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TG53 - Postgraduate Research Training in Building and Construction

**TG63 - Disasters and the Built Environment
POST DISASTER RECOVERY CHALLENGES
IN SRI LANKA**



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Post disaster recovery challenges in Sri Lanka

A collection of research papers based on a series of undergraduate research works carried out in Sri Lanka in 2007

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A collection of research papers based on a series of undergraduate research works carried out in Sri Lanka in 2007

A joint publication of CIB Task Group 53 (Postgraduate Research training in Building and Construction) and CIB Task Group 63 (Disasters and the Built Environment)

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ABOUT THIS BOOK

This is a joint publication of CIB Task Group 53 (Postgraduate Research Training in Building and Construction) and CIB Task Group 63 (Disasters and the Built Environment).

This book is a collection of research papers based on a series of undergraduate research works carried out in Sri Lanka in 2007. The papers were submitted to, peer reviewed and accepted for a special session of the CIB International Conference on Building Education and Research (BEAR 2008), held from 11th – 15th February 2008 at Heritance Kandalama, Sri Lanka. The session was organised by CIB Task Groups 53 and 63.

CIB, International Council for Research and Innovation in Building and Construction

CIB is the world's foremost organisation for construction researchers and practitioners. With its headquarters in Rotterdam, CIB is an international body dedicated to the research and documentation of the building industry. It brings together professionals from a broad spectrum of building organisations worldwide. The unrivalled collection of expertise of the 600-plus members is organised through a network of working commissions whose subject matter extends over every area of building and construction.

CIB Task Group 53, Postgraduate Research Training in Building and Construction

CIB Task Group 53 aims to transfer knowledge and experience between built environment research institutes on doctoral research methods and initiatives to increase the level of training received by researchers within the field.

CIB Task Group 63, Disasters and the Built Environment

CIB Task Group 63 aims to stimulate ideas for future research by exploring the range of perspectives from which the construction industry is able to contribute towards improved resilience to disruptive challenges and by facilitating the dissemination of the existing knowledgebase.

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1. Introduction

Keraminiyage K, Jayasena H. S, Amaratunga D, Haigh R.

During the past decade, the number of disasters has risen sharply worldwide. The Annual Disaster Statistical Review 2006 [1] highlights that the number of natural disasters that occurred in the period 1991 to 1999 varied between 200-250, while the figures have almost doubled during the period 2000 and 2006. Despite the continuous and rapid growth in the number of natural disasters, the number of actual victims affected by disasters has varied considerably along the timeline and across regions. During the last two decades, the average annual number of victims affected by natural disasters ranged between 100,000,000 to 300,000,000 [1]. Further, the Asian continent has experienced the greatest loss of lives due to natural disasters, in absolute terms and in proportion to the population. As CRED [2] reports, the figures showed an average of 83.7% people killed in natural disasters in Asia, compared to 10.55% in Europe, 3.54% in America, 2.16% in Africa and 0.05% in Oceania during the period 2000-2005.

Within the fatality rates mentioned above, a significantly higher death toll is evident in developing countries compared to that of developed countries [3, 4]. For example, the earthquake which hit central California in 2003 with a magnitude of 6.5 in the Richter scale took two lives and injured 40 [5] whereas the earthquake which hit Iran four days later with a magnitude of 6.6 killed at least 26,000 people [5]. As one would suspect, this immense difference in the death toll is not uniquely related to factors such as population densities, as in this instance, both were similar. Rather, it often shows a strong link to the level of preparedness of the country to disasters. For example, in recent events such as hurricane Katrina which hit the United States, the potential damage was pre-assessed and plans were in place to minimise the impact, whereas the Indian Ocean tsunami caught its victims almost by surprise. Developing countries not only experience higher levels of mortality during a disaster, but also generally require longer periods for post disaster recovery.

As the “Mind the Gap” report [4] highlights, even though developing countries often receive financial and other humanitarian support from the international communities, non-governmental organisations and donor agencies in the form of immediate relief aid, generally post disaster recovery has primarily been identified as a state-led matter. That being the case, traditionally, donors and other organisations work towards humanitarian relief and pay less attention to longer term recovery. However, developing countries that are victims of disasters often fail to launch successful disaster recovery programmes due to a lack of resources and capacities, in terms of both finance and expertise. This inability hinders the value of the resources dispersed and services rendered by the donor agencies within the immediate relief stage. This suggests there is a timely need to assess the long term disaster recovery issues in developing countries.

The construction industry’s role in disaster management contexts is well documented. In particular, this importance has been discussed in literature frequently giving special emphasis to the context of developing countries (for examples see: [6], [7], [8], [9]). Thus, the importance of

improving the construction industries of developing nations is widely recognised, highlighting a need to equip them to better manage post-disaster scenarios [10]. Construction is typically required 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. Further, there is growing recognition that the engineering community has a vital role to play in finding and promoting rational, balanced solutions to what remains an unbounded threat [11] and that the construction industry has the broadest role to anticipate, assess, prevent, prepare, respond and recover from disruptive challenges. Pena-Mora [12] suggests 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 destroys that infrastructure. Specifically, he emphasises that construction engineers possess valuable information about their projects and that information can be critical in disaster preparedness, as well as in response and recovery. The information they possess, he argues, may be the difference between the life and death.

1.1 The case of Sri Lanka

The case of Sri Lanka provides a valuable insight into the triangulated link between developing countries, disaster management and the construction industry. Sri Lanka is one of the worst effected countries of the December 2004 Indian Ocean tsunami. Before the Indian Ocean 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. However, the Tsunami affected 75% of the coastline of Sri Lanka. It also resulted in the destruction of more than 100,000 homes [13]. The destruction of houses also resulted in wiping out of several livelihoods such as fishing, farming, tourism and handicrafts-related activities. In addition to commercial and non-commercial property damage, the number of deaths apportioned to the Indian Ocean Tsunami is estimated to be in excess of 250,000, with at least 40,000 of those in Sri Lanka [14]. A lack of awareness has been identified as a major reason behind the huge loss of life [6]. Indeed, the term “Tsunami” was heard by most of the ordinary Sri Lankans only after this devastation. Both awareness and preventive steps are needed to prevent huge loss of human life in future. However, the problem continues beyond the pre-disaster stage into recovery, where Sri Lanka has again demonstrated the need for proper information and knowledge dissemination, as this has often been highlighted as the reason behind unsuccessful post-Tsunami recovery activities. A lack of prior knowledge and a proper point of reference have made most of the recovery plans mere guessing games, eventually failing without adding appropriate values to the recovery attempts [15].

1.2 About this book

This book aims to place the reader in the middle of this context and to provide an insight about some of the post disaster reconstruction challenges faced by Sri Lanka. This is a collection of seven research papers compiled by a group of emerging researchers, under the guidance of experts in the relevant subject areas. Actual research activities related to these papers were conducted in 2007 within Sri Lanka. The papers are primarily outputs from a series of undergraduate research projects carried out at Sri Lankan Universities.

1.3 Organisation and overview of the book

The seven papers presented within this book are structured in a manner where the reader is gradually placed within the context of post disaster reconstruction challenges in developing countries. Nissanka, Karunasena and Rameezdeen start the book by presenting a prelude to the context, where they discuss factors affecting post disaster housing reconstruction. This paper presents the findings of a series of interviews conducted with stakeholders involved in post tsunami reconstruction activities in Sri Lanka, where the reasons behind the prolonging of the Sri Lankan post tsunami reconstruction programme is revealed. At the very outset, it highlights the fact that the issues related to post disaster reconstruction starts at strategic level, commencing with the inconsistency of the post tsunami housing policy and poor coordination issues.

Having discussed the factors affecting the post disaster housing reconstruction activities, the reader is next presented with an inquiry about the capacity of the construction industry to meet the challenges of post disaster reconstruction. Accordingly, Sathyendrakajan, Weddikkara and Karunasena focus on exploring how capable the construction contractors are to meet the challenges posed by the post tsunami reconstruction in Sri Lanka. Among various other factors, they conclude that the construction contractors in post disaster situations can be incapacitated in terms of meeting the sudden surge of demand in labour created by the challenges of post disaster reconstruction activities.

Further stimulating the discussion about labour issues in post disaster reconstruction scenarios, Jayawardena, Seneviratne and Jayasena brings the perspective of “production vs. acceptance” of trained workforce in the construction industry. They highlight the fact that in the Sri Lankan context, the skilled construction workers do not receive proper levels of treatment for their formal training during recruitment, leading to productivity issues in the construction industry. This paper sets out a different perspective to the question raised by Sathyendrakajan, Weddikkara and Karunasena: that perhaps the issues of labour shortages in post disaster reconstruction scenarios have its roots in productivity and acceptability of trained skilled workforce within the construction industry.

The whole issue of construction workforce productivity and acceptability cannot be focused purely on skills development issues. Hapuarachchi and Sepani Senaratne introduce a team management perspective to the context, where they argue, as with other industries, construction is governed by generic management principles. Their findings on how construction teams develop, in comparison with the experiences of other industries, prompt us to consider the fact that some of the challenges posed by post disaster reconstruction may be tackled by sharing good practices from other industries and general theories applied in various other contexts.

Along with challenges, opportunities also arise. In the next paper, Ratnayake and Rameezdeen take the reader to a comparative mode, where two actual approaches adopted for post disaster reconstruction in Sri Lanka after the December 2004 tsunami were presented as a comparative analysis. The opportunities produced by the two different approaches presented were triggered through various post disaster reconstruction challenges and are discussed in the preceding papers. The authors present insights of both the approaches, their benefits and drawbacks under

various circumstances given. They conclude that despite other considerations, an approach to post disaster reconstruction should carry a strong focus on understanding and satisfying the needs of the end user, which is the affected community.

