss and Corbin state [11, p. 28] without at least appreciation of both, there is a danger that students will take into their careers 'dogmatic positions … in favour of either'. Reliability and validity are arguably very important but complex issues for students to grapple with. It is therefore questionable whether it can reasonably be expected that undergraduate students should display knowledge of reliability and validity in their dissertations.

## 2. Literature review

Holt [1], Fellows and Liu [2], and Naoum [3] illustrate loose consensus about structure for dissertations. Language used to describe research goals is consistent, that is aims, research questions, objectives and hypotheses. There is agreement that research in construction is often problem based. However, some terminology in texts is variable, for example according to Hart [15, p. 9] the first part of a dissertation should be a rationale; Holt [1, p. 9] asks for a broad discussion, Naoum [3, p.14] suggests a purpose, and Fellows and Liu [2, p. 9] a proposal. Also, there does not appear to be consensus about the rigour of analysis that should be present in undergraduate dissertations. Construction research methods texts do not give examples of robust qualitative analysis, particularly that is in the context that as Creswell [17, p. 140] points out 'undoubtedly, no consensus exists for the analysis of … qualitative data'.

## 3. Methodology

A questionnaire was used to collect data. The population for the study was built environment students studying BSc (Hons) programmes in UK universities. The sample was construction students attending The University of Bolton, UK. There were 50 replies. A basket of statements was used to measure the variable labelled 'student perception of success of research learning outcomes'. A Likert scale was used. The five possible student replies were scored in the range of 0 to 4, with 4 indicating a positive perception of success, and summed totals were calculated from the basket of questions. Results were converted arithmetically to a percentage scale, whereby for example a score of 60 out of 120 became 50%. Inferential tests were undertaken to detect for differences in the perception of success scores for five subject variables. Tests of internal reliability were undertaken; the p value was set at 0.05. Actual student marks from tutors are considered to help improve the validity of the study.

## 4. Results and Analysis

The overall mean scores for 'student perception of success of research learning outcomes' was 68.4% for level two students and 72.1% for level three students indicating good to very good achievement. The research methods module at level two was highly valued by students (86.9%), and graduates found the dissertation process challenging (86.1%). In the context that the research seeks to identify areas for corrective action, inferences are sought and interpretation undertaken below for all

measures of success that fell below the mean score of 60%. These were in the following areas: (i) students were not able to use quantitative or qualitative analytical tools appropriately (ii) not citing work Harvard Style, (iii) not being able to include a clear hypothesis in work and identify variables, (iv) working independently and working in teams, and (v) tutors giving contradictory advice about research methodology. The mean scores for the research methods module and dissertation for 2006/07, obtained from the university database were 54.7% and 58.10% respectively. Part-time students felt that the period of time to complete their dissertations was too short. Students reflected that they tried to do too much in the time available and time management was identified as being the most challenging aspect of completing dissertations. Some tutors were strict in the supervision process, setting tough interim targets for students and insisting on regular meetings. Other tutors were more laissez-faire. Differing and contradictory advice from dissertation tutors was again highlighted as a problem. Also tutors give contradictory instructions about how to cite Harvard style. One student commented that the dissertation was the 'most joyful module', and wrote very positively about life skills that had been developed.

## 5. Conclusion

It is for debate whether universities should seek to equip all academics with research skills, or if alternatively it is just a political fact of life that some academics are just 'excellent teachers'. Similarly, it is for debate whether universities should seek to impose rigorous regimes on the supervisory process, or alternatively leave it as a matter for tutors and students to come together (or not) in a manner that reflects their own working preferences. Time management is clearly a big issue for students. There is a need to emphasise the need for personal plans or work schedules, and ensure that progress is monitored against them. More tuition work is needed in the areas of (i) citing Harvard style, (ii) identification of variables, (iii) house style, and (iv) analytical techniques. The issues about whether students should employ rigorous analytical tools and specify variables etc, is perhaps best solved by ensuring that only students who do these things get the better marks**.** An appreciation of the real life limitations of research can only be understood with good underpinning knowledge about the concepts of reliability and validity. It is argued, that only students who do demonstrate understanding of these concepts should be awarded marks in the first class category. The overall mean scores of 68.4% for level two students and 72.1% for level three students indicate good to very good achievement in measurement of the variable 'student perception of success of research learning outcomes'. It is recommended that further work is undertaken, using samples drawn from more UK universities. Views should also be sought from tutors.

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# Working in collaboration: a review of an overseas programme and development

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*The changing market for education in the UK and the growth of the global village has created needs and opportunities to seek alternative business for the education deliverers in the UK, and elsewhere. This paper reviews the development of a collaboration between a post-1992 university in the UK Midlands and a university with a similar profile in Hong Kong to deliver a top-up programme to BSc (Hons) Construction Management and how this will lead to the introduction of a Masters programme with the same partnership. It considers the reasons for the relationship to be sought and the design of the programme delivered. A review of the internal validation process prior to first delivery, the professional body accreditation of the programme and the implications of this to achieving a viable demand. The partnership has been in place since 2000 and has had to adapt to changing educational and political environments, greater competition in the local market, changing student cohort expectations, staff illness and travel restrictions (most notably due to the SARS epidemic and a virtual travel embargo on visits to the far east). The paper identifies key events during the partnership and how it has developed to meet these changing circumstances yet remain viable. It will also address how the experiences have influenced the introduction of a Masters programme. The paper concludes with best practice recommendations to assist other institutions in identifying opportunities for similar mutually beneficial partnerships.*

**Keywords:** Collaboration, Overseas delivery, intensive programme

## 1. Introduction

The development of a programme of study overseas was one strand of a School-wide strategy made by the School of Engineering and the Built Environment (SEBE) at the University of Wolverhampton (UoW) some ten years ago. From this strategy a collaborative programme was developed that has been delivered successfully for the last eight years. The experiences of the design, implementation, growth and development of the programme have been recognised within the university and are being fed into ongoing and planned collaborative links with both UK-based and international partners.

## 2. History

UoW had an existing relationship with City University in Hong Kong (CityU) and the School of Continuing and Professional Education (SCOPE) as a result of previous international marketing initiatives; an additional initial contact was made between staff at each of the institutions through mutual contacts in HK. Through these two initial contact routes and meetings at various levels within the management of the departments the possibility of a joint initiative were discussed. The choice of the programme to be delivered was largely the product of fortune and of the existing relationship between the staff at the respective institutions.

Once the initial ideas had taken shape the three departments (SEBE, CityU and SCOPE) worked together to agree a viable structure and format for the programme that would satisfy both UK and HK internal and external requirements. All parties were involved at all stages of the design and validation of the programme through face-to-face meetings, via email, post, telephone conversations and videoconferences.

At the time the programme was first considered CityU was one of only two institutions in HK to offer full time degrees in building/construction management recognised by the Hong Kong Institute of Engineers; the proposed programme would be the only part time first degree programme in HK.

## 3. Programme design

Delivery of programmes overseas can be expensive to operate. Taking due consideration of the highly intensive working culture in Hong Kong a model needed to be developed for part time delivery. HK students were required to study 3 modules at level 2 (45 credits) and a full level 3 programme (120 credits). The level 2 modules were delivered in the first semester with the level 3 modules being delivered over the remaining 3 semesters. At the start of each semester there was a three-week period when each taught module was delivered by the UK lecturer. Lectures consisted of six 3 hour long sessions between Sunday and Saturday; tutorials with local tutors were organised between semester weeks 4 and 11; UK lecturers returned for 9 hours taught sessions and examinations were taken in week 15. UK lecturing staff were responsible for the provision of all teaching and assessment materials and for grading all assessments. One week prior to the start of each semester the UK lecturers provided their module study materials. [1]

Revisions to the model include the introduction of an additional level 2 module to address concerns regarding the students' report writing abilities and the programme being extended over five semesters to reduce the student workload. Initial validation

allowed for Diplomats in Building from CityU programmes this was extended to include students with equivalent qualifications from all HK institutions and those with Associate Degrees in Building, Surveying and Architecture [2].

The HK programme fits within the UK assessment board structure: module results are presented to subject boards, in the UK, and student transcripts to progression and award boards, again in the UK.

The HK programme was revalidated and subject to QAA audit (2006) [3] and consistently receives positive feedback from students and external examiners. It has been successfully accredited by the Chartered Institute of Building.

To aid marketing of the course professional accreditation was sought from the Chartered Institute of Building (CIOB). The accreditation application required the creation of detailed documentation including the submission of mapping exercises firstly for the entry Hong Kong diploma and secondly for the remaining top up program against the CIOB education framework document [4]. The application also required a visit to the host institution including the inspection of any paperwork records and administration that the programme had generated together with meetings with staff, local tutors and administrators. The part-time delivery in HK was fully accredited by the CIOB.

## 4. Challenges

Challenges that the programme team have overcome include: staff illness, travel embargo due to SARS pandemic, visa restrictions on some staff and differences in student learning styles and cultures.

## 5. Future developments

A number of alternatives are currently being investigated; these include the introduction of a Masters level qualification to introduce a natural progression route to higher level qualification, alternative honours degree qualifications, work-based learning qualifications to enable students and their employers to benefit from experience gained through work, distance learning opportunities (to enable students working in mainland China to gain a qualification) and credit accumulation options (to meet needs of students who want to study at a slower pace than available on alternative routes).

## 6. Conclusion

This paper has reviewed the introduction and development of an honours degree in Construction Management through a collaborative partnership between a UK HEI and one in HK. It has identified the design of the programme and the delivery methodology as well as changes to the programme and reasons for the changes being made. The needs to meet internal and external quality assurance requirements and to achieve professional body accreditation were discussed. Challenges to the programme team, and how these were overcome, have been identified and potential future developments highlighted.

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# Capstone Courses as the Vehicle to Employability Improvement of Construction Graduates

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*Although Bachelor of Technology (BTech) graduates in South Africa are employed in the construction and allied sectors many employers have expressed dissatisfaction with the abilities of these students to perform effectively in the construction sector. Given the current SA construction boom, and the severe skills shortage in both construction management and site skills almost all construction graduates from Universities of Technology are able to find employment despite their skills being inadequate. Traditional universities that offer a Bachelor of Science Honours (BSc. Hons.) degrees in construction management and quantity surveying are perceived to produce a better graduate despite the BTech co-operative education and training being the preferred method of training for construction graduates. The offering of a capstone course may be seen as an avenue to achieve a better quality BTech construction graduate that meets the needs of the SA construction sector. This paper presents the views of employers in an exploratory pilot study on their perceived acceptability and value of a capstone course to both students and industry practitioners.*

**Keywords:** Construction, management, capstone course, quantity surveying

## 1. Background

Many employers of South African Bachelor of Technology (BTech) Construction Management (CM) and Quantity Surveying (QS) graduates hold that gaps exist between their academic performance and the importance of various subject areas relative to the workplace [1]. Traditional universities that offer a Bachelor of Science Honours (BSc. Hons.) degrees in construction studies, namely CM and QS are perceived to produce a better graduate despite the BTech co-operative education and training being the preferred method of training for construction graduates. This contrast with a study in the United States of America in their 1996 survey of Associate Schools of Construction members found the co-operative education method to be the preferred method of training construction graduates [2]. The offering of a capstone course may be seen as an avenue to achieve a better quality BTech construction graduate that meets the needs of the SA construction sector. Co-operative education incorporates productive work into the curriculum as a regular and integral element of a higher education course [3].In order to achieve stated national goals [4] universities in South Africa have a responsibility to adjust their programmes where the needs arise. Capstone courses are designed to merge participatory learning with academic inquiry allowing student interaction in simulated environments organized around activities that require rigid procedures and processes and unique creative solutions [5].