Post disaster reconstruction involves communities. Even though the affects of each disaster are unique to the affected communities, post disaster reconstruction can hardly be classified as a unique or first time activity. Thanurjan and Indunil Seneviratne introduce the role of knowledge management in post disaster housing reconstruction. They argue that the knowledge intensive nature of construction enables deploying knowledge management principles for effective and efficient use of resources and improved decision making capabilities to address some of the challenges of post disaster reconstruction.

Fernando and Jayasena provide concluding remarks to the book by improvising the cyclical nature of the relationship between the disasters and post disaster reconstruction. It is often recognised that only built disasters are manmade. However, it is widely debated: has not mankind stimulated the destructive behaviour of the “nature”, aren’t these natural disasters the responses of “nature” to mankind for his destruction of “nature”? This being the case, should the post disaster reconstruction attempts complete the loop by creating another opportunity for more disasters? The answer should be “certainly not”. As energy consumption is a key stimuli of the destructive behaviour of the nature, Fernando and Jayasena’s investigation on how to practice the energy efficient designs in buildings provide food for thought for the stakeholders of post disaster reconstruction projects.

The last two papers stimulate discussions about how to deploy current research and technological advancements while the preceding papers present the challenges and opportunities in post disaster reconstruction. Overall, the book provides some guidance to overcome the key challenges in post disaster reconstruction in developing countries.

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2. Study of Factors Affecting Post Disaster Housing Reconstruction

Nissanka N.M.N.W.K, Karunasena G, Rameezdeen. R.

Abstract

Disasters are now considered to be one of the biggest obstacles to sustainable development and the social security of nations. Sri Lanka is prone to natural disasters such as floods, landslides and drought. In December 2004, Sri Lanka was hit by a Tsunami that affected it severely. Recovery is therefore a momentous challenge for those with less experience in large scale post disaster reconstruction. In this research paper, factors causing delays in the housing reconstruction programme in Sri Lanka and related issues are addressed. Data was gathered through interviews with government organizations, NGOs and affected communities. The findings reveal various reasons for the prolonged post Tsunami reconstruction and the disturbances caused in the smooth flow of reconstruction process through certain gaps in it. Inconsistencies in post Tsunami housing policy, land titles, government lack of planning and recovery strategies, and the enforcement of a buffer zone are the main factors affecting post Tsunami housing reconstruction programmes in Sri Lanka.

2.1 Background

The world is experiencing an intensity of disasters – natural and man made - with devastating impacts. When a disaster strikes, individuals and communities are affected through serious disruptions to normal day to day functions. The disasters cause widespread human, material and environmental losses. As reported by the Secretariat of International Strategy for Disaster Reduction [1], the last ten years saw 478,100 people killed, more than 2.5 billion people affected and about US \$ 690 billion in economic losses caused by disasters. Events triggered by hydro-meteorological (weather related) hazards amounted for 97% of total people affected by disasters, and 60% of total economic losses [2].

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. This could be linked to climatic change and scientists predict that global warming will result in more extreme weather patterns. [3]. Therefore, challenges of recovery from natural disasters will be with us for the unforeseeable future, with the resulting need for effective post disaster response strategies.

On December 26, 2004 the deadliest Tsunami known to history hit Sri Lanka, triggered by a massive earthquake of momentous magnitude, 9.0 – the largest earthquake recorded in 40 years. According to the Joint Report of the Government of Sri Lanka (GoSL) and Development Partners 35,322 people were killed, 1,000,000 people were displaced and over two thirds of the island's coastline was affected by the Tsunami. [4]. Sri Lanka faced a big challenge in rebuilding the nation for a country that had not previously experienced such a disaster.

Relief, recovery, rehabilitation and reconstruction are the main activities in rebuilding an affected nation, where Government and Non-Government Organisations are the main stakeholders. However, as reconstruction and rehabilitation progresses it is clear that moving from immediate relief effort to addressing the massive reconstruction tasks, reconstruction involves different tasks and large-scale complex challenges. Donor-driven and owner-driven are the main housing reconstruction programmes observed in the current post Tsunami reconstruction process. Whether reconstruction of housing was started at the proper time and was executed properly to achieve appropriate recovery of livelihoods as scheduled, these are just some of the factors affecting the success of the reconstruction process. It is evident also that the need for effective reconstruction and rehabilitation has reduced through time. A careful and in depth study is necessary to ascertain the success of the reconstruction process. The identification of issues that delay reconstruction programmes will help in achieving a better future for affected communities. As natural disasters are recurrent in Sri Lanka, an in depth understanding of the post-disaster reconstruction processes will help them prepare and face another disaster. This research paper addresses issues related to post Tsunami housing reconstruction in Sri Lanka.

2.2 Research Methodology

Interviews, semi-structured and unstructured, were conducted with governmental and non-governmental organisations and communities. The purpose was to collect data on post Tsunami housing reconstruction work to identify involvement of various stakeholders in reconstruction processes, their successfulness and to identify those factors that hindered progress, such post Tsunami housing reconstruction work. Five leading government and five non-government organisations were selected for interviews. Homeowners from owner driven and donor driven housing reconstruction programmes were also interviewed.

2.3 Survey Findings: Factors affecting post Tsunami Housing Reconstruction

Several factors affecting related to post -Tsunami housing reconstruction programmes were identified through interviews, which are discussed below under several topics.

2.3.1 Inconsistencies in Tsunami housing policy

Tsunami housing policy

Tsunami housing policy consists of three phases: the imposing of a buffer zone, the relaxation of the buffer zone and the conversion programme.

Imposing of buffer zone or setback zone - Phase I

After the Tsunami, the government adopted a "no development" 100 meter buffer zone policy for districts of Kilinochchi, Mannar, Puttlam, Gampaha, Colombo, Kalutara, Galle, Matata and Hambantota; and a 200 metre buffer zone for districts of Jaffna, Mullaitivu, Trincomalee, Batticaloa and Ampara. The policy prohibited any new construction of buildings (permanent or

temporary), reconstruction of completely or partially damaged buildings, and additions or alterations to existing undamaged buildings within the buffer zone. The introduction of a buffer zone led to two types of housing programmes. They are:

- Home Owner-driven housing reconstruction (In-Situ)
- Donor-driven housing reconstruction (Relocation)

Home owner-driven housing reconstruction programme (in-situ)

Damaged (fully or partially) homes located within the buffer zone were repaired/reconstructed on the same site. The GoSL provided grants provided from development banks and bilateral donors to affected homeowners to reconstruct their houses. The financial criteria included an assessment of damages, on a points basis, where a house deemed to be more than 40% damaged would qualify for a grant of Rs. 250,000 in four instalments, based on progress. A grant of Rs. 100,000 would be made available to rebuild a house damaged less than 40%, in two instalments. However, as revealed by homeowners, the high costs of raw materials and labour charges made it impossible to complete a house with such amounts at phase 1.

Donor-driven housing reconstruction programme (relocation)

Donors in private, government and non-government sectors, local and international, built or assisted in building houses at the relocation sites for families who lived within the said buffer zone. The donors provided each new settlement with an internal common infrastructure while the GoSL provided utility services up to the relocation site. The beneficiary remained the legal owner of his/her property within the buffer zone and received a full title to the property at the resettlement site.

The buffer zone of 100m and 200m was revised in late 2005 and in April 2006, when the RADA issued a revised housing policy. Enforcement of the buffer zone delayed the commencement of reconstruction programmes by more than six months. Due to the lack of reconstruction activities in Sri Lanka, some donors left with their unutilised grants and moved to other Tsunami affected countries. Sri Lanka missed out on a considerable amount of such intended grants, with the completion stages of reconstruction programmes affected due to insufficient funds.

As per the MoU signed by the government and some NGOs, to carry out donor driven housing reconstruction programmes, the GoSL was to provide land to donors to construct homes and to provide utility services up to such relocation sites. Delays in providing them caused further delays in supplying necessary assistance by donors when constructing houses.

Relaxation of buffer zone - Phase II

In 2006, the GoSL revised its post Tsunami housing policy by relaxing the buffer zone and published its “Revised Tsunami Housing Policy”. Buffer zone relaxation changed the number of housing units falling within one type of housing reconstruction programme to the other and created immense confusion amongst beneficiaries. Only a few understood clearly their housing entitlements from the beginning. With the switch from one scheme to the other, the

district/divisional secretariats had to revise the lists of beneficiaries falling under each particular scheme. Additionally, the government had to arrange fresh funding sources and allocate funds for additional new beneficiaries.

Conversion programme – Phase III

Phase three of the permanent housing reconstruction programme is the conversion programme. The major issues in the revised Tsunami housing policy are as follows.

Revised Tsunami Housing Policy

- Government land + donor built homes built under a donor driven housing programme are primarily for those who lived within the previous buffer zone.
- Government land + a government cash grant (Rs. 250,000) to construct a new house + donor assistance to complete a house (not less than Rs. 250,000 depending on costs to meet a minimum standard) through a co-financing agreement.
- Government cash grant (Rs. 150,000 for 3 divisions in Ampara and Rs. 250,000 for 3 divisions in Ampara and Rs. 250,000 for Colombo) to purchase a land + government cash grant (Rs. 250,000) to construct a house + donor assistance to complete a house (to a minimum standard) through a co-financing agreement.
- A housing reconstruction grant (Rs. 250,000 for fully damaged and Rs. 100,000 for partially damaged houses) + donor assistance to complete only a fully damaged house to a minimum standard, through a co-financing agreement.

It allowed families to take government grants and build their houses on relocation sites. It included extended families, lessees and squatters. At phase III, homeowners were granted a number of instalments through co-financing agreements between the GoSL and donors. Though the first instalments were released rapidly, subsequent instalments were subjected to thorough verification and approval processes. In some cases, monitoring visits and approval processes took too much time which led to small gaps in the reconstruction process.

Co-financing policy

According to the revised housing policy, NGOs and INGOs co-funded reconstruction of partially damaged units. The co-financing policy formulated by GoSL stipulated an equitable approach and recommended addressing funding needs of the most vulnerable families with regard to reconstruction of fully damaged homes. However, in practice this policy was not followed. Approaches implemented by co-financing agencies were built within a compensatory framework.

Rules on selecting contractors for the reconstruction process

Government stated in the MoU that NGOs should select only contractors who have registered with the Institute for Construction Training and Development (ICTAD) would carry out housing reconstruction programmes. By that time, some donors had already started reconstruction programmes, with the participation of the affected communities themselves (community based

system), in certain districts such as Galle. This resulted in a stoppage of work due to this new rule - which was later discontinued with.

Contractor selection for donor driven housing reconstruction programme was done by NGOs themselves. Thus, there was a tendency to select the lowest cost rather than on other factors such as quality. Hence, this necessitated in some defective reconstructed homes being demolished.

2.3.2 Conflicts on land titles

In the post Tsunami housing reconstruction process in Sri Lanka, donors were given land to construct homes within the donor-driven housing programmes. For owner-driven housing programmes, their own lands were used, while at phase III house owners were allowed to buy land from grants provided.

Scarcity of land

After imposing the buffer zone, the GoSL was unable to provide sufficient land for relocation housing projects because of the scarcity of land. According to the MoU signed by the donors and the GoSL, it states that the number of housing units agreed to be reconstructed by donors would also be determined by the availability of land. There were about 2,880 damaged units not relocated due to scarcity of land within Colombo.

Inappropriate conditions of provided land

The government provided marshy, futile land to construct houses for some donor funded projects. It was necessary therefore for donors to develop the land before constructing houses. However, the donors did not accept that developing the land was according to the MoU, and that land and infrastructure development was to be carried out by the government. Due to insufficient funds, the government failed in this and later therefore the donors had to develop the land. Considerable time was taken to arrive at this decision through discussion. In addition, by engaging in the additional land development, donors were unable to complete the number of housing units they had agreed to reconstruct. They spent more time on revising budgets several times over than they had in spending time constructing a house, including developing the land. There is a special issue in the case of the Homagama-Kahathuduwa housing reconstruction project, as experienced by the Red-Cross Society. They were asked to construct 700 units as flats while the affected community preferred single storey houses. The land was sufficient for only about 350 single storey houses. Hence, none of the donors agreed to fund construction at that site. Still, after more than 2 ½ years, the construction has not started.

Land acquisition

The government provided both state owned and acquired private land to donors to construct houses under the donor driven housing programme. However, some landowners initiated legal actions against such acquisitions. Due to court orders some housing projects were discontinued

with and it has taken some considerable time to solve these problems legally. Due to such, donors were unable to start the reconstruction process that ultimately has created gaps.

2.3.3 Ineffectiveness in monitoring funds

NGOs were allowed to manage funds themselves in the reconstruction programmes. Corruption has taken place in managing these funds, which ultimately reduced the actual amount made available for reconstruction. The actual amount of funds received by homeowners also diminished in similar fashion due to the absence of government monitoring. As emphasized by RADA, some house owners were over granted while others were inadequately granted. The total funding requirement for the owner driven programme is Rs. 10,690 million as estimated at the end of 2006.

2.3.4 Insufficient capacity of the construction industry

The capacity of the construction industry in the aftermath of the Tsunami, in terms of professionals, material, labour etc. was insufficient to execute construction smoothly due to high demand. Prices also increased due to lack of material, labour etc. Due to high inflation rates, homeowners were unable to complete reconstruction of their homes with the limited grants in phase I of the housing reconstruction programme. It was especially difficult for international NGOs, to complete the number of houses due to the complex situation of the construction industry in Sri Lanka. As a result, they had to hire technicians from foreign countries to carry out construction work.

2.3.5 Affected community's crappy behaviour

As experienced by the National Housing Development Authority, which assessed damages for compensation, conflicts have arisen when identifying houses as partially and fully damaged. In some cases, house owners damaged their houses in order to obtain Rs. 250,000. Houses were built by agencies and donors to different standards, sizes and costs for a great variety of reasons. Some families received government grants as well as many other grants from agents while others received little or no grants at all. This resulted in inequity in districts, leading to social/communal tensions. As a result, beneficiaries were switching donors or waiting for the "best offer", thus delaying the reconstruction process. Some house owners misspent their grants. This also delayed the process and raised complexity for NGOs in handling funds.

2.3.6 Government's lack of planning and recovery strategies for post Tsunami reconstruction

Absence of a quality control system in donor driven housing reconstruction programmes has led to many issues. Due to their inferior quality, some of the houses constructed by donors have had to be demolished and reconstructed, especially in the Galle district. It is stated that a policy is being drafted in respect of providing grants to people who live in inferior quality donor driven housing programmes to rectify the damages and enhance the quality of construction. The

establishment of organisations such as TAFREN, TAFRER, RADA etc. to implement reconstruction programmes with less experience in housing has resulted in lowering effectiveness. Absence of the National Housing Development Authority in carrying out housing reconstruction programmes is a significant point of interest, as the NHDA is a hugely experienced, mass scale, national house builder.

Although it is stated in the MoU that donors shall enter into contracts with ICTAD registered contractors and that the work should conform to ICTAD specifications, it is a questionable feature to note the inferior quality in reconstructed houses.

2.3.7 Lack of communication and coordination among stakeholders

While some house owners were eligible to receive donor driven reconstructed houses continued to live in temporary housing, those who were ineligible have been granted reconstructed houses. It was also noted that while some affected families who were entitled to be relocated under donor driven housing programmes have been assisted with rebuilding, others who were eligible to rebuild with grants under the owner driven housing programmes have been relocated.

There were difficulties in coordination with more than 200 organisations involved in reconstruction programmes all over the island. Signing MoUs at both national and district level led to several difficulties such as reconciling commitments and progress; NGOs were inconsistent in reporting progress and attending coordination meetings. Some information at national level was ambiguous and resulted in misinterpretations at district levels. Furthermore, frequent cancellations of coordination meetings caused many gaps in a continuous programme. This was evident by the oversupply of houses in the South with approximately 6,000 housing units. The NGOs emphasised that within the project team conflicts arose as different parties were involved with their own objectives in the process. In particular, some foreign elements possessed private agendas over the post Tsunami reconstruction programme of Sri Lanka.

2.3.8 Existence of hostilities

Due to the conflict/violence in the North and East provinces, gaps have occurred in both categories of reconstruction programmes. From distributing subsidies to completion of permanent shelters, gaps have occurred at certain phases of the reconstruction process. According to NGOs, difficulty in access, refusal to allow construction companies to function, inadequate facilities for NGO staff and labourers, restrictions on transportation of building materials are the main reasons for the gaps. Time and money have both been wasted due to repetition of construction works from the damages occurred during the civil war. Worldvision, a NGO, emphasised that after building about 40 foundations for a relocation housing site in Sampoor, they were moved due to security reasons and restarted the construction works. Both time and money had been wasted due to inaccessibility.

2.4 Conclusions

The success of the post Tsunami recovery largely depends on the success of housing reconstruction programmes. The family is the basic unit of society and needs to recover well before moving to develop a country. The findings of the survey revealed that for various reasons the post Tsunami housing reconstruction processes in Sri Lanka has been prolonged. The smooth flow of the construction process was disturbed by certain gaps that occurred throughout the reconstruction programme.

Relocation housing programmes were delayed mainly due to unavailability of appropriate land to build large scale housing schemes, unavailability of clear beneficiary lists for consultation, unwillingness of beneficiaries to be relocated, inadequate provision of infrastructure by government and finally by the unavailability of good construction companies. Donors were unable to complete the number of units pledged due to challenges of the construction industry, complexity of work, high inflation, raw material and labour rates etc. After relaxation of the buffer zone some families preferred to return to their own lands even though they were provided with houses built under donor driven housing programmes. Some donor driven houses are unoccupied still, due to this. The absence of a technical quality control system in the donor driven housing programmes is another major issue. It resulted in inferior quality houses being built and funded by donors. Some of those houses were demolished and reconstructed, wasting both time and money.

Owner driven housing reconstruction programme was affected with gaps mainly due to insufficient grants. Particularly in phase I, house owners were provided with a maximum grant of Rs. 250,000 to reconstruct their homes. It was not sufficient due to high inflation and increasing prices of construction material, labour and professional charges etc. To overcome this, the government changed the way of granting funds at phase III. However, there were still a lot of equity issues. The absence of the government in handling top up grants is the reason behind this. In some instances the beneficiaries mis-spent grants on alcohol etc.

In addition, all reconstruction programmes were affected by inadequate technical capability and unclear delegation of responsibilities among divisional, district and central government agencies and a lack of coordination among the community and various other parties such as affected/non-affected communities, INGO, NGOs, private sector, and donors. Enforcement of the buffer zone delayed the housing reconstruction programme for about six months. Due to lack of construction activities, some donors left Sri Lanka and missed out on a considerable amount of grants which now delay the latter stage of the reconstruction programme. In the first phase, community based reconstruction is not allowed and some donors and communities who started the construction works face problems there. The declining security situation is the main reason for the slow progress of housing reconstruction in the North and East provinces.