## 2. Current Status

In South Africa the various Voluntary Associations and Professional Registration Councils have to date not recognized the BTech degrees in CM and QS as vehicles for direct Professional Registration. In order to be registered and obtain corporate membership of these councils and associations respectively, BTech graduates have had to satisfy additional and onerous requirements such as board examinations and extended post-graduate training. Jones [6] found that construction employers in California, U.S.A. regarded students who had successfully completed the CalPoly capstone course as properly prepared for the rigours of construction employment.

## 3. Delivery of capstone courses

Capstone may be delivered either through case studies, structured interviews, extended Site visits, integrated projects or a final year dissertation.

## 4. The Research

An exploratory study was completed to determine the attitudes of construction employers towards capstone courses. The sample comprised of employers who employed BTech CM and QS students from the University of Johannesburg. A structured questionnaire comprising both open- and closed-ended questions was distributed among the 67 employers and 31 completed questionnaires were received, representing a response rate of 46% which was deemed adequate for an exploratory study. The data was analysed using the Statistical Package for Social Sciences (SPSS).

## 5. Data Analysis

The respondents were requested to rank on a 5 point Likert scale the extent to which certain competencies were required by graduates and also the extent to which graduates possessed these competencies. The comparative results using the means of responses are discussed. In all cases the actual competencies demonstrated by graduates were less than the level expected by

employers. They reported moderate satisfaction (mean = 2.93) with regard to current training levels of graduates.. They support the introduction of capstone (mean = 3.78). The integrated project is the most preferred method (mean = 4.32). They tended to support the capstone course being offered in the last year of the Diploma (mean = 3.93) and the Degree (mean = 3.97). They tended to support (mean = 3.79) that the capstone be done throughout the year. They also preferred that the method of evaluation should be a combination of a written submission and an oral presentation of the project (mean = 4.10). Sixty eight percent of the respondents felt that industry should be involved throughout the course offering at every level. Most respondents (54%) reported that a mark of between 65% and 74% was preferred. Most respondents (45%) felt that capstone should contribute 25% or 50% (34% of respondents) to the overall final grade. The respondents (mean = 3.55) felt that the capstone course could lead to registration as Professional Construction Managers. Apart from working in teams (ranked 4$^{th}$) a BTech graduate should have skills largely related to the financial aspects of construction projects. Working in teams, WBS, PERT, knowledge and understanding of specifications and ability to schedule using computer software ranked 1$^{st}$ through 5$^{th}$ respectively in terms of actual graduate abilities. There is some mismatch between the preferred abilities and that which graduates actually possess.

## 6. Conclusions

BTech CM and QS students are currently employed despite these graduates completing their final year/s of study and not being in possession of the expected skills to perform adequately in the industry. The study suggests that the inclusion and successful completion of a capstone course that includes multiple components such as an integrated projects and extended site visits will contribute to the improvement of the quality of BTech graduates. The course outline needs to cover all phases of the construction process with mastery levels set fairly high around 70% and comprising 25% to 50% contribution to the final overall grade. The gaps between the importance that employers accord certain skills and competencies and the actual perceived performance by graduates must be addressed. Overall construction employers are supportive of the introduction of a capstone course into future construction-related BTech offerings which would lead to professional registration with councils and corporate membership of voluntary associations.

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# Are we changing students' perceptions of sustainability?

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*In the current 'Decade of Education for Sustainability' universities have responded by implementing initiatives to promote sustainability education. This paper provides the results of a research project that was undertaken to examine student 'perceptions and awareness of sustainability' both prior to and after completion of a new course that focused on sustainability. As part of this investigation students were asked to complete a paradigm shift exercise both at the beginning and end of the semester in which the course was taught. In each instance, students were asked to consider four groupings of words. The choices they made determined whether they had a leaning towards the 'status quo' characterised by a functional analysis ontology, an economic individualistic values system; the ruling elites as agents of change; and an instrumental process approach to sustainability/change;. as opposed to a 'green' paradigm characterised by a social ecology ontology, a post-materialistic values system, community as agents of change and an experiential approach to change/sustainability. The data collected were analysed to establish whether participation in the course over the semester was associated with any changes in the overall paradigm within which students operated, which could be either 'status quo' or 'green'. Results show that whilst few students adopted a 'green paradigm', there was a statistically significant shift towards 'social ecology' and 'community driven change' from the beginning of the course to its completion.*

**Keywords:** Education, Green paradigm, Perceptions, Sustainability

## 1. Introduction

Universities have responded to the UN's 'Decade of Education for Sustainability' [1], which aims to ensure that all higher education curricula include a focus on sustainability and sustainable development, by undertaking a number of initiatives to promote sustainability education within higher education programmes around the world.

In a large university of technology in Melbourne Australia, a one-year action research project was undertaken in 2005 that aimed to embed sustainability within the core curriculum of different schools across the university [2]. Its design was action research based and focussed on curriculum and assessment change based on reflections from a previous study [3]. The project aimed to create meaningful and lasting change in the student learning experience [4].

Within the School of Property, Construction and Project Management the project focussed on embedding sustainability capability into core curricula of four undergraduate programmes (construction management, property management, project management and valuations).

These students are entering an industry which is currently experiencing an awakening and a significant move towards more sustainable developments. With increased awareness through the written and visual media, clients are 'going green' and starting to ask for elements of sustainability in their buildings, chiefly to reduce their carbon footprint. In addition the construction industry has recognised the need to implement environmentally sensitive and sustainable management policies, practices and operations in order to meet new government policies and legislation.

## 2. Methodology

As part of the planned class activities, at the beginning (pre) and end (post) of Semester Two 2006, students were asked to complete a paradigm shift exercise adapted from 'A Green Questionnaire' by Ariel Salleh [5]. The paradigm shift exercise required students to read a numbered checklist of words/phrases subdivided into four groups (namely: ontology, values, agency and process) and circle the number appearing alongside any word/phrase which regularly featured in their writing or oral communication. These were then scored according to the frequency of odd numbers circled, and the frequency of even numbers circled, in order to determine student paradigms. The paradigm shift exercise therefore aimed to assess whether the students are working in or had moved to a new greener paradigm, using the language of sustainability (more even than odd); or whether they were still operating in the 'status quo' (more odd than even). Students were asked to submit their results as part of the research project. Participation in the research was entirely voluntary (the research was subject the university's ethics and the proposal met with ethics approval).

## 3. Data analysis

Data from the pre-post course paradigm exercises were collected and analysed to determine the paradigm in which the students were operating at the beginning (pre) and end of semester (post) and to establish whether there had been any change and whether participation in the course could be associated with this change.

## 4. Results

The results demonstrate that none of the students were operating in a green paradigm at the commencement of the course. By the end of the course two of the 28 students had adopted a green paradigm. Results also showed that by the end of the course the majority of students who completed the paradigm exercise broadened their lexicon to include words associated with a social ecology *ontology* as well as a post-materialistic values system. The impact of this is that a majority of students demonstrated a visible shift in their use of language suggesting a move to a 'greener' paradigm by the end of the course. Whilst there is statistical evidence of a move towards the usage of words associated with a shift to a 'green paradigm', there was no evidence of an increase in the use of words associated with a sustainability paradigm that proposes that the community should be viewed as the agent for change or that the process for change should be democratic.

## 5. Discussion and Conclusions

Although only a small number of students were seen to cross the threshold to a green paradigm, a majority of the students did move towards the threshold by the end of the course, particularly in the areas of ontology of social ecology and a post-materialistic value system. This may be associated with the focus of the course that encouraged students to explore their values and beliefs in relation to sustainability and to engage in learning activities that were designed and directed at supporting this. Findings therefore suggest that it is possible to help some students to change their conceptions, but that this is not easy to achieve through participation in a stand-alone, one-off course experience. While this is hopeful news for education for sustainable development, it also points to the need for much more connected work aimed at supporting student conceptual change.

Effective student learning that leads to conceptual change involves students actively engaging in learning for understanding, as opposed to memorization; based on experiential approaches that are underpinned by a learner-centred methodology where the focus is on students' experience of learning rather than the teachers' experience of teaching [6].

Whilst this course attempted to address these issues, education for sustainable development needs to be integrated in context across all courses and by all discipline instructors if we are to see lasting change.

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# Personal Development Planning (PDP) using ePortfolio

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*The Dearing Report [1] identified that programmes in Higher Education need "to equip graduates with the skills and attributes needed to be effective in a changing world of work and upon which to found and manage a number of careers. Graduates will need to be able to identify their own development needs and be committed to lifelong learning". This paper reviews the action taken by a post 1992 University in the UK to introduce PDP to students on construction-related courses. The university developed a bespoke web-based PDP tool that is now used university-wide at all levels of sub-degree, degree and post-graduate delivery. The paper will explain how the use of this tool has been embedded in the built environment curriculum, the benefits to the students and how other HEIs can introduce such a tool within their programmes. There is potential to exploit the tool more widely within general CPD. The paper concludes by identifying how this could be achieved.*

**Keywords:** Personal Development Planning, CPD, ePortfolio

## 1. Background

In May 2000 the Quality Assurance Agency (QAA) *et al* [2] issued a policy statement on the development of a Progress File for Higher Education. This policy statement came from recommendations within the *National Committee of Inquiry into Higher Education* more commonly referred to as the Dearing Report [1].

The Guidelines gave an implementation date for Progress Files as the start of the academic year 2005/6, from this date the QAA could include PDP in their institutional audit.

Within the University of Wolverhampton, PDP was strategically placed within the Institutions' Learning and Teaching Strategies. An outcome of the strategies was the development of an institutional framework for the process of PDP which set out that the main outcome should be a formative student-centred process that provided a product that documented a student's achievement and experience at the university. The PDP processes are integrated throughout the whole of the student experience, they are developmental and used with tutor guidance. A consequence of this framework was the development of an electronic tool (PebblePad©).

## 2. ePortfolio

In the academic year 2003/4 the University undertook a review of PDP practices across all undergraduate provision. That review showed that there were lots of activities that could be classed as PDP. Best practice was gathered and suggestions were made to find some form of electronic student portal that would, as a minimum function, allow students to access Microsoft Word™-based PDP templates from both their own and other academic disciplines.

In 2004/5 the University of Wolverhampton worked with an external company, Pebble Learning [9], to develop and pilot the software PebblePad©. At the start of the academic year 2005/6 this tool was rolled out across the whole of the University.

Over 2005/6 and 2006/7 new communities of users emerged that were early adopters and 'champions' of the new software and an ePortfolio users group was established.

In June 2007 a review of PDP at level 1 [10] showed that all academic schools were using PebblePad© in some way to deliver PDP in the first year (undergraduate) curriculum. This is a system designed to support both formal and informal learning, and it allows users to build a diverse collection of items related to their studies, personal development, continuing professional development or any event of personal significance. These can then be published on-line. The software promotes reflection and gathering of evidence, any digital file can be linked to the software giving the ability to add such things as video, images and sound.

The newest version of the software offers 'Profile' and 'Proforma' tools that allow additional functionality that will be useful for CPD.

## 3. ePortfolios within Construction related courses

PebblePad© provides a tool through which students can engage with PDP whilst at university and on into their professional careers.

Within the School of Engineering and the Built Environment the course leaders have identified core modules at each level of study for students on undergraduate programmes where there is already a requirement for reflection on personal development within the module. Having identified the modules within which the reflection will be both formatively and summatively assessed the course team develop the existing practice to incorporate engagement with the e-portfolio tool to ensure student engagement at an appropriate level and to show increased engagement and understanding from level to level.

Key to student engagement is a demonstrable link to their future career and professional body requirements to maintain the currency of any professional qualification through CPD activities.

There is a requirement on most professionals to engage with Continual Professional Development. Students at the University of Wolverhampton will become familiar with the ePortfolio tool during their studies, they will be able to use the tool to create soft copy, or hard copy CVs, to publish blogs and websites and to engage with personal development planning. Alumni will continue to have access to the tool beyond completion of their programme and will find it useful in maintaining their CPD records for both their personal / professional use and to provide evidence to their professional body, if required.

Through the adoption of a reflective approach to a student's personal and professional development an individual is able to identify reason and structure to their action planning to ensure that future activities are undertaken for appropriate reasons and with a particular goal in mind: whether that be for personal or professional needs. Structuring one's activities in this way will show long term benefits to the individual, their professional body, their employer and the economy in general by targeting time and effort to appropriate and effective uses.

The ePortfolio tool used at the University of Wolverhampton (PebblePad©) has shown itself to be an effective and adaptable tool that is used widely within, and outside, the HE sector. As the growth in lifelong learning and development of alternative learning continues PebblePad© can be used as an effective tool within the professional's portfolio. A key potential use is for professionals to create personal learning records against existing professional requirements [14] for use in recording experiential, work-related and work-based learning that could be used towards achievement of a qualification at an appropriate level. The learning record created can be presented in a variety of either electronic or hard copy formats to suit the individual's needs whilst retaining the ability to be developed to reflect the user's changing professional development.

## 4. Conclusion

This paper has reviewed the introduction of Personal Development Planning within a post 1992 University within the UK and its development, implementation and embedding through PACE files (Professional, Academic, Careers and Employability) to an ePortfolio tool (PebblePad©). It has shown how ePortfolios have been embedded within Construction related courses at the University and offers a model that could be transferred to other HEIs.

The institutional stance, policies, support and attitude to the implementation of PDP influences student engagement with PDP processes through the use of an ePortfolio to enable students to evidence their reflection and personal development.

Through the students' experiences with ePortfolios at the University professional bodies will benefit from the students' ongoing CPD through their ability to target time and effort to appropriate and effective personal development that should be valued by all.

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# Developments in the curriculum of Environmental Building at the University of Plymouth

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*The Environmental Building Group at the University of Plymouth educates students towards accredited degrees in Building Surveying and the Environment, Environmental Construction Surveying and Construction Management and the Environment; close links are in place with the local School of Architecture. The group has been active in this field for 10 years, and has pioneered the theme of environmental building surveying. Teaching efforts have led to national recognition in the form of a National Teaching Fellowship and membership of the Centre of Excellence in Teaching and Learning focused on Education for Sustainable Development (CETL-ESD). This paper reflects on the strengths and weaknesses in the current curriculum, contributing to an upcoming course review evaluation in 2008. It aims to position the teaching at the University of Plymouth within a changing practice, where sustainability has become a mainstream concern. The paper will review the changes taking place in each of the major disciplines taught on the programme: surveying, building technology, renovation, law/finance, and project management. For each of these disciplines, the paper will discuss initiatives that are planned to keep the curriculum at the leading edge of the environmental building / sustainability field. The paper concludes with an overall analysis of the programme, taking a look beyond individual fields and assessing the overall content of the curriculum.*

**Keywords:** Sustainability, curriculum, SWOT-analysis, future trends

## 1. Introduction

The Environmental Building Group at the University of Plymouth offers students a range of courses that help them to prepare for a career in the fields of *Building Surveying and the Environment*, *Environmental Construction Surveying* and *Construction Management and the Environment*. These are offered at different levels: a foundation pathway course, BSc (Hons), MRes, MSc and PhD. The courses are all accredited by the relevant professional bodies (CIOB and RICS). The programme is part of the School of Engineering, and also has close ties with the School of Architecture at Plymouth, with some shared modules and courses.

The programme is strongly related to professional practice in the building industry. While the programme offers all Higher Education Levels that students might undertake, there is a continuous influx of students entering academia at all levels after a period of working in practice. Furthermore, the programme has close ties with practitioners who provide guest lectures and take part in student assessment panels.

The Plymouth programme has a history that dates back to 1996, and has pioneered the theme of environmental building. The Plymouth programme has a strong track record in terms of pedagogical quality, having been awarded the second highest aggregate grading for teaching excellence in England by the Quality Assurance Agency in 1998, a National Teaching Fellowship in 2004, and a Green Gown Award from the Higher Education Environmental Partnership Improvement organization in 2007. The fruits of these developments have been presented to national and international audiences over the last seven years, see for instance [1], [2], [3].

## 2. Incremental curriculum development

Over the 10 years that the programme has existed, important developments have taken place in the construction industry as well as in education. New technology and information sources have become available; the students starting their education today are different from those of 1996, and the industry has different expectancies of the skill and knowledge base they will be bring into practice. In general the building industry is increasingly aware that the environment and factors related to sustainability have become a major issue. The full paper provides subsections that discuss the developments and their impact on education within the main subjects that are taught within the programme: building surveying, building technology and building science, renovation and refurbishment, law and finance, process management, and land and environmental surveying. These disciplines are taught by a wide range of approaches, which involve student-centred learning [4], traditional lectures, workshops, laboratory experiments, site visits, design project work, and management games. In doing so, it identifies the incremental changes that are feeding into the curriculum.

## 3. New curriculum directions

Sustainability is fast emerging as a central paradigm for construction education as demonstrated by The RICS inclusion of sustainability as a mandatory competency for all types of surveyor [5], the UK government and other professional bodies such as the CIOB and RIBA [6]. While the Environmental Building Group has taken structured and active steps both to assess and enhance the sustainability content of the Environmental Building Degree Programme the implications of this new paradigm is that within ten years the curricula of ***all*** construction-related programmes will be expected to fully embrace sustainability.

In the long term future, the Environmental Building Group at Plymouth expects a larger emphasis on safety, and the role of industry in the general future of humanity – allowing the human race to cope with a range of pressing issues like climate change, population growth, shortage of fossil fuel, and ecological problems (ecodiversity, acid rain etc). Given the scale of

these problems, it seems unlikely that mitigation is going to solve all; it therefore seems paramount that the discipline starts working on resilient technologies, and response to inevitable changes in our environment. Furthermore, the group recognizes two approaches towards a 'sustainable' future: 1) gradual change, with a residual gap between what is needed and what is actually achieved, and 2) step change, which requires instant changes in the workings of the industry.

Preparing itself for this future, the Environmental Building Group at Plymouth has put in place a strong base for ensuring the sustainability literacy of our students, by providing them with an understanding of the set of environmental problems faced, as well by handing them the knowledge and skills to contribute to changing the industry. At the same time a new impetus is given to work that aims at helping the industry respond and adapt to change; this work has a strong research component, as this a developing field. Both these efforts align well with gradual change to a sustainable future. On a longer horizon, the team is starting to contemplate the needs of working to step change, and its impact on both the understanding, knowledge and skills this will demand from future staff, students and construction professionals.

## 4. Concluding remarks

- 'Environmental' and 'sustainability' issues are having an increasing impact on the construction industry, and on the academia that prepare new professionals for a career in this field. Students need to be equipped to take a leading role in guiding their profession into the future.
- Although the science underlying the curriculum in Environmental Building is quite stable, rapid changes are taking place in the application of these underlying principles in construction practice, building methods, and building systems.
- There remains a need to ensure that students become critical, independent thinkers, and that the programme does not slip towards what is named 'greenwash' in industry (a term used to denounce projects that seem more concerned with an environmentally friendly appearance than with actually addressing the underlying environmental issues).

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# Entry and Success in Architecture Education in Uganda

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*Entry into university level built environment programmes in Uganda has been based on the high school leaving examination results - The Uganda Advanced Certificate of Education (UACE).Since its introduction as a field of study in Uganda, architecture has been perceived as being no different from engineering. As such entry criteria into architecture programmes have largely been similar to those for engineering programmes. Consequently, most students seeking to do architecture were told to pursue the 'pure sciences' as part of their preparations for their high school leaving exams, the Uganda Advanced Certificate of Education (UACE). The subjects regarded as adequate preparation for architecture were Mathematics, Physics and Chemistry. This had the effect of not only restricting the number of potential entrants into the profession, but also restricting applicants from women and students who had studied in rural schools – both of whom would have not undertaken sciences for the UACE due to bias in the school system which continues to direct women to the soft sciences, and the fact that rural schools cannot afford the equipment needed to teach science based subjects. While high scores in the UACE and in the prescribed subjects enabled entry to a university based architecture programme, they however were not a guarantee of success of the students in the programme. A review of the existing entry criteria and the architecture programme in the Faculty of Building Technology and Architecture at the Uganda Martyrs University has been to realign the intake criteria to not only broaden the intake of students – increasing the number of female students and students from rural backgrounds, but also to ensure a better completion rate for students entering the programme, as well as a better connection with the social context in which the programme is situated.This paper reports about the rationale for the changes, experiences of Faculty, and the impact the changes have had both on students and staff, and on the wider profession in Uganda.*

**Keywords:** Intake Criteria, Architecture Pedagogy, Curriculum, Uganda, Outcomes

## 1. Introduction

To assure the competency and abilities of students, universities have always screened applicants seeking entry to their programmes. Recently, interest in the intake criteria for university entry has been brought to the forefront due to the greater demand for places in higher education. In professional education fields such as architecture, interest in intake criteria have also centred on whether there is a relationship between admission criteria and success in the profession. [1]

Traditionally, entry into higher education institutions has been based on the High School Leaving examination referred to here as the High School Record (HSR) – which for all intensive purposes is still regarded as the most appropriate means of controlling admission into higher education. The HSR is regarded as being the best reflector of the abilities of the high school leaver to undertake further studies at university level. The relatively few university places relative to the number of applicants has meant that it was necessary to devise means to select applicants. While the HSR is a convenient means of making this assessment, it has unfortunately served to reinforce the elitist nature of higher education. More often than not it has been students from elite schools that excel and achieved the scores necessary for entry into universities. [2,3,4] It was also based on the assumption that high school grades were an accurate reflection of a person's ability and motivation to undertake university level studies.