The absence of a government entity to control grants has caused equity issues all over the country. The government, in the leader role in the reconstruction programme has to be more concerned regarding involvement in reconstruction programmes in depth. Due to the absence of

any programme regarding this, there are no records regarding top up grants and it is difficult to manage as a result. Furthermore, the absence of clear records about how much the reconstruction programme costs to the country is a point where considerations have to be paid.

A huge amount of money, from foreign countries/local donors, was mis-spent due to inefficiency of the government to handle a reconstruction programme. Hence, the opportunity given by the Tsunami to develop the country has not been optimised. The number of completed houses is the only measure which can be used to measure progress or success of a post disaster housing reconstruction programme. Post disaster housing reconstruction programmes have to be more humanitarian than other developments. The ultimate goal of post disaster reconstruction processes shall be to attain a standard of living that is even better than what existed before the disaster. As a large scale disaster, the Tsunami is a completely new experience to Sri Lanka. Therefore, conducting a 100% successful housing reconstruction programme cannot be expected. In the present context, shortcomings in the post Tsunami housing reconstruction process have accepted by government authorities and other responsible authorities to a certain extent. However each person involved in the post disaster reconstruction process has to acknowledge their responsibilities, and their capacity to achieve the goal of reconstruction in moving to a development goal for the country.

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3. Capacity of the Construction Industry in Post Disaster Reconstruction

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Abstract

Natural and man-made disasters have caused increasing loss to human life and damage to property 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 housing sector damaged significantly compared to other sectors. The need for managing disasters through the construction industry has gained importance in recent years. The construction industry has a much broader role to play in order to obtain the successful implementation of reconstruction and the capacity of the construction industry is therefore a critical issue. Capacity building and construction industry development are becoming inevitably linked in successfully managing disasters. The Sri Lankan construction industry did not possess the required finance, human resource management, etc for the accelerated tsunami reconstruction work. The purpose of this study is to explore the capacity of the construction industry in post disaster housing reconstruction.

This study was undertaken through systematically reviewing the literature on capacity and the principles of reconstruction. The data collection mode used for the study was a questionnaire survey and documents survey, with data collected from contracting organisations involved in post disaster housing reconstruction. Findings of the research reveal that, contractors give importance to human resource, finance and management capacity elements of capacity building. The contractor financing base reduced to a considerably smaller proportion in response to reconstruction circumstances. Capacity in terms of contractor's organisational capacity was also explored. Credit facility of the contractors shows an increase in the last three years. Main challenges they face in the successful implementation of the reconstruction are; non availability of labour and materials. Significant remedies to overcome such challenges are the planning of material requisition and the pre-demand for construction workers.

3.1 Background

Disasters, both natural and human-caused, have been occurring with increasing frequency and effect in recent decades in many countries around the world. They have had a disproportionately heavy toll on developing countries both in terms of loss of lives and damage to property [1]. More concerns have been given to the area of disasters and it is becoming a main area of research, due to its impact on human lives and assets.

According to Dilley et al [2], "Earthquakes, floods, drought, and other natural hazards continue to cause tens of thousands of deaths, hundreds of thousands of injuries, and billions of dollars in economic losses each year around the world". EM-DAT, a global disaster database maintained by the Centre for Research on the Epidemiology of Disasters [3] in Brussels, records upwards of 600 disasters globally each year. It continues that disaster frequency appears to be increasing. Disasters represent a major source of risk for the poor and wipe out development gains and accumulated wealth in developing countries.

Sri Lanka is prone to natural disasters commonly caused by floods, cyclones, landslides, droughts and coastal erosion for generations with increasing losses to life and property in the past few decades [4]. He further indicates that the devastation caused by tsunami in 2004, however, took Sri Lanka by surprise warning that Sri Lanka is also vulnerable to low-frequency high impact events with extensive damage. The devastation, according to Sisira et al [5], the earthquake that caused the tsunami on 26th December occurred at 6.58am Sri Lanka time with the large wave hitting the east coast at 8.35am. Within a very short time over 36,000 people were dead and several hundred thousand had been displaced. In addition, massive damage had been inflicted on thousands of houses and other buildings, railways, bridges, community networks and other infrastructure and capital assets. From this, the magnitude and significance of the impacts of the tsunami in 2004 is very clear.

Considering the progress of the housing sector it is stated that in the IUCN 2005a [6] that the construction of semi-permanent and permanent homes began at government-designated resettlement sites located outside of the buffer zone. However, reconstruction was unevenly distributed and paced throughout the country. Even though several initiatives were taken by the governments in the past to reduce these damages they were mostly reactive actions rather than proactive to minimise the cause of the disasters.

It is further stated in the ADB's Report 2005 [7] that the national construction industry does not have the necessary contractors, equipment, skilled workforce, modern management practices or access to finance required to speed tsunami reconstruction work. Inflation of construction materials is also a problem. Further challenges include procurement delays, environmental safeguards, security in un-cleared areas and capacity constraints. Capacity building is the critical element of the recovery and reconstruction process [7].

It is evident from above that the construction industry must be developed in terms of their capacity. It is necessary to provide the construction industry with the requisite capacity and capability [1], so that the Sri Lankan construction industry is able to carry out the required reconstruction, especially in the housing sector, with proper concerns about capacity development.

One of the major factors which causes delays in successful housing reconstruction is capacity of the construction industry. Therefore the aim of this study is to explore the organisational capacity of the contractors in post disaster housing reconstruction and to investigate remedies to help face the challenges in successfully implementing the reconstruction. The objectives to achieve this aim are; to recognise the concept of capacity and capacity building, to identify the important elements of capacity building in housing reconstruction, to explore the demand created by the tsunami and the current status of the housing reconstruction, to explore the organisational capacity within contracting organisations and to identify the challenges and remedies in successfully implementing the housing reconstruction.

3.2 Research Methodology

The research methodology started with identifying the research question from the literature survey. The literature review was done on the research subject area to understand the basic concepts in capacity and reconstruction. The collected literature was used to achieve some objectives and to identify the factors for capacity building elements, organisational capacity, challenges and remedies in successful housing reconstruction. The literature shows that there is no academic work that examines the current situation of capacity of the Sri Lankan construction industry, in relation to natural or man-made disaster reconstruction.

This study, for the purpose of data collection set its boundaries within the context of the contractors to the construction industry. So that the 'unit of analysis' selected for this study is 'contracting organisations' in the Sri Lankan construction industry. In this research 30 contractors involved in housing reconstruction in the Colombo region were contacted to explore their capacity. Their ICTAD grading ranged from M1-M6. The research design revealed the demand for primary as well as secondary data. For this purpose a questionnaire and document survey was used. Data or information collection mainly dealt with the type of data and the appropriate data collecting techniques employed for the study.

The purpose of the analysis was to provide evidence of relationships and to aid the understanding of the objectives. The structured questionnaire was prepared from the literature synthesis and it comprised a checklist and Likert scale rating. After the data had been checked and entered, the next step was to display them for exploratory data analysis, by way of tables, bar charts, etc. The Relative Importance Index (RII) and Frequency Analysis were used as the analysis techniques. The contractor's capacity was considered for the construction industry's capacity and housing was considered for the reconstruction process. The research was limited to the contractors who worked in the Colombo region only.

3.3 Literature Synthesis

3.3.1 Housing reconstruction in post disaster

The Center for Research on the Epidemiology of Disasters [8] in Brussels, Belgium, uses the following definition for disaster, "a disaster is a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance". According to Songer [9] disasters are commonly categorised by their origin; natural or man-made. Most disasters investigated in the literature are natural disasters. He further follows that disasters may occur suddenly in time (a quick onset) or they may develop over a period of time (a slow onset). Most occur suddenly and perhaps unexpectedly. However, some events develop gradually, including some floods and famines related to drought. There are many factors that contribute to the vulnerability of communities and societies to the impacts of hazards. CERO [10] lists the causes of disasters as poverty, population growth, rapid urbanization, lack of public awareness and information, changes in cultural practices, environmental degradation, war and civil strife.

The aftermath of the disaster should be given much consideration in terms of development. Shanmugaratnam [11] states a post-disaster situation can be seen as one of new opportunities for reconciliation, investment and growth, sustainable resource utilisation, human capital formation, employment generation and human development. Therefore proper planning should be made in order to obtain maximum benefits. International and consequently national capacities for coordination, funding and implementation of post-disaster activities 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 [12]. Further it continues to state that reconstruction is a high-cost and long-term commitment per capita, required after the disaster.

Disaster management is a new and innovative method for preparing companies and organisations to address the substantial risk of disasters in the workplace [13]. Disaster management aims to reduce or avoid the potential losses from hazards, to assure prompt and appropriate assistance to victims of disaster, and to achieve rapid and effective recovery [14]. According to the Asian Disaster Reduction Centre [15] the disaster risk management cycle, consists of four phases: prevention/mitigation and preparedness in the pre-disaster stage, and response and rehabilitation/reconstruction in post-disaster stage.

Jayawardane [4] indicates that natural disasters in Sri Lanka are commonly caused by flood, cyclone, landslide, drought and coastal erosion. The author further argues that the devastation caused by Indian Ocean tsunami in 2004, however, took Sri Lanka by surprise warning that Sri Lanka is also vulnerable to low-frequency high impact events with extensive damage.

According to the ADB's report in 2005 [7], it was estimated that Sri Lanka had 9.6 million building units of which 4.6 million or 48% were used as dwellings. 1.12 million building units (around 12% of all building units in the country) are located in administrative divisions along the Sri Lankan coast and were affected by the tsunami. A damage overview and recovery need was produced by the ADB 2005 [7]; the tsunami surge completely destroyed around 99,480 homes and partially damaged about 44,290 others. The completely and partially damaged houses together comprise 13% of the housing stock in the administrative divisions along the coast. The net replacement cost for housing is estimated between LKR 46 to 51 billion (\$437 million to \$487 million). Since most of the affected housing stock was built over a long time period, its replacement value was depreciated by 30% to determine the damage estimate, which is in the order of LKR 32 to 36 billion (\$306 million to \$344 million) [7].