A review of the literature revealed that not many architecture specific studies have been carried out to ascertain links – if any - between the intake criteria and success in architecture school. A study by Moore [5] reviewed the HSR and the Architectural School Aptitude Test (ASAT) as they were used in architecture schools in the USA to predictors of success in architecture. Another study in the United Stated by Groat and Ahrentzen [6] looked at the social dynamics of architecture education and its impact on the progress of women and minorities in architecture schools. Goldschmidt et.al. [1] undertook a survey that looked at a number of architecture schools across the world. This study was an exploratory study that investigated the different intake criteria employed across the world to select students for entry into architecture programmes. In the context of Africa, a study by Murray [7] looked at the entry criteria for the University of Cape Town in the context of the changing educational climate of South Africa. These studies amongst others highlight the fact that intake criteria are not standard and do not always give the desired results. The existence of several admissions criteria is in part an indication of the ongoing search for appropriate criteria to aid selectors in the admission of students.

## 2. Conclusions

Certainly no single means of assessing students for entry into architecture programmes is 100% reliable; as such a combination of different assessment criteria would be desirable. At the end of the day, the goal of education is to enhance the potential of an individual, as such it is important that appropriate means of establishing this potential be sought. The Faculty of Building Technology and Architecture is constantly striving for high achievement from its programmes, and as such the changes it has initiated are geared towards attaining the Faculty objective of being one of the best built-environment programmes in Africa. [12]

As the process of defining and refining the selection criteria that meets the needs of the Faculty as well as the profession in the 21st Century continues, a lot more research has to be undertaken to guarantee success. By broadening the intake criteria and changing the criteria for selection, the Faculty hopes that it will be able to attract a wider range of students, as well as improve

the completion rates of students in the undergraduate programme as well as improve the number of students seeking entry into the graduate professional programme – the Bachelor of Architecture.

While at this stage it is too early to judge the success of the changes, it is hopped that through a constant review of students, instructors, course content and intake criteria, the Faculty will go a long way towards making the experience of architecture education more meaningful and the graduates more attuned to the role of the profession in the 21st Century. This would also be a step to dispel the perception of architecture as an elitist male dominated profession.

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# SECTION XX

## INFORMATION AND COMMUNICATION TECHNOLOGY

# Identifying and Confirming Drivers and Barriers to E-Procurement in Construction Organisations

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*There are many drivers and barriers to e-procurement. Previous studies in the US and Australia have ranked these for the general procurement of goods and services. A pilot study for this research, Eadie et.al ranked the drivers and barriers to e-procurement from a construction contractor's perspective in the Northern Ireland public sector. This work lacked the reporting of rigorous verification of the applicability of goods and services e-procurement drivers and barriers to construction. This paper collates the findings on identified drivers and barriers from literature and reports on the Delphi process confirming which apply to construction.*

**Keywords:** Drivers and Barriers, e-procurement, e-readiness

## 1. Introduction

### 1.1 E-Procurement in Construction

E-business savings and efficiencies in other industries show the benefits that construction could potentially harness. To investigate the low uptake of e-procurement in construction, it was deemed necessary to identify the drivers and barriers to e-procurement. There is a considerable amount of research reported on drivers and barriers to e-procurement. However, there is only a limited amount of research reported on its application to construction. Eadie et.al.[1] attempted to address this issue by applying general e-procurement drivers and barriers to e-procurement in construction. They then rank these drivers and barriers according to their importance in the construction industry. This paper validates the applicability of general e-procurement drivers and barriers to construction using the Delphi methodology.

### 1.2 E-Procurement drivers and barriers identified from literature

An extensive literature review identified a list of 21 drivers and 31 barriers to e-procurement

## 2. The Delphi Process

The Delphi Methodology is a defined process allowing the collection of tacit knowledge from a group of experts utilising a series of questionnaires and controlled opinion feedback [3,4]. It is well suited as a research instrument when there is imperfect knowledge about a problem or experience.

The identification and confirmation of drivers and barriers to e-procurement does not lend itself to precise analytical techniques but is more suited to the collection of group opinions from experts who can contribute as they represent diverse backgrounds within the construction industry.

### 2.1 Delphi Process Industry Expert Focus Group (IEFG) Selection

The IEFG for the Delphi process was selected so as to represent the entire construction industry, therefore, a list of attributes that measure representativeness were identified. A detailed analysis of these attributes indicated that the IEFG members satisfied these criteria.

Brockhoff [2] suggests that a general positive relationship between group size and group performance cannot be recognized and smaller groups perform equally well to larger groups provided that the group is homogenous. The analysis of the IEFG showed this to be the case allowing the reduction in group size to five.

## 3. Findings and Conclusion

Delphi methodology requires a minimum of 60% consensus among the participants. This research managed to surpass this benchmark for each driver and barrier within two iterations of Delphi consultations. This provided the following list of Drivers and Barriers to Construction e-procurement.

| | Drivers from Literature and Delphi Process | Barriers from Literature and Delphi Process |
|---|---|---|
| 1 | Process, Transaction and Administration Cost Savings | Upper Management Support / Lack of Leadership |
| 2 | Service / Material / Product Cost Savings | Other Competing Iniatives |

| | Drivers from Literature and Delphi Process | Barriers from Literature and Delphi Process |
|---|---|---|
| 3 | Increasing Profit Margins | Resistance to change |
| 4 | Strategic Cost Savings | Lack of a widely accepted e-procurement software solution |
| 5 | Enhanced Inventory Management | Magnitude of Change |
| 6 | Shortened Overall Procurement Cycle Times | Lack of a national IT policy relating to e-procurement issues |
| 7 | Shortened Internal and External Communication Cycle times | Lack of Flexibility |
| 8 | Reduction in time through greater transparency (Less objections) | Bureaucratic dysfunctionalities |
| 9 | Reduction in Evaluation Time | Complicated procedures and extended relationships |
| 10 | Reduction in purchasing order fulfilment time - Contract Completion | Lack of technical expertise |
| 11 | Reduction in time through increased visibility | Staff turnover |
| 12 | Increased Quality through increased competition | Company access to the internet |
| 13 | Increased Quality through Benchmarking (Market Intelligence) | Insufficient assessment of systems prior to installation |
| 14 | Increased Quality through increased visibility in the supply chain | Security in the process - Data transmission to the wrong person |
| 15 | Increased Quality through increased efficiency | Confidentiality of information - unauthorised viewing |
| 16 | Increased Quality through Improved Communication | Prevention of tampering with documents - changes to documents |
| 17 | Gaining Competitive Advantage | Data transmission reassembly - incorrect reassembly of data transmitted in packets |
| 18 | Increased Quality through increased accuracy (Elimination of errors through Computer use) | Partial Data Display - incomplete documents provided |
| 19 | Convenience of archiving completed work | Lack of pertinent case law |
| 20 | Develops the Technical Skills, knowledge and expertise of procurement staff | Different national approaches to e-procurement |
| 21 | | Proof of intent - electronic signatures |
| 22 | | Clarity of sender and tenderer information |
| 23 | | Enforceability of electronic contracts |
| 24 | | Information technology investment costs |
| 25 | | Internal and External interoperability of e-procurement software |
| 26 | | Investment in compatible systems |
| 27 | | Reluctance to "buy-into" one off systems |
| 28 | | Perception of no Business Benefit Realised |
| 29 | | Lack of publicity / awareness of best practice solutions |
| 30 | | Lack of a forum to exchange ideas |

A detailed survey of the UK Construction Industry will be completed to rank these drivers and barriers.

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# The Strategic Role of ICT within the Turkish AEC Industry

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*Today it is widely accepted that ICT is becoming a strategic asset for any organisation to deliver business improvement and achieve sustainable competitive advantage. However, traditionally the construction industry has approached investing in ICT with a lack of strategic focus and low level of priority to the business. The nature of such investments have been made very much in an ad hoc manner, with the focus on improving specific processes predominantly driven by technology rather than towards business improvement driven by the strategic objectives of the business. As such, this may have delivered isolated areas of improvement within the organisation but has contributed little in the context of strategic benefit. This paper presents a recent study focused on investigating the current strategic role of ICT in the Turkish Construction Industry. The study explores issues relating to the role of ICT strategy, reasoning behind ICT investments, barriers to the successful implementation of ICT and role of ICT through the facility/project lifecycle.*

**Keywords:** ICT, Strategic Role, Investment, Turkish AEC Industry, ConstructionBackground

Over the last 30 years the evolution of ICT has led to construction organisations increasingly adopting technology in support of their businesses. ICT is now widely accepted as becoming a key element of any organisation as they strive to ensure sustainable competitive advantage. However, since the initial enthusiasm of the industry during the 70's in their adoption of CAD applications, the investment in ICT has (in the main) been extremely ad-hoc. Traditionally, ICT investments have been driven either by demands generated at operational levels to satisfy particular needs (bottom-up pressure) or requests issued by senior management to meet specific business requirements (top-down). This 'Technology Push' approach to investments in ICT results in the development of ICT-driven solutions that are unlikely to deliver real strategic benefit to the organisation. Furthermore, the nature of the industry has been such that ICT investments have not been perceived of strategic importance and a priority to the business. The results of previous research on measuring ICT usage and trends in Turkey [1],[2] indicated that, as similarly to many countries, the Turkish construction industry has been facing difficulties related to communication and loss of information due to fragmentation in the industry. In 2002, ICT was viewed as a strategic resource by senior industry figures in Turkey and they indicated that they were ready to spend time and effort in order to increase the ICT awareness and improve training. The overall research aimed to identify whether the Turkish construction industry currently views ICT as strategically important.

The study began with a comprehensive literature review in the area, by looking at the role of ICT in the AEC industry and the studies on evaluating the usage and benefits of ICT for AEC organisations. In the next stage, semi structured interviews were conducted with 21 major contractors and consulting organisations in the Turkish AEC industry in light of a questionnaire. The questionnaire formulated consisted of 19 questions. The first group of questions investigated the role of ICT strategy in the organisation, while the next set explored the reasons behind ICT investments. Further questions focused on the role of ICT in recruitment, structure of ICT departments, barriers and facilitating factors for the successful implementation and management of ICT in the organisation and finally, the role of ICT through the various phases of the construction lifecycle.

## 1. Analysis of the Survey Results

The results of the first set of questions demonstrated that ICT is seen as a value adding part of the overall business strategy, for gaining competitive advantage and for wining work. Most of the organisations that participated in the interviews mentioned that they do not have a properly documented ICT strategy, while the organisations that have a documented ICT strategy developed this in the requirement for standardisation reasons (i.e. ISO 9001). The majority of the organisations have chosen to follow technological developments/advancements in order to make decisions for further investments in ICT. This approach can be seen as a technology-oriented/driven approach for forming a strategy. However, the organisations are not aware of the bigger (industry) picture while formulating their strategy, as most of them are not driven by their competitors' actions and investments. The survey results highlight that business needs/objectives play an important role in forming ICT strategies. However the organisations also follow an approach towards implementing the latest technologies possible to accomplish their business objectives. The majority of the organisations invest in ICT either to reduce costs or add value to the current form of processes, i.e. ICT investments are not made for strategic reasons (gaining competitive advantage) but are made for supporting the processes. In parallel with the results of a previous survey [1], training on ICT appeared as an important aspect of the overall organisational strategy. The reasoning behind ICT training was various but the main focus was towards facilitating business processes through the better use of technology. The greatest barriers related to successfully implementing and managing ICT were identified as infrastructure problems and inefficient use of software. The infrastructure problems indicated are mainly related to telecommunications, e.g. low bandwidth in communications and internet access, while the inefficient use of software is mainly due to the lack of support from software vendors in Turkey. On the other hand, the importance given to ICT training and support from software vendors appeared as the most critical factors for successfully implementing ICT. The interviewees mentioned that ICT training acts as a road from failure to success, and in parallel they also indicated that without the support from software vendors a successful ICT implementation cannot be accomplished. In fact, the authors disagree with

this industrial point of view, and believe that the success in ICT implementations should never heavily depend on external factors. In response to final question the majority interviewees mentioned the role of ICT as 'supportive' in different phases of the construction lifecycle; this indicates that (similar to the role of ICT from organisational point of view) ICT is also not seen as a strategic resource (by the majority of respondents) from the construction lifecycle management perspective.

## 2. Conclusion

In Turkey, there is a shift towards the recognition of the strategic importance of ICT in terms of value adding in winning work and achieving strategic competitive advantage, as opposed to simply supporting and facilitating business processes. However, although there is recognition of the strategic importance of ICT, the focus of investments in ICT is very much towards business process improvement rather than achieving strategic competitive advantage. This poses further research into exploring this gap between the 'strategic thinking' and the actual 'process-focused practice'. Furthermore, the development of a well formulated and documented ICT strategy is not common practice. In such cases, the strategy is driven by business needs by focusing on technological advancements/developments, while the investments of competitors are of no concern, i.e. pointing towards an internally focused nature to investment.

ICT training is evidently important in terms of investment, which in the main is towards delivering the ICT strategy, i.e. business process improvement facilitated by technology. In terms of the successful implementation and management of ICT, the main barriers identified are predominantly technological and process related rather than associated to people and strategy. In terms of the critical success factors, these are very much aligned with the barriers in that continuous training policy, learning from previous implementation efforts, and the re-design-engineering of currently ill-defined processes were identified. Interestingly, benchmarking against other competitor organisations was not identified as important, which further substantiates the internally focused nature of organisations in their ICT strategy and investments. Finally, overall ICT is having a supporting role throughout the lifecycle of a facility/project. However, ICT is perceived vital particularly during the design phases along with the management of time/cost and the supply chain. The role of ICT is in the main valued in the management of AEC projects in Turkey.

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# A Decision Support Model for Best Value IT Procurement for Construction Organizations

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*IT knowledge has become increasingly essential to the success of today's construction and will become more so in the future. Ineffective IT exploitation and poor procurement practices in construction organizations often create obstacles in reaping the full potential of IT investments. This paper presents a Decision Support Model for procurement of IT for construction organizations, which uses a value-based framework drawn from value engineering. It enables the identification of best value IT procurement options for various IT solutions and requirements. The research was carried out in Sri Lanka using the construction industry as the forum for development of the system.*

**Keywords:** Information Tehnology Procurement, Value engineering, Construction industry, Procurement model, Decision Support System

## 1. Background

Lack of effective IT exploitation methods in construction organizations often creates difficulty in justifying future expansion and use of IT innovations. The task of identifying best IT products, procurement approaches, costs and benefits are some reasons behind that. This problem is global and drawbacks are experienced in all types of enterprises [1].

A survey on the usage of IT in the construction industry of Sri Lanka revealed that there is organization wide poor utilization of IT [2]. This demands the introduction of a tool to evaluate and prescribe procurement approaches and provides feedback on their probable successes or failures. This research hypothesizes the use of Value engineering (VE) as an appropriate methodology for providing a solution for the problem of selecting best value IT procurement option. VE is an organized approach in providing necessary functions at lowest cost [3].

## 2. Research methodology

The approach was to review previous theoretical considerations and current industry practices and to synthesize a new approach for IT procurement. It was modeled using a value based framework drawn from VE. The conceptual model was then further developed using object oriented modeling techniques allowing the users to make an intelligent and informed decision on the procurement route. The model was tested with real life IT procurement scenarios and evaluated using domain experts. The evaluated model was then implemented to as a Decision Support System (DSS) prototype with the intension of providing a user-friendly guide for IT procurement in construction organizations.

## 3. Industry Survey

A comprehensive survey of industry was conducted to establish current status in terms of use of VE and methods of IT procurement. Following are the main findings of the survey.

### 3.1 Use of Value engineering

Most construction organizations consider VE as a relatively new concept. The only reported significant application of VE was in the construction of the World Trade Centre (Colombo) [4]. The key factors contributing to poor usage of VE are: Greater fragmentation of the industry; less knowledge about benefits of VE among professionals; unavailability of Sri Lankan standards or guide; no statutory requirement or encouragement to use VE [4].

### 3.2 IT Procurement Methods

Current practices regarding IT procurement in construction organizations reveal the following [5]:

- 97% of organizations consider IT as a strategy to improve organizational performance.
- 75% of organizations hardly adhere to any rules and regulations for procurement of IT. Only 10% of government organizations even adhere to the "Guidelines on Government Tender Procedure (1997) for procurement of material and equipment including IT".
- Only 3% had licensed software. This is in fact violation of international copyright laws.

- Approaches available for IT Procurement include: Consulting services, Off-the-shelf IT supply and maintenance, Systems supply & installation and Systems Engineering. These options were used with different methods of payment: direct purchase, hire or leasing.
- Although organizations were conscious of the value of investments, there is no evidence of use of VE techniques to evaluate IT procurement.

In addition survey revealed information relevant to problems in IT which immensely contribute to the problems associated with IT procurement. The major causes of concern were the poor levels of knowledge of professionals, unavailability of a procurement guide, and difficulty of identifying best products. All these factors underlines the need for greater guidance for IT procurement to assist professionals in the construction industry.

## 4. Decision Support Model

The main function of the model is to facilitate its users in intelligent and informed decision making on available procurement routes for the procurement of IT. The model is designed for senior management, particularly those without adequate knowledge of IT procurement but responsible for selection and procurement of IT. It provides a ranked list of best-valued procurement methods with details of procedures and associated merits and demerits.

The benefits expected from IT procurement model is the assurance of the best value, cost savings and better performance in the procurement process which encourage greater investment in IT. The major limitation of the model is it is at the moment a prototype system; it is not fledged as to become an Expert System (ES) but can be considered as a Decision support system (DSS).

## 5. Conclusions

Increasing organisation productivity has become a key to remain competitive. IT provides a means to attain greater productivity and competitive advantage to most enterprises. The construction industry is not an exception to this. Through a comprehensive construction industry survey, Perera et.al, [5] identifies the adverse effects of poor IT procurement and consequent hesitation in investment on IT. This places emphasis on the need for formal guidance to assist in the decision-making process.

The research makes a significant contribution in developing a knowledge base for IT procurement that facilitates the selection of best valued IT procurement option. The model serves as a knowledge repository and its object oriented nature allows it to be expanded to incorporate procurement experiences from the construction industry and to be further developed as a generic model for IT procurement.

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# Knowledge-based Material Cost Control for Building Construction Project using Expert System Approach

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*Poor project monitoring and control process has been identified as one of the main reasons for construction projects not achieving project cost objectives. Other factors contribute to this condition include: lack of documentation on project lessons learned, not optimum in adopting information technology, and a long process in making decisions. Documentation of lessons learned corrective actions can help project team in identifying various project risks. It is an important feedback in the effort to achieve better project performances, to prevent occurrences of specific risks or to prepare responses to such risks. This paper discusses the development of knowledge-based corrective actions related to controlling project material cost, which includes identifying the impacts, the causes and corrective actions. A survey on various high rise building projects was selected as the research method, and structured interviews with experts on such projects was used as data collecting method. Probability matrix, statistic and simulation were used to analyse the data, and expert system was used to develop decision support system based on cost control theory and practices. The results of the research show that there are four cost performance indicators, fifty eight impacts with fifty seven causes of risks for developing knowledge based lessons learned corrective action which provides about one hundred and fourteen corrective actions*

**Keywords:** Knowledge base, cost control, lessons learned

## 1. Introduction

Improvement in construction process is required in order to have a better quality performance management. This improvement should consider factors that directly influence the quality of construction process, particularly those that are related to documenting lessons learned, management techniques and technology used [9]. Many cost control techniques using software project management system have been developed and used to support project cost control process. However, is yet to provide optimum solution, in particular to support anticipating cost overrun. Therefore, a development of a decision support system tools using an expert system approach for corrective action in controlling project cost would be very beneficial, which in the end could improve quality performance management.

Base on the above problems description, the purpose of this paper is to discuss the development of a decision support system for project material cost control based on expert system approach as well as cost control theory and practices. To develop such system, it starts with identification of source of risks that cause cost overrun, then continued with the identification of appropriate lessons learned corrective actions.

## 2. Research method

To achieve the research aim, the following approach has been adopted:

- Primary data was collected using questionnaire surveys and structured interview to different experts and experience project personnel.
- Data collected is analysed using Delphi method, risk assessment techniques, and statistical analyses.
- The knowledge based system was developed using a scenario decision flow diagram, which considered various condition related to decision making process.
- The validation of expert system application was done to compare the results with the opinion of experts.

## 3. Research results

Knowledgebase for project cost control process are based on the relationships between cost overrun indicators with related events and causes. In the initial stage of the research, these relationships were grouped into the related project cost components.

Project material cost has four indicators, i.e. purchasing cost, transportation cost, storage cost and excess (waste) material cost [10, 11, 12, 13]. Survey and interview with construction experts have identified 58 events that influence these cost overrun indicators. The four cost overrun indicators and fifty eight events make up 225 relationships.

57 causes of project material cost overrun have been identified, which can be grouped into ten as follows: planning & scheduling (12.3%); organization & key personnel (15.8%); purchasing (12.3%); transportation (7%); QA/QC (1.8%); storage (10.5%); usage (12.3%); change order (7%); monitoring & control (10.5%); and external factors (10.5%).

The main objective of material cost control is to have the required materials as scheduled. It is an important part of materials management. The important steps in implementing materials control are planning, executing, monitoring, analysing performance, evaluating variance and developing necessary corrective actions [14].