Demand for housing reconstruction was immense following the tsunami devastation. The following statistics demonstrate the demand created by the tsunami and the current status of the housing reconstruction. From the RADA report [16], the number of temporary shelters after the tsunami struck as at 31st December.2005 was 57,057 and by 31st December.2007 this figure was reduced by 77.78% to 12,682 temporary shelters. The original count after the tsunami struck was 98,525 and the revised count was 116,135. 78.10% of permanent homes have been completed up to August 2007 and 22.08% of the homes are in progress according to the revised count. Of the permanent houses completed 19.82 % are donor driven and 77.79% are owner

driven houses. 28.14% of the houses were owner driven and 70.68% were donor driven in houses that are in progress.

In considering the housing reconstruction, Southern province has the completion percentage of 105.87% and western province has 17.65%. In the North Western province it has reached the 100% and in the Eastern and Northern provinces completion percentages have reached 80.02% and 36.71% respectively. There are still some outstanding works to be carried out in the reconstruction of housing. The government of Sri Lanka expects the outstanding works to be completed by the end of this year.

From the above data it is evident that the progress of the housing reconstruction is not within the stipulated time framework. Despite the many reasons that hindered the planned progress of housing reconstruction, the capacity of the construction industry remains as issue. Since the Sri Lankan construction industry lacks capacity to fulfil the requirement due to a disaster, it is very important to make sure the contracting organisations have the capacity to face any kind of challenges in relation to issues relating to natural or man-made disasters. The need for understanding of the construction industry's capacity to carry out reconstruction and to predict the performance of future disasters is becoming inevitable. Therefore consideration must be given to the capacity of the construction industry in detail.

3.3.2 Capacity of the construction industry

In considering the capacity of the construction industry, a lot of attention has to be given to organisational capacity, since most of the stakeholders in the industry are with the organisation. In simple terms, the organisations capacity is its potential to perform, its ability to successfully apply its skills and resources to accomplish its goals, and to satisfy its stake holder's expectations [17]. The aim of capacity development is to improve the potential performance of the organisation as reflected in its resources and its management.

Therefore, to improve the capacity of any organisation there should be capacity building activities. The meaning of capacity building varies depending on the context where it is being used. According to the International Development Research Centre [18] in referring to the framework for organisational assessment, organisational performance, organisational capacity, external operating environment, and internal environment are the main elements. Organisational performance refers to the ability of an organisation to meet its goals and achieve its mission. Organisational capacity refers to the resources, knowledge, and processes it employs. The external operating environment refers to the external environment in which the organisation carries out its activities. The internal environment refers to internal factors that influence the direction of the organisation and the energy displayed in its activities.

Ofori [1] indicates that it is necessary to provide the construction industry with the requisite capacity and capability. He further states that in particular, the construction industries in developing countries need to be equipped for these purposes, given the apparent differential frequency and severity of various types of disasters. This can only be achieved through

deliberate, planned, strategic and systematic efforts. Furthermore the author states that firstly, human resource development should equip construction professionals with the knowledge and skills required to undertake appropriate designs and construction. Secondly, a programme of materials development should be instituted in each region to find high-performing (disaster-resistant) materials that are suited to the local context and are of good quality, durability and affordability. Thirdly, it is necessary to put measures in place in pursuit of the technological development of the industry to ensure that it has the capability to handle the various projects that will be required to provide protection against disasters, and those that the post disaster reconstruction process will involve.

Due to the high demand created by the tsunami, in order to cope with the planned progress the contractors must increase their capacity. When they must increase their capacity in quantity and speed, more experienced and skilled resources are required to actually manage the projects. In addition to construction expertise, possibly large-scale, basic project management experience was also essential. For both of these skill-sets, smaller developing countries may not have people with this large-scale time-critical management experience, and ex-patriots with these skills frequently do not have the experience to understand the environment adequately. Rex 2006, as cited Haigh et al [19].

According to Haigh et al [19], there is growing recognition that the construction industry has a much broader role to anticipate, assess, prevent, prepare, respond and recover from disruptive challenges.

3.4 Key Findings

3.4.1 Important elements of capacity building in housing reconstruction

The main identified capacity buildings elements of organisations taken from the literature review are management systems, financial, human resource, information systems and marketing. The respondents then ranked the importance of each of these elements to their organisation in carrying out the housing reconstruction.

All the elements of capacity building were ranked using RII (Relative Important Index). According to RII calculated from the survey results, the human resources ranked first (RII - 75%). It is evident therefore that human resources, especially labour, is important as a capacity building element in post disaster housing reconstruction.

The financial system was ranked the second (RII – 73%) mostly needed element in the capacity building in post disaster housing reconstruction. The respondents believed that it is important because it decides how much they can commit to any reconstruction work. The donors and government agencies were also looking into these issues because other factors such as experience would not be relevant in this case due to the fact that housing construction on this large scale was very new to everyone.

Furthermore, respondents believed that management was important in order to carry out disaster housing work without any disruptions to the housing reconstruction, which was one of the main causes of backlogs in housing reconstruction in Sri Lanka. This was ranked third (RII - with 72%). The other elements of capacity building such as information systems, marketing, etc. were ranked relatively low by the contractors involved in housing reconstruction activity.

3.4.2 Exploration of the current capacity of the contracting organisations

Exploration of current capacity of the contractors was focused through organisational capacity. Organisational capacity was considered in terms of financial management systems, financial stability, diverse and sustainable funding, management and staffing capacity, internal performance analysis and finally customer service orientation. In addition to these, the credit facility of the contractors was considered for the years after the tsunami struck (2005-2007).

Financial management system

A well-functioning financial management system puts internal policies and practices in place for a contractor to monitor and maintain its financial health and to help ensure its long-term sustainability. 90% of the contractors have stated that they conduct yearly or bi-annual audits. Conducting an audit represents good business practice for the contractors. It assesses whether the financial reports of the contractor are presented fairly and whether the contractor has complied with applicable laws and regulations. 76% stated that they received the qualified opinion on its audit. 70% indicated that they have no substantial concerns with the internal controls. Internal controls are an organisation's accounting and other fiscal control policies and procedures that seek to minimise the likelihood that assets are misused or accounts are misstated. These must be the result of good management practices among the contracting organisations in order to keep up their grades and perform well to achieve their objectives.

Financial stability

Financial stability refers to an organisation's ability to manage the flow of funds in to and out of the organisation, and its ability to deal with a short-term cash shortfall. A contractor's total annual budget serves as an indicator of its general size, and perhaps the scope of its works and the size of its client base. About 65% of the contractors have a total annual budget of over 20 million Rupees. 90% of the contractors indicated that they have a reserve of funds or ready access to cash. Well-managed organisations maintain a line (or lines) of credit or at least some access to cash in case they experience a short-term shortfall or otherwise need access to cash quickly. 14% of the respondents stated that they have delayed payments and 14% stated they have cancelled contracts in particular circumstances. In considering the types of clients they treat, since one contractor serves many types of clients, 54% are residential clients, 62% are government clients, 46% are industrial clients, and 53% are commercial clients. It shows the client's base is on average flexible and the contractor can expand in a reasonable manner to take advantage of opportunities for growth in the market, while not over extending itself.

Diverse and sustainable funding

97% of the contractors have indicated that they plan to grow the business in the future as all of them are profit oriented in the stream of contracting business. However, growth that occurs too quickly or without forethought can actually hinder sustainability if a contractor's revenues cannot keep up with its increase in staffing and other expenses. 66% of contractors' finance base has increased from 0-15% in response to reconstruction circumstances and 20% of the contractors' funding base increased above 20%. Since all of the contractors are involved in housing reconstruction then reconstruction work became part of their business - although only a smaller proportion.

Credit facility

The credit facility of the contractor was calculated by adding the total credit facility of each contractor type in the years of 2005, 2006 and 2007. Then the percentage change in the years 2005-2006 and 2006-2007 was calculated. The weighted average was used to get the final credit facility changes in the sample size with the different number of contractors in each type. The final credit facility on the contractor graph shows the increase in the year 2005-2006 and 2006-2007. The percentage increase in the year 2005-2006 was higher than the year 2006-2007. This may be due to the fact that the tsunami housing reconstruction activities were higher in 2006 compared to 2005 and 2007.

Management and staffing capacity

The leadership and staffing of any organisation is critical to its ability to provide high quality and reliable construction work for its clients. 26% of the staff have 0-20% of the sufficiently relevant educational experience in relation to the construction industry and 46% of the staff have 40-60% of sufficiently relevant educational experience. These results occur because most of the local construction industry do not employ highly educated staff. However, 53% of the staff have been well trained according to the contractor's general approach. This is because the most of the contractors do not provide a standard training system or there are no proper rules and regulations governing the training for the staff. Capacity building is needed in these areas to train existing staff.

Internal performance analysis

Any organisation that is interested in maintaining and improving its organisational capacity should conduct regular and thorough analyses of its work and how it could improve its service delivery, as well as its overall results. 17% of organisations stated they assess and review their own performance monthly, 33% stated they do so quarterly, 40% stated that they do so annually and 10% stated that they neither assess nor review performance. Most of the contractors review their performance in order to find whether they are in line with their objectives and for good organisational practices. 83% have stated that they do solicit information from clients to

determine their satisfaction. The majority of the contractors solicit information because it leads the contractor to review of performance and the proper functioning of their business.

Customer service orientation

Contractors will work closely with the staff, potentially over a long period of time. Customer service is of particular importance and 55% stated that they do provide adequate and appropriate customer service resources. It is at an average level and most contractors do not offer client service orientation except the big contracting organisations. 52% have indicated that resources are readily available to the client and their staff. Customer service is around the average and indicates the need for development in order to provide a satisfactory service orientation.

3.4.3 Challenges and remedies in successfully implementing housing reconstruction

Challenges in successfully implementing housing reconstruction were identified in the literature synthesis and given to contractors in the form of a questionnaire with the 5-scale Likert scale rating. The RII was calculated to each challenge and then ranked. The same procedure was done for all remedies to overcome the challenges in the post disaster housing reconstruction.

It is very evident that the contractors have suffered during the housing reconstruction by the non-availability of labour and materials. Availability of labour was the biggest challenge with the RII of 86%. The availability of materials was the second biggest issue with the RII of 83%. These two problems were at the forefront compared to the other challenges they faced in the housing reconstruction. This is due to the high demand for materials and labour aftermath of the tsunami. The devastation led the country to provide more than 100,000 houses in a fraction of the normal time. It caused a very high demand for materials and labour. The effect also indirectly affected the wages for labourers.

The third issue they face mainly is project management with the RII of 79%. This was due to the fact that the availability of the labour and materials caused a delaying effect on project management. Other factors such as insurance processing, poor IT infrastructure, were lowest in the contractor's priority. This is because the Sri Lankan construction industry is not as developed compared to other developed countries. The poor IT infrastructure and insurance processing were not considered by the contractors a high priority since most of the contractors were small in size, compared with the challenges for them.

In considering the remedies to the challenges, according to RII calculated from the survey results, the Planning of Materials Requisition was ranked first (RII - 81%). Therefore, the majority of the respondents stated that the planning of materials requisition is important in post disaster housing reconstruction to overcome the challenges. This was due to the biggest issue of non-availability of materials. The pre-demand for construction workers was ranked second (RII - 75%) as this was mostly needed in overcoming the challenge in post disaster housing

reconstruction. This was due to the higher demand situation that existed for the labourers after the tsunami.

Furthermore, the respondents believed that proper co-ordination is important in order to carry out the disaster housing without disruption to the housing reconstruction, which was one of the main backlogs in housing reconstruction in Sri Lanka. This was ranked third in the RII, with 70%. Other factors such as better cost planning and control, earlier assessment of the impacts of disaster elements and other factors came relatively low in prioritising the factors which could be used to overcome the challenges, by the contractors involved in housing reconstruction activity.

3.5 Conclusion

According to the results, it can be concluded that most of the contractors have become involved in the tsunami housing reconstruction work compared to other disasters. This may be due to the magnitude and significance of damage caused by the tsunami devastation in Sri Lanka.

The capacity of the construction industry was not in a position to cater for the demand created by the tsunami. From the results of the document survey, the demand was not met by the existing capacity of the construction industry within the stipulated time to complete the all houses. The comprehensive literature review further reinforces this conclusion. The capacity building element for an organisation is important in considering its future development. From the contractor's perspective, human resources, finance and management are considered to be the most important elements in capacity building in housing reconstruction.

Financial management systems of the contractors are well above the average and show that good capacity levels and financial stability of the contractors is also above average. Diverse and sustainable finance of the contractors showed to be above the average level. This shows that the financing capacity is also above average. Management and staffing capacity is below average and shows the need for development of capacity. Most of the contractors do review their internal performance and that is above average. Client satisfaction orientation is below the average level and shows the avenues for improvement in the capacity in terms of organisation.

Credit facility of the contractor's shows the increasing nature following the years after the tsunami. This shows the contractors ability, in the housing reconstruction after the tsunami, in financial terms. Among the many challenges faced by contractors in successfully implementing the housing reconstruction, the availability of labour and materials are the main factors which hinder the planned progress. Planning of material requisition and the pre-demand for construction workers, were prioritised by the contractors, to overcome the challenges in the housing reconstruction.

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4. Skilled Workforce in Sri Lankan Construction Industry: Production vs. Acceptance

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Abstract

The quality of the workforce is one of the major determinants of organisational success, which ultimately leads to competitive advantage. As a predominantly labour intensive industry, the construction sector obtains huge benefits from the skilled workers. In this regard, effective training programmes are of paramount importance to enhance the skill levels of workers. This research was undertaken to unearth the answer to the research question of “how the skilled labour production could gain acceptance in the Sri Lankan construction industry”. Desk research was carried out to find training courses available for the construction trades. Accordingly various training programmes, for different trades, were identified which were conducted by five key training institutes, viz. ICTAD, NAITA, DTET, VTA and CCI. A questionnaire survey was conducted among 77 recruitment officers in medium to large size contracting firms and 34 subcontractors - in six distinct trades. The findings suggested that when recruiting workers who belong to trades such as plumbing and electrical, the contractors gave extra concern to their training qualifications. However, when it came to trades such as masonry, carpentry, bar bending and painting the contractors’ consideration to training qualification was at a lower level. The study further revealed that HR managers were more knowledgeable about training institutes than the Site Engineers or the PMs.

4.1 Background

4.1.1 Skilled workforce

In the contracting organisation it is evident that there are groups of people who have special skills that are essential for the construction process. One of the groups that were discussed less often than others is the skilled workforce or tradesmen. They are crucial, because without them the architect’s concepts and engineer’s designs would not become a reality. According to 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”. Skilled trades’ workers have always been a benefit to a local economy. They are instrumental in turning materials into useful items. Their training, expertise and experience have helped craft products and build industries [2]. At the construction phase, the performance of the skilled workforce is one of critical factors in the success of any construction project. In 2003, it was estimated that direct labour engaged in the construction industry was around 330,000 while the total labour force of all industries was 6.9 million. The contribution to Sri Lanka’s Gross Domestic Product by the construction industry sector was 6.97% [2].

According to Gunawardane and Jayawardena [4] the Sri Lankan construction industry is dominated by unskilled workers and has only six traditional skills as shown in the Figure 4-1. In addition they further stated that Sri Lankan workers are “all rounders” within their broad field. For example, masons very often do all work related their trade such as brick laying, concreting,

plumbing, plastering, tiling, scaffolding and even bar bending. When it comes to carpenters, they often erect formwork and false work, fabricate door and window frames, fit glazing and so forth. These practices are common in building projects.

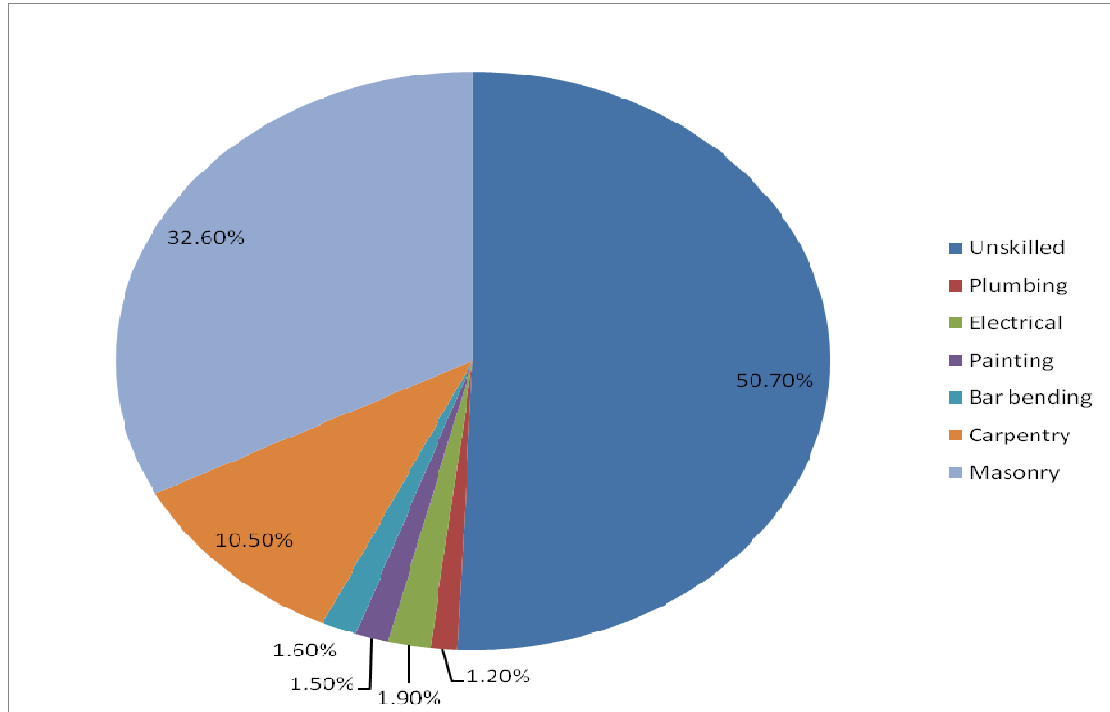


Figure 4-1 - Occupational Structure of Sri Lankan construction trades

Construction is a labour intensive industry that places heavy reliance upon the skills of its workforce [3]. Paucity of the skilled workforce results in poor quality, high wastage and long-term productivity decline in the industry [4]. According to Dainty et al. [5] insufficiency of skilled workers in the industry can generate poor work quality and delays in project completion times and it leads general contracting firms to restrict their ambitions for growth, despite the buoyant nature of the construction industry. Therefore it is evident that the recruitment of skilled construction workers emerged as one of the key concerns of the contractors. Although a skilled workforce offers several benefits there is no standard method for determining the skill level in construction at the recruitment stage. Agapiou et al. [3] highlighted the contractor’s recruitment criteria vary from one to another and it depends on local labour supply factors in construction.