For project materials, the cost overruns are related to 58 events and 57 causes. There are 114 corrective actions, which recommended to rectify these problems. Good understanding and experiences are needed to recommend the corrective actions that are appropriate for a particular cause of cost overrun.

From the 114 recommended corrective actions for project materials cost control, almost 90% of them tend to be preventive in nature. They are more likely lessons-learned corrective actions as they are used to prevent the similar events from happening. As an illustration, in planning & scheduling related events, materials are purchased way before they are needed which is caused by inaccuracy in materials scheduling. The recommended corrective action is for supervisor to review planning document before works execution. Another example: delay in decision (organisation & key personnel related events), which is caused by lack of support from head office, the recommended corrective action is to apply appropriate procedure.

The use of decision support system (DSS) in selecting corrective actions can improve the effectiveness and efficiency in getting recommended corrective actions that lead to better project cost performances.

The program starts with an introduction and instructions to use the program. The second sub-model defines the project information, such as project type, contract type and contract value. The third sub-model consists of two modes of process, i.e. lessons learned mode and DSS mode. The fourth sub-model provides report of the process results. C++ has been used in developing the program.

The validation of the program was done by conducting several trials to construction experts. These experts were asked to assess the program and the results it provides. The assessment used in the validation include: completeness of knowledgebase system, speed, user friendliness, accuracy of the results, and level of application. Most of the experts involved in the validation gave good assessments for the program. They also suggested that an improvement in design can make the program more attractive

## 4. Conclusion

The paper discusses the development of a decision support system for project material cost control based on expert system approach, cost control theory and practices. In the first step of the development four cost overrun indicators have been identified. Those indicators are purchasing, transportation, storage and excess material costs. The four cost-overrun indicators have fifty eight events and fifty seven causes. To rectify these costs overrun, one hundred and fourteen corrective actions have been recommended by high-rise building construction project experts.

Relationships between cost overruns-events and events-causes are complex. They require effective and efficient corrective actions that can lead to improve project cost performances. It is very significant to document those relationships as part of project cost control system. Those relationships make up a basis for a good knowledgebase to select corrective actions The use of DSS program can support the selection of effective and efficient corrective actions.

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# Virtualisation of disaster recovery centres

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*Governments, NGOs and International organisations must work together and contribute towards strategic disaster recovery planning process of countries [5]. Emergency management plans should be in place and tested fully well ahead of any adverse situations. Quantification of probable risks and preparedness can save time, costs and most valuably, lives in the disaster response and recovery effort. ICT system infrastructures play a significant role [8] in connecting various experts at disaster recovery centres around the world in a tactical environment. Virtualisation [4] of disaster recovery centres can provide high availability and efficient system deployment strategy for any emergency management plan. This paper proposes a systematic virtualised infrastructure and associated tools for the operation of disaster recovery centres by capitalising the state-of-the-art for leveraging its use.*

**Keywords**: Disaster recovery centres, Virtual Data Services, Virtualisation technology, ICT infrastructure

## 1. Introduction

### 1.1 Finding a sustainable solution for facing disasters

Eliminating disasters cannot be achieved under most circumstances. Therefore efficient warning systems and preparedness at all levels must be established to minimise the aftermath. Based on the damage to the existing communication infrastructure the recovery process could be an overwhelming task. Due to collapse communication centres, antennas, power and mobile networks, transportation infrastructures, etc. recovery teams may not be able to reach the helpless. People could not survive without adequate basic needs for more than a few days or hours based on their health condition. It is clear that for recovery teams the time is the most important factor for reaching individuals affected. This is with the assumption that the recovery teams can accommodate all the necessary equipment, food, etc. in time when they reach individuals for salvation. Due to a number of reasons adequate quantities of such materials may not be able to be transported where required. With the experience of recent disasters around the world governments, organisations and researchers are aggressively seeking solutions for various aspects involved to find more sustainable solutions for facing future disasters.

Researchers are concentrating on finding the most appropriate solutions for various matters that are associated with disasters; natural or manmade. Firstly it is important to provide sufficient lead time as well as appropriate guidance based on the expected impact from the disaster in concern so that people and rescue teams take adequate precautions to minimise damage. This can be achieved by audible warnings [6], visual extrapolation of impending disaster, etc. after the disaster has been detected by the equipment and sensory devices and experts have completed the primary risk analysis of perhaps the inevitable. Such warning signals generated by the devices can be received by the disaster recovery centres through satellite networks or through global mobile network base stations via dedicated emergency channels established for such communications. Secondly after the disaster, it is vital to locate the affected people /communities for providing the required emergency assistance. Although many could assume that people can communicate for requesting emergency rescue services based on the level of disaster and the inadequate sophistication of available communication infrastructures this may not be possible. Vice versa, rescue teams and authorities (local or international) may not be able to locate or reach helpless people within an acceptable time frame. Inefficiencies of global diplomatic protocols [5] also may have an adverse effect on this matter. Standard mobile handsets are not designed to utilise the satellite communication network directly therefore they should communicate to a nearest base station and establish a connection for reaching other destinations. Lack of functioning mobile communication towers, base stations and telecommunication networks can isolate people under disaster conditions. Similarly lack of power networks can jeopardise reaching people through radio, TV, etc receives for information dissemination or provision of related advice. Specialised /switchable satellite networks that can reach ordinary mobile handsets, ample of portable GIS handsets to access detail imagery of the disaster area and globally funded automated disaster detection and recovery infrastructure armed with specialised teams that can reach any part of the world without a delay (E.g. political barriers) are some sustainable solutions for solving these matters. Finally provision of disaster relief during the most difficult period and thereafter continuing support until the civilisation recovers from the tragedy needs to be thought ahead and acted upon spontaneously until an adequate momentum of recovery to a reasonable expectation can be achieved. With the assumption that some local authorities have access to satellite phones and organisational specific wireless communication hubs it would be possible to create ad-hoc networks for people to make emergency communication via these hubs [1]. While current generation mobile handsets are capable of switching between up to four bands to accommodate various continental standards the future mobile handsets can be designed with the capability of switching into such universally accepted emergency bands via ad-hock networks.

This paper proposes a virtualised [4] disaster recovery centre (VDRC) that could be mobilised into the danger zone to assist the field workers and experts. The infrastructure proposed is built on the state-of-the-art services available to maximise their use. Recent knowledge created by European Projects (E.g. SIMDAT: Virtual-GISC), Federal Emergency Management Agency (FEMA)[2] of the United States as well as research and industry contributions from experimental virtual emergency operations centre established by Telematics Lab at Simon Fraser University [3], SAR Technology [7], SAHANA Project initiated by the Sri Lankan Boxing Day tsunami [8][9], etc. drive defining the proposed infrastructure. While staff from the VDRC directly advise teams (ground, water, air based or tactical analysers) on recovery process, it captures information for mass delivery to

the external parties and other VDRC's for constructive analysis. Experts around the world and staff from other centres can lively assist many scattered recovery teams with more informed manner from information received through VDRCs of the live condition. The writing is divided into three sections to expand the virtualised disaster recovery centre infrastructure proposed for emergency situations.

- Design of a system architecture for robust deployment
- Establishment of a broadband wireless communication and / or satellite system
- Provision of software services required for assisting the field workers through virtualised disaster recovery centres

## 2. Conclusion

The proposed system, infrastructure and software tools that are described in this paper takes the disaster recovery process another step forward under different circumstances. It is envisaged to pilot this proposal for refining the baseline architecture suitable for ad-hock deployment in the near future. The VDRC infrastructure described which combines the above features while supporting an innovative capacity for dynamic integration of such tools within the given volatile environment. The Virtualisation Technology [4] allows the ability to mix and match variety of softwares and systems together that facilitate the disaster recovery effort. While the recovery communities and organisations may not have adequate resources to develop their own tools, softwares and infrastructures for this purpose it becomes very important to move with the latest global developments and capitalise on the state-of-the-art.

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# Introduction of a model for pre-qualification of contractors based on the Fuzzy Topsis method

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*The aim of this paper is to introduce a model for pre-qualification of contractors in construction projects. In the recent years huge funds has been wasted due to the inappropriate selection of contractors for the construction projects. So, the appropriate selection of the qualified contractors is one of the most important strategies in such projects. However the nature of such decision making is sophisticated. Several quantitative and qualitative factors can be employed in the assessment procedure. The assessment of Iran construction codes shows that the most important criteria in construction contractors pre-qualification are experience, quality & safety, current projects, resources and company repetitions. In the present paper the language terms will be used in contractors' evaluation. These language terms are including triangular and trapezoidal fuzzy numbers. After that, a multi criteria decision making system based on the fuzzy set theory is introduced in order to clarifying the ranks of the contractors due to their qualification. In the proposed method, after determining the fuzzy weight of each criterion using Buckley method, the fuzzy topsis method is used for ranking the contractors due to their qualification. Finally the proposed model is assessed using a numerical example and sensitivity analysis has been done.*

**Keywords:** Pre-qualification, Fuzzy Topsis method, Fuzzy Set , Multi Criteria Decision Making

## 1. Introduction

Contractors play a significant role in construction projects. So it can be concluded that the contractor selection is the most important decision made by the project owners. The contractor selection process has significant risks for the project owners; consequently they try to reduce these risks [1].In the present paper a fuzzy method will be introduced to determine the qualification level of each contractor. After determining the fuzzy weights of criteria, the closeness coefficient for each contractor will be obtained and finally based on the owner idea limited number of qualified contractors will be invited to participate in the tender.

## 2. Literature Review

The tender competition has a long history in the U.S.A. Hatush shows that this system has been employed in New York State since 1847. The main employment of this method was in highways and bridges tenders [2]. Few countries including Italy, Portugal and Peru have chosen a system in which the best proposal is not necessarily the minimum financial proposal. The main philosophy used in this system is that the best proposal is the most acceptable one, not the one with the minimum price. The most acceptable proposal is near to the average price of received proposals [3].

## 3. Fuzzy Set Theory

Fuzzy set theory, to treat fuzziness in data, was proposed by Zadeh in 1965. In Fuzzy set theory the membership grade can be taken as a value intermediate between 0 and 1 although in the normal case of set theory membership the grade can be taken only as 0 or 1.The function of the membership grade is called its "membership function" in Fuzzy theory. The membership function will be defined by the user in consideration of the fuzziness. In remote sensing it is often not easy to delineate the boundary between two different classes. In such cases as unclearly defined class boundaries, Fuzzy set theory can be usefully applied, in a qualitative sense [4].

## 4. The Proposed Model Based on the Fuzzy Topsis Method

The proposed model diagram for prequalification of contractors is indicated in Figure 1.

## 5. Numerical Example

To evaluate the proposed model a case study was conducted. This study was performed in a real construction project in Iran. Firstly, by distributing the questionnaires among experts and apply of mentioned method the weight of each criterion has been specified. After that in order to rank the contractors the language terms will be used. After determining the language terms and criteria' weight It can be assigned an especial manner for each criterion of each contractor. Considering the experts' ideas for each criterion and each contractor a language term has been assigned. After locating the equivalent fuzzy of language terms in the above matrix, the decision making matrix will be obtained. In the next step, by normalizing the decision making matrix using the aforementioned method, the normal matrix will be obtained.. In the next step, by multiplying the criteria' weight by the normal matrix, the normal weighted matrix will be obtained .After determining the normal weighted matrix, the positive and negative fuzzy ideals will be obtained for each criterion. The closeness coefficient for each contractor is calculated based on the distances from the ideal values. In the next step, having FPIS and FNIS for each criterion, for each contractor the

distances form the mentioned boundaries will be calculated. After that the summation of these distances is determined and finally the closeness coefficient for each criterion is calculated. Finally after ranking the contractors based on these coefficients, the sensitivity of this kind of ranking to each criterion's weight should be investigated in the following section.

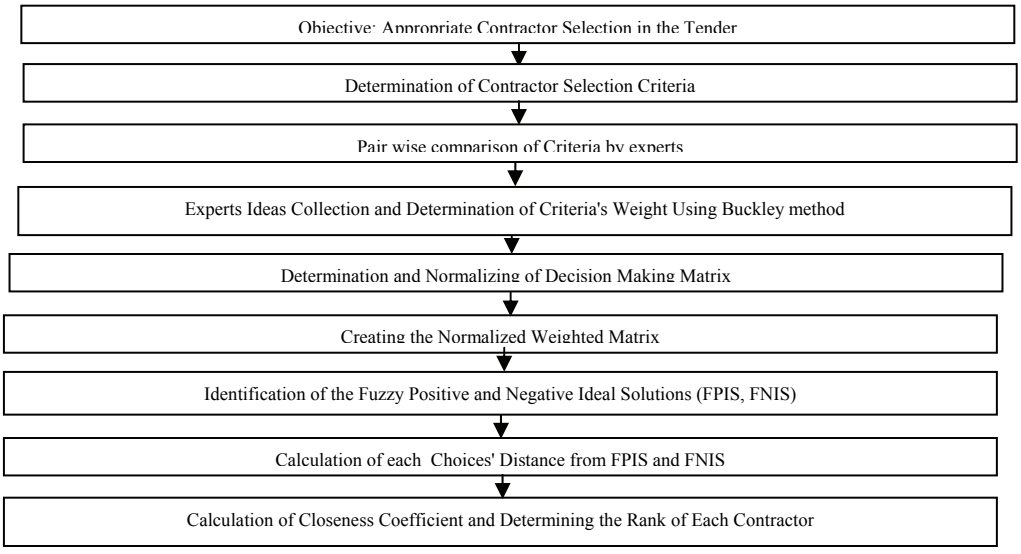


*Figure 1: Proposed diagram for contractors' Pre-qualification model.*

## 6. Sensitivity Analysis

For evaluating the effect of criterion's weight on the closeness coefficients and contractor's ranking the weights of criteria will be changed .Figures 2 shows the effect of changing weight of first criterion on the contractor's ranking.

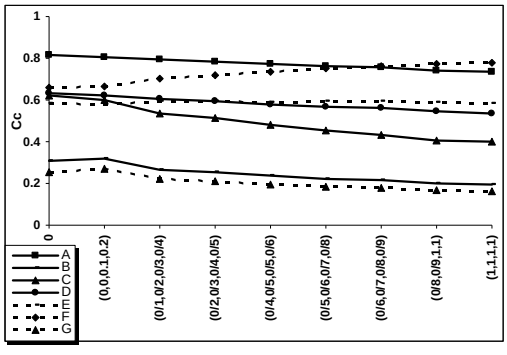


*Figure 2: Experience Criterion – Fuzzy Topsis*

## 7. Conclusion

Considering the sensitivity results the following conclusions can be obtained: The contractor's ranking by means of Fuzzy Topsis method is too sensitive to criterion's weights. So determining the relative weight of each criterion has a significant importance in this method; and, The presented method is not appropriate for careful decision makers accepting low risks in their decisions.

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# A neural network approach for predicting total construction costs (TCCs) of apartment projects in Vietnam

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*There is the need for accurate prediction of total construction costs (TCCs) for apartment projects in Vietnam. This paper presents the application of artificial neuron networks (ANNs) in estimating TCCs of apartment projects. A computerized tool was developed using Visual C++ in order to apply the neural network to realistic projects. The results suggest that this model is reasonable in predicting TCCs for apartment projects and reinforce the reliability of using neural networks to cost models. The results are useful not only to researchers and practitioners in Vietnam Construction Industry (VCI) but also to participants in other developing countries in South East Asia.*

**Keywords:** Neural networks, cost modelling, prediction, total construction costs, Vietnam

## 1. Background

The correctness of estimates depends on the estimator's experiences. Experienced estimators rely on their personal expertise to incorporate the effect qualitative factors in their estimates [1]. Neural networks are the tool that helps less experienced estimators to integrate such effects.

### 1.1 Previous works

The neural network has been applied successfully in variety of construction cost management, including cost flow forecasting [2], the construction mark-up estimation [3], the prediction of total construction cost in UK [4], models of highway construction costs [5]. Moreover, neural network (NN) technique has been used in other majors such as estimating productivity of various construction tasks, prediction of earthmoving production, the forecast of residential construction demand, the processing the subjective information needed for crane type selection in a consistent manner, the estimation of the acceptability of new formwork systems, predicting the performance of design-build projects, estimating construction productivity of dozer operations.

### 1.2 Objectives of the study

It seems that little effort has been spent to apply neural networks to apartment in developing countries, where the construction environment is risk due to the impact of the changes on direct costs. An effort is made to illustrate the use of neural networks for forecasting TCCs of apartment projects in Vietnam.

The major objective of this study is to develop a NN-based model for estimating TCCs of apartment projects in conceptual design phase.

## 2. Methodology

This study focuses on a neural network based approach for forecasting the preliminary construction cost of apartment projects. A systematic methodology was implemented in order to achieve objectives of the study. It comprises of main four steps: (1) identifying input variables and choose a proper neural architecture; (2) Collecting data for training and testing; (3) training and testing the neural network model; (4) applying the NN-based model for predicting the TCCs.

## 3. Model development

In order to fit into conditions in the VCI, the preliminary questionnaire designed from literature review was needed a pilot test. Based on characteristics of a set of available data and results from the questionnaire survey, seven input variables were identified as input variables categorized as scope variables and material price related variables.

Based on principles pointed out in Ezeldin and Sharara [1], a three-layered feed-forward network was chosen. This model consists of an input layer with 7 nodes, which are number of floors (I1), total floor areas (I2), the project rank (I3), year of construction (I4), petrol price (I5), steel price (6), and cement price (I7), and an output layer with one node (Figure 1).

The data use for training was actual data set of 14 apartment projects. The date set of other five projects was used in the testing and verification of the model. Since back-propagation training is one of the most common methods for training neural networks given historical data [6], this method was used for training the model. A commercial software "MATLAB" was used as a tool for the NN training

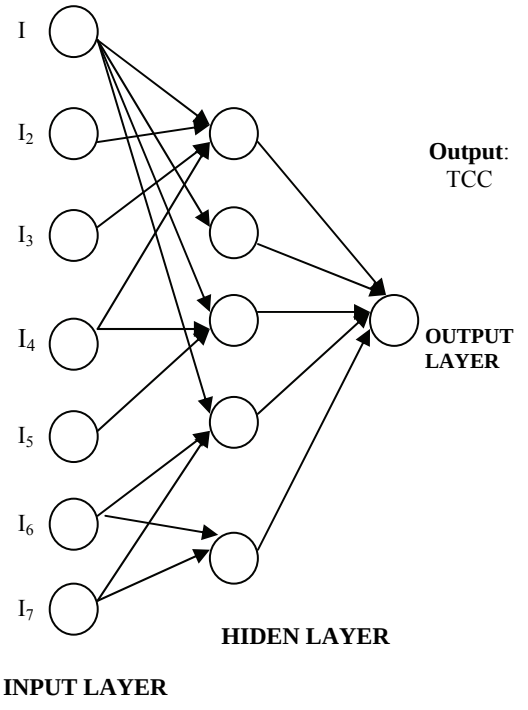


*Figure 13:* Description of NN inputs and outputs

The process of training considered 5000 epochs in testing because the appropriate training and acceptable converge were achieved. The mean square error (MSE) for a second train is $4.85403 \times 10^{-16}$. This value is acceptable for generalization from data. The study adopted a measure, namely MAPE, of accuracy dealing with percentage errors pointed out in Goh [7] to compare the forecasting results of the NN-based model. Since the MAPE value of the ANN-based model consistently fall within the acceptable limit of 10% [7], the capability of ANN in predicting TCC of apartment projects has been confirmed and reinforced in this study.

## 4. Conclusions

The main purpose of this paper is to develop an ANN-based model to predict construction costs for apartment projects in Vietnam. The results of the study suggested that the ANN-based model has potential to improve the cost estimation model for apartment projects. Although the proposed model is not validated in a rigorous way, the ANN-based model is useful for both practitioners and researchers. It facilitates systematic predictions in early phases of construction projects. Practitioners are more proactive in estimating construction costs and making consistent decisions in initial phases of apartment projects. Researchers should benefit from exploring insights into its implementation in the real world.

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# Knowledge value perceptions in Thailand: an interpretive case study

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*The paper aims to explore the knowledge value creation capability and maturity of a high-tech organisation in Thailand. The research adopts an interpretive stance and employs a survey and a case study approach involving multiple data collection methods. The paper is based on one of the author's personal expertise and involvement in the selected case study organisation for over a decade. The results indicate that (a) the selected organisation has demonstrated its readiness to migrate to a value creation culture underpinned by knowledge sharing and creation practices, (b) the distinctive collective characteristic of Thai culture engenders a strong human and social sense of community, which in turn promotes knowledge-friendly practices, and (c) a knowledge culture requires essential socio-organisational ingredients, including trust, confidence, motivation, continuous learning. This empirical study provides a foundation to further the research to: (a) explore the role of knowledge management systems in promoting value creation, and (b) investigate the key distinctive features of Thai culture which underpin and influence knowledge management perceptions and practices of Thai employees.*

**Keywords:** Knowledge management, Value creation, Interpretive case study, Information Systems, Thailand

## 1. Introduction

The increasing popularity of knowledge management (KM) has been reinforced by the quest for innovation and value creation [1, 2]. Because of this, it is perceived that the future of KM tends to focus on value creation [3]. Value creation is grounded in the appropriate combination of human networks [4], social capital [5], intellectual capital [6], and technology assets [7], facilitated by a culture of change [8].

KM solutions, including environments supporting information exchange, knowledge sharing and integration, and virtual communities, present a high and promising potential for developing countries. However, very few articles have reported KM implementations and strategies in third world/developing countries, including South East Asia. The aims of the paper are to (a) investigate overall KM practices in Thailand and (b) explore value creation capabilities in a Thai Hi-Tech organisation, covering technical, cultural, and organisational aspects.