4.1.2 Training of workers

Since, training provides an indication of the skill level of the workforce [6] some employers consider qualifications acquired from undergoing a formal training course as the basis for the recruitment of workers. Therefore training is of vital importance for any type of employment. In literature, it has defined “employee training” in a variety of ways. Amongst these, following Wickramasinghe [7] is one of the most commonly cited definitions related to human resource

management. According to them, “training is a process of updating the knowledge, developing skills, bringing about attitudinal and behavioural changes and improving the ability of the trainee to perform his or her tasks efficiently and effectively”. It demonstrates that training can enhance the worker’s skills and ability and improve their career options. In addition, training can change the attitude and behaviour of the trainee. Therefore it is evident that, “employee training” has been and is being widely used to denote updating of skills, knowledge, attitudes or behavioural patterns of the employee. It means changing what employees know, how they work, their attitudes towards their work or their interaction with co-workers or supervisors. To the extent that the construction industry is concerned the above scenario can be similarly applied for a workforce in contracting organisations. In recent years a number of training institutes have been established, for skilled workers in Sri Lanka, which provide training of varying quality at different levels and awards standard qualifications/certificates such as the National Trade Test (NTT) equivalent to National Vocational Qualification system (NVQ) in the United Kingdom.

4.1.3 Recruitment of workforce

Vacancies in organisations generally come up because of the departure of existing workers, which is called ‘labour turnover’. Additionally, it might arise because a new position has been created. In such occasions the organisation has to make a strategic decision regarding how it will build its workforce. Accordingly effective recruitment is essential for the successful functioning of an organisation. Recruitment is a process to discover the sources of manpower to meet the requirements of the staffing schedule and to employ effective measures for attracting that manpower in adequate numbers to facilitate effective selection of an efficient workforce” [8]. Successful recruitment depends upon finding people with the necessary skills, expertise and qualifications to deliver organisational objectives and who have the ability to make a positive contribution to the values and aims of the organisation. This scenario can be similarly applicable for the recruitment of a skilled workforce for contracting firms also. According to literature there are criteria such as experience, work history, formal qualifications, attitude, task flexibility which are normally adopted by the employers in the recruitment of a skilled workforce in construction industry.

Dainty et al. [5] stated that in the United Kingdom most of construction organisations recruit workers who had not completed their qualifications. Few firms recruit workers who had progressed on to advanced apprenticeships and higher-level National Vocational Qualifications. They further revealed that contractors think modern apprenticeships and the qualifications systems that underpinned them did not produce the quality of skilled worker’s experienced. According to Gunawardena and Jayawardena [4] most of the contractors and clients in Sri Lanka do not demand workers have trade tested qualifications or National Vocational Qualifications for employment. In addition, most of the skilled workers do not possess formal qualifications and have gained their skills experientially. The CCI Bulletin stated that the majority of Sri Lankan contractors adopt their own criteria for the recruitment of the skilled workforce, such as one year of experience. It was further stated that the contractors who follows carefully conceived recruitment practices are in a difficult position when they consider which certificate to accept and which one complies with industry requirements. Therefore by looking

at these issues, it is evident that the skills gained through undergoing training programmes is not the major concern when determining the skill level of the workers in both the foreign and Sri Lankan context. If the skills gained from training programmes are not treated on their merits, by contractors, then a huge amount of money and time which is spent on this will be wasted. This put the workers in an ambiguous situation as they did not have a proper idea of what was more important in order to cater for the demands of the construction labour market [9].

Although various research was been carried out on the subject of training, only a limited number of these have focused on construction. Out of these, only a few have been conducted in the Sri Lankan context and none of these have addressed the issue of “how the skilled labour production is catering for acceptance.” Thus, this research intended to fill the research gap by studying skilled workforce production and acceptance in the Sri Lankan construction industry.

4.2 Method of Study

Desk research was carried out to collect secondary data regarding training programmes that exist for construction workers in Sri Lanka. A survey approach was adopted for the primary data collection. A sample of contractors was selected based on probability stratified sampling technique. Questionnaires were presented to 77 Recruitment Officers (Project Managers or 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. To establish the most typical values for the group of data obtained by questionnaire survey, statistics called minimum, first quartile, median or second quartile, and third quartile or maximum were used.

4.3 Research Findings

4.3.1 Skilled workforce production

In Sri Lanka the training of construction industry craftsmen is mainly carried out by a series of training institutions, which belong to the public and private sector [10]. The public sector training institutions are the Vocational Training Authority (VTA), National Apprentice and Industrial Training Authority (NAITA), Department of Technical Education and Training (DTET), and the Institute of Construction Training and Development (ICTAD). In addition, there are a few private sector training institutions such as the Chamber of Construction Industry Sri Lanka (CCI), Jayalath Construction, etc. They have larger number of trainers involved in specific training. These institutions have their own curriculum prepared for six to eighteen month training courses. The

Table 4-1 illustrates the training programmes that are conducted by key training institutes in Sri Lanka, at present for different trade workers.

Table 4-1- Training programmes for construction workers in different trades

Key Training institutes	Courses Conducted					
	Masonry	Carpentry	Bar Bending	Painting	Electrical	Plumbing
ICTAD	√		√	√	√	√
NAITA	√	√		√	√	√
DTET	√	√		√	√	√
VTA	√	√	√	√	√	√
CCI	√	√				

In addition it was revealed that there are two schemes for establishing the skill levels of construction workers, by training institutes in Sri Lanka.

National Trade Test (NTT)

This is a programme to trade test and issue a “certificate of proficiency” to those who possess relevant skills. Informally trained practicing craftsmen mostly use this scheme to obtain a recognised certificate to improve their local and foreign employment opportunities. At present there are three levels of certificates namely grade III, grade II and grade I which means semi - skilled, skilled and highly skilled levels respectively. In Sri Lanka, NTT is carried out by the National Apprentice and Industrial Training Authority (NAITA).

National Vocational Qualifications system (NVQ)

National Vocational Qualifications are designed to measure the competency of different vocational skills. The intention of having NVQ is to produce a Sri Lankan workforce that is globally competitive, through a standardised technical and vocational education system. The main objectives of setting up the NVQ are to recognise vocational skills locally and internationally, match and cater vocational training or skills with market demand, recognise the certificates possessed through the NVQ system and to create an internationally competitive workforce in Sri Lanka.

The National Vocational Qualifications Framework of Sri Lanka (NVQSL) has been established to support the efforts of fulfilling above objectives of NVQ.

National Vocational Qualifications framework of Sri Lanka (NVQSL)

National Vocational Qualification (NVQ) framework makes provision for a nationally consistent skills development relevant to economic and social development and is of an international standard. The National Vocational Qualifications (NVQ) of Sri Lanka is based on the national skills standard identified by the industry stakeholders. The skill standards include relevant core and generic skills. Recognition of the skills of Sri Lankan workers is important to

fulfil the requirements of National Policy for Human Resources Development. The Skill Development Project (SDP) has joined with the Government (TVEC) to resolve problems of mismatching training programmes with current market demand, duplication of training provided by institutions and non-availability of a unified standards.

The NVQSL is therefore supporting the sustainable and strategic solutions to national training needs. As such the NVQSL is now able to achieve international recognition for qualifications of skills set up by the system and certificates offered by the institutes. Competency Based Training (CBT) curricula and appropriate training, learning and assessment materials are included in the framework. The system awards qualifications at seven levels as given below. Each level describes the process, learning demand and the responsibility applicable to each level of performance.

Table 4-2 - National Vocational Qualification Levels

Level No.	Qualification	Description
Level 1	National certificate	Level 1 recognises the acquisition of core or entry level skills.
Level 2 Level 3 Level 4	National certificate	Levels 2, 3, 4 recognise increasing levels of competencies. Level 4 qualification provides for full national craftsmanship.
Level 5 Level 6	Diploma	Level 5 and 6 recognise the increasing levels of competencies ranging from technician level to management level.
Level 7	Bachelors degree or equivalent	This level includes planning, resourcing, management processes.

4.3.2 Skilled workforce acceptance

Contractors' awareness of training institutes in Sri Lanka

The results of the questionnaire survey revealed that the majority of medium size (M4 and M5) contractors' Site Engineers/PMs have substantial awareness of training institutes, rather than large size (M1, M2 and M3) contractors'. Thus it is obvious that medium size contractors recruit more workers with formal training qualifications on a project basis rather than large contractors. It was revealed that most of the large size contractors tend to sub-contract almost all of their work rather than by adopting their own labour force. As a result, Site Engineers or PMs who are recruiting workers on project basis may not be concerned about recruitment of skilled workers and they may not have much awareness regarding training institutes. Since medium size contractors have a higher tendency to perform in the industry by means of their own labourers especially on project basis, they were vigilant about recruitment of workers. As a result a larger proportion of Site Engineers/ PMs of medium size contractors have considerable awareness of training institutes for construction skill trades in Sri Lanka. When evaluating HR managers' awareness, large size contractors were advanced to medium size contractors. Hence, it is clear that large contractors are concerned more about a permanent workforce than medium contractors are. However, comparatively, HR managers have superior awareness than Site Engineers/PMs in both medium and contracting firms. It explains why HR managers who recruit permanent workers give more concern to awareness of training institutes with the

intention of recruiting a high quality workforce, with formal qualifications, than Site Engineers/ PMs who are recruiting project basis temporary workers. In case of subcontractors, it was revealed that electrical and plumbing trade subcontractors have supreme awareness of training places while bar bending and painting subcontractors were less aware of training institutes. Carpentry and masonry subcontractors have considerable awareness regarding all five key training institutes in Sri Lanka.