## 2. Research methodology

The research context used for the investigation is a case study, BETA (a pseudonym), a Thai Hi-Tech Research and Development (R&D) organisation which conducts research in Information Technology. A case study approach is well suited to Information Systems research. It is widely used in qualitative information systems studies and can be applied in positivism and anti-positivism investigations. The case study aims to provide in-depth analysis of the selected organisation (BETA) for which KM is perceived as essential. The selected research units involve a number of knowledge-intensive production departments, which comprise several high-profile research teams. An interpretive stance is adopted as one of the researchers has worked in the organisation for over a decade. Indeed, the researcher has, over the years, acquired substantial personal knowledge of the organisation's culture and work environment. The case study involves the use of five instruments: survey questionnaires, interview, process mapping, direct observation, and documentation.

## 3. Findings and Conclusions

The value creation 'equation' in BETA is grounded in human networks underpinned by strong social structures facilitated by technology. Socio-cultural factors, including trust and confidentiality must be blended successfully toward the shared KM vision. Therefore, the migration path to value creation is grounded in human and cultural elements and is an exercise in change, which requires new mechanisms to enable participation and communication. The research reveals that the management has tried to adopt reward systems to motivate employees to share and create knowledge, and the employees have responded positively to the introduction of monetary and non-monetary rewards. There is a strong awareness amongst executive staff that managing the change process should not be overlooked to sustain this knowledge sharing and creation culture.

The research has investigated the KM capabilities in BETA, a Thai Hi-Tech organisation. It has also explored the perception about the value that is created out of knowledge. The results indicate that (a) BETA has demonstrated its readiness to migrate to a value creation culture underpinned by knowledge sharing and creation practices, (b) the distinctive collective characteristic of Thai culture engenders strong human and social networks, which in turn promote knowledge-friendly practices, and (c) a knowledge culture requires essential socio-organisational ingredients, including trust, confidence, motivation, continuous learning. BETA, as any other knowledge-based organisation, needs all of its employees to adopt a culture that promotes the virtues of knowledge sharing and creation. The culture of a company is the set of values, norms and attitudes shared amongst the members of the organisation. A knowledge-based culture requires a number of essential attributes, including: (a) a culture of confidence and trust in which people are willing to share the information and knowledge they have, (b) a culture that

recognises that much knowledge is tacit and nurtured in social networks. This recognition places an emphasis on promoting open dialogues between staff so they can develop social links that can promote shared understandings, and (c) the support for human networks where members continuously strive to increase their shared understanding of their collective tasks and to seek continuous improvements in their practice.

The research confirms that Thai employees are full of perceptive insights into creating value out of knowledge and KM practices. Human networks, social capital, intellectual capital, and change process emerge as essential conditions to enable value creation. Focusing on social capital, the research identifies the collective capabilities derived from social networks facilitated by a supportive Thai culture. The higher the level of social capital, the more distributed communities are stimulated to connect and share knowledge. Social capital can be applied to create value for organisations and end-users. It has been shown that end-users in BETA are organised into teams with a strong social community dimension. Moreover, members of these teams and communities will be more inclined to use adapted knowledge management system (KMS) when they are (a) motivated to share knowledge with others, (b) able to share knowledge, and (c) have the opportunity to share knowledge. KMS that embed social awareness can play an important role in addressing these requirements, and promote social capital within and across teams.

Clearly more empirical research is needed to explore the role of KMS in promoting value creation in Thailand. A potential research avenue is to measure KM performance in organisations. It is hoped that the paper will stimulate this debate and trigger further research.

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# Dynamic management models for simulation of construction company development

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*This paper presents models that are used for the prediction of the development of construction sector companies. These models are used for teaching management in the Czech Technical University. The models are based on the system dynamics method. The process of the model development and the usage is described in the paper. The first model describes the behaviour of the complex system representing the future development of a residential building market. The main subsystem is the stock of houses under development and stock of finished houses. The simulation program for hypothesis testing has been developed. The output parameters can be investigated from the investors, developers, construction companies point of views. The second model calculates the amount of finished work in the projects that depend on the resources used in the project. It is an important issue nowadays in states with fast growth of the construction sector where a large worker shortage exists. The topic of the paper is more the description of the model development and learning process than a detailed description of the problem situations.*

**Keywords:** System dynamics model, Dynamic behaviour, Housing market trends, Learning process

## 1. Introduction

We can observe in the Czech Republic the fast development of a construction industry production, see Figure 1. This industry comprises of 2355 companies with more than 20 employees that completed in the half year 2007 the construction works of 55.6 billions CZK. It was more by 28.7 % than in the half year 2006 [1]. The construction companies suffer from worker shortage and from material shortage. This development evoked new issues concerning the management methods in the companies as well as new tasks for the teaching processes in the universities. Project management and resources management subjects deal with the above described problems.

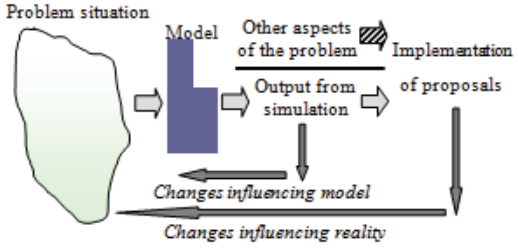


*Figure 14: Relationship between problem situation and model*

The presented models are based on system dynamics. System dynamics allows us to understand the dynamic behavior of the complex system [2-4]. The method can be used for the simulation of any system but most applications are focused on socio-economic systems at the company level. The system dynamics models are used at the Czech Technical University, Faculty of Civil Engineering in subjects concerning management of the construction companies. The whole process of problem solving is described in Figure 1.

## 2. Examples of models

Two models are presented. The first one is the model for the prediction of the residential building market. The main subsystem is the stock of houses under development and stock of finished houses in a certain region. The number of finished houses depends on the capacity of the building construction companies and on the demand for new houses.

The objective of the class is to find the output parameters (finished houses during the next ten years) for actual input values and consequently to perform sensitivity analysis with goal to find the combination of input parameters that can ensure the growth of the market. The example of the resultant values are shown in Figure 3.

The second model deals with the problem of resources in the project, see Figure 4. Students investigate the influence of the amount of the workers, their productivity and the improvement time. The example of the outputs is in Figure 5.

The main output parameter is *Finished tasks*. It is the amount of the accomplished tasks in the project or in the projects during a defined period. The model is suitable for all project-oriented companies but in this case the investigation is focused on solving problem of the key parameter - workers. Students are also encouraged to improve the structure of the model, e.g. to introduce new elements describing the cost of the labor force.

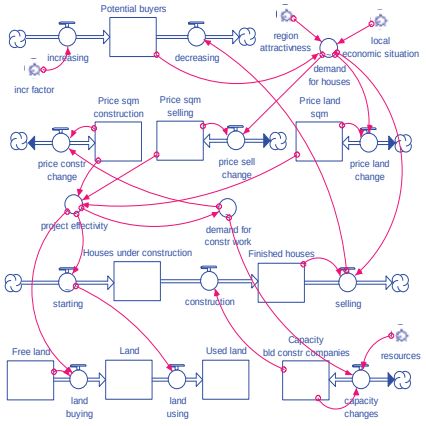


*Figure 2: System dynamics model – residential buildings market*

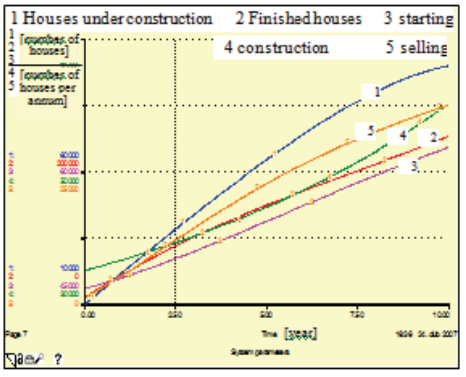


*Figure 3: Output parameter values I – building market*

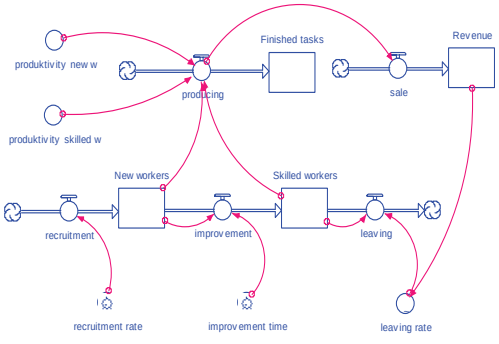


*Figure 4: System dynamics model – project management*

*Figure 5: Output parameter values II – project management*

## 3. Conclusions

System dynamics models improve the learning process. The experiments in real world are very expensive and can caused serious problems in companies. Another problem is the impossibility to train all students in existing companies in the building sector. The simulation in the virtual world brings new experiences for students. They can practise decision making without any apprehension. One advantage of using computer models is the possibility to compress time because students or any model designer can obtain many outputs in a very short time. The learning outcome is therefore very significant.

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# Call for Papers

**Special Issue of International Journal of Disaster Prevention and Management on the subject of Disaster Management and the Built Environment.**

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**Background and Expectations**

The construction industry's role in reconstruction activities following disasters is well documented. Construction is typically engaged in a range of critical activities: temporary shelter before and after the disaster; restoration of public services such as hospitals, schools, water supply, power, communications, environmental infrastructure and state administration; and, securing income earning opportunities for vulnerable people in the affected areas. However, there is growing recognition that the construction industry has a much broader role to anticipate, assess, prevent, prepare, respond to and recover from disruptive challenges. This revised lifecycle poses significant and far reaching challenges for the construction industry. The professions must recognise the link between disaster and development, adapt buildings to deal with the consequences of climate change, and promote rational, balanced solutions to deliberate attacks on infrastructure, which remain an unbounded threat. Moreover, construction professionals have a key role to play because they are involved in the construction of the infrastructure, and therefore should also be involved when an event threatens or destroys that infrastructure; they possess valuable information about their projects, and that information can be critical in disaster preparedness, as well as response and recovery. The construction professions are also in a strong position to frame the discussion on the cost-benefit tradeoffs that occur in the risk management process. In this context, the focus of this special issue is to promote research that examines the role of building and construction professionals to anticipate and respond to unexpected events that damage or destroy an infrastructure project – from earthquakes and climate change to terrorist attacks – and reflect construction's ongoing responsibility toward an infrastructure's users.

**Themes**

Contributed papers may deal with, but are not limited to the following themes:

- Disaster preparedness, response and reconstruction
- Restoration of major infrastructure and rehabilitation
- Link between development and reconstruction
- Stakeholder consultation in the decision making for development projects
- Participatory construction risk appraisal tools and needs assessment
- Strategic leadership for post-disaster reconstruction
- Logistics and resource planning and monitoring
- Construction project management for post-disaster reconstruction
- Construction waste management and recycling after a disaster
- Knowledge management practices at different phases of the disaster lifecycle
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