Contractors' correct awareness on key training institutes

Although contractors are aware of training institutes, it is imperative to test out whether their awareness is correct or not. It was determined through testing that the marked courses for particular trades used by contractors are really conducted in training institutes. Large size contractors' correct and incorrect knowledge was compared with the medium size contractors', subcontractors' knowledge and was compared trade wise. Accordingly even though the majority of medium size contractors' Site Engineers/PMs have substantial knowledge regarding training institutes compare to large size contractors, the large size contractors have more accurate knowledge than medium size ones. Results of the survey demonstrated that HR managers who are working in both large and medium size contracting firms have equal correct awareness regarding training institutes. Taking into consideration subcontractors situation it is evident that exclusive of bar bending and painting sub contractors all of remaining subcontractors were knowledgeable about training organisations.

Popularity of training institutes for different trades

According to responses, NAITA was identified as the most popular institutes among recruitment officers for trades like carpentry, electrical and plumbing; while ICTAD and DTET were popular institutes for masonry, bar bending and painting respectively. Although some contractors recognised VTA and CCI as training institutes for skilled trades in construction industry, they were not popular among all.

The results of the questionnaires presented for subcontractors revealed that NAITA was the most popular training institute for masonry trade among masonry subcontractors, while ICTAD, NAITA, DTET, VTA and CCI were popular equally among carpentry trades. VTA was identified by most of bar bending subcontractors as a training institute for their trade. Although there was no leading popular training institute identified for the painting trade ICTAD, DTET and VTA were evenly identified by painting specialists. In the electrical trade, some other training institute(s) were popular among particular subcontractors, however ICTAD, NAITA and DTET were similarly popular among electrical trades. In the case of plumbing, most of plumbers were familiar with other institute(s) and they have had similar awareness about ICTAD, NAITA, DTET and VTA.

Level of consideration of skilled worker's formal training qualifications at the recruitment Stage

By conducting the research it was possible to assess the extent to which contractors consider training qualification as a criteria at the recruitment stage of a construction worker. The results were categorised by trade such as masonry, carpentry, bar bending, painting, electrical and plumbing for ease of comparison.

Most recruitment officers of medium and large size contractors and subcontractors suggested that they sometimes consider training qualifications for the recruitment of masons. It implies they do not give much weighting for training at the recruitment stage. As to the reasons for that, the majority of recruitment officers revealed that for the masonry trade, formal training is not essential and there is a deficiency of trained fresh workers for the masonry trade due to the fact that it is a hard working and less reputable trade within the industry.

Considering the circumstances of three types of recruitment officers, it is evident that with the exception of carpentry subcontractors, the majority of Site Engineers/PMs and HR managers of both medium and large size contractors sometimes consider training qualifications for the recruitment of carpenter.

It was apparent that according to the recruitment officers' judgment, during bar bender recruitment they give less weighting to formal training qualifications and rarely considered it at all for permanent workers and project-based workers. The reason for that, they said was although appropriate training is important for bar benders' employment due to the nature of their work, there is a lack of qualified bar benders. They further revealed that bar benders should have ability to interpret drawings and undergoing a formal training course is necessary for that.

In the case of the painting trade, the largest proportion of recruitment officers of large and medium contractors and subcontractors gave some weighting for formal training requirements during both permanent and project-based painting worker selection. The majority of recruitment officers declared that painting is a trade, which does not need as much awareness and formal training for their workers and it is sufficient to have experience to carry out the task successfully.

Electrical trade results demonstrated that most HR managers of large size contractors always consider formal training for permanent electricians more than Site Engineers/PMs, while the contrary situation exists in medium size contracting firms. Taking into consideration the overall circumstances it can be concluded that most of recruitment officers state training is crucial for trades like electrical. This is because workers have to deal with technical works and the necessary technical awareness should be acquired through undergoing a formal training course rather than by trial and error.

According to the recruitment officers of large and medium size contractors, they often consider training requirements for plumbing trade while subcontractors only consider it occasionally. Their opinion was that formal training is needed for the plumbing trade because the skills required for performing tasks in the trade cannot be obtained through trial and error.

4.4 Conclusions

The prime aim of this research was to find out “how the skilled labour production has catered for acceptance in the Sri Lankan construction industry.”

The desk research revealed that there are number of training programmes available for construction workers in Sri Lanka, which are structured for various trades. Some organisations have widened their spectrum up to island wide training programmes that focused on both rural and urban youth; while others are limited only for urban trainees. Furthermore it was discovered that the selected five key organisations - ICTAD, NAITA, DTET, VTA 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 trade test and issue a “certificate of proficiency” at three levels to those who possess relevant skills. Informally trained practising craftsmen mostly use this scheme to obtain a recognised certificate. National Vocational Qualifications systems are designed to measure the competency of different vocational skills with the intention of producing globally competitive workforce in order to suit an industry specific, through a standardised technical and vocational education system.

The data analysis revealed that site engineers from medium size contractor organisations 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 who were in medium size ones. 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 knowledge of training institutes whereas bar bending and painting sub contractors were having a lesser amount of knowledge. With respect to the accurate of their information, it was disclosed that site engineers of large contracting firms have up to date information regarding training organisations while HR managers’ knowledge level was alike in both large and medium contracting firms. Nevertheless, site engineers are more aware than HR managers within both types of contracting firms. Considering sub contractors’ awareness, the study found that masonry, carpentry, plumbing and electrical sub contractors are 100% up to date regarding training institutes for construction skilled workers 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. The results show that masonry and bar bending sub contractors’ revealed that ICTAD is the most popular training institute among them and DTET was most popular amongst painting sub contractors. The study further discovered that the recruitment officers often consider formal training qualifications for electrical and plumbing trades while occasionally they consider it for masonry and carpentry trades. The empirical findings further disclosed that recruitment officers rarely gave consideration for formal training qualifications when recruiting workers in trades such as painting and bar bending.

Therefore, it can be concluded that most of Sri Lankan contractors and subcontractors are aware of available training institutes and courses for construction skilled trades. Another important finding of this study is that although contractors were asked to list formal qualifications of skilled workers that they recognised at the recruitment stage, no one was able to identify even one training qualification. Therefore, it is obvious that contractors are familiar with training courses rather than training qualifications. According to literature, the general presumption was of contractors' acceptance of formal training courses is not at 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 traditional boundaries and have undergone lesser improvements in terms of technology. The workers were therefore still capable of learning skills through trial and error.

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5. Construction Project Teams and Their Development: The Case in Sri Lanka

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Abstract

The construction industry is highly susceptible to the benefits from teams, as the construction products are delivered by a collection of diverse professionals. However, effective teams cannot be created at a stroke and they need time and opportunity to mature. This is normally referred to as team development and this area has been subjected to various research. However, there is a deficiency in published research on team development with regards to construction teams and none has been reported in Sri Lanka. Therefore, this study explored how construction project teams in Sri Lanka go through the team development process. This research problem was approached through case studies of three construction projects, which were operating under the traditional procurement method with re-measurement contracts. Semi-structured interviews were conducted with five distinct participants of construction teams during data collection. Based on the findings, a new model of team development with regards to Sri Lankan construction teams was developed. The new model indicates that construction teams progress basically in a linear sequence (forming-storming-norming-performing-adjourning) as suggested in the literature. However, the study unearthed that within this basic linear sequence, several cycles can be created due to the conflicts that may occur when the team is at performing level. The results further revealed that construction teams in Sri Lanka were lacking in mutual accountability and with formal attempts to get long-term benefits.

5.1 Background

Although issues on teamwork have been frequently addressed by the contemporary management researchers in a more structured way, the practice of teamwork has its roots in the very beginning of human life. For example, according to Cornick and Mather [1],

“when early man started to hunt something that was bigger than any one person could handle, he started to do it with others. The hunting party was a group with a very important common goal- to obtain food to survive.”

Various researchers have defined the term “team” in various ways. However, amongst the different definitions for team, the following given by Katzanbach and Smith [2] is one of the 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.”

This definition by Katzanbach and Smith [2] is clear and comprehensive to an acceptable extent.

Researchers all over the world have highlighted the significance of teams in an organisational perspective. Most organisations that seek improved efficiency have embraced teams in the

belief that they are the way to meet the demands of a turbulent and challenging market place [3]. A research carried out by Bacon and Blyton [4] indicated that teamwork has a greater positive impact upon both organisational performance and human resource outcomes. Further, usage of such teams results in increased productivity [5]. In addition, Murray and Moses [6] have stressed the idea that teams play a central role in the organisational learning process.

This concept of “teamwork” is very much appropriate for the construction industry as the construction products are delivered by a collection of professionals. Various authors have highlighted the importance of teamwork in construction. In a survey of AEC (Architectural/Engineering/Construction) companies in the U.S., Arditi and Gunaydin [7] identified that collaboration among parties in the design team was ranked first among the many factors that affect quality in design phase. Further, according to Albanse [8], teambuilding approaches in projects has contributed to lowering the total project cost by avoiding rework, improving trust, reducing scope definition problems, lowering variation order rates, and improving understanding of project objectives. In addition, improved teamwork in construction projects will increase the job satisfaction of project participants [9].

Since, teams offer numerous benefits both in organisational and construction perspectives, the knowledge of how teams develop is of paramount importance for team leaders. Over the years, many researchers intended to identify how teams in general organisational perspectives develop and offered different models to represent this process. According to Gersick [10], amongst these models, the model developed by B.W. Tuckman in 1965 is frequently cited today in management literature. According to Tuckman’s model, a team has to go through four stages called **forming** (team comes together and gets an initial awareness about each other), **storming** (conflict and competition within the team rise to higher level), **norming** (team members try to set norms for appropriate behaviours) and **performing** (team maturing as an effective team) during its life.

Later, in 1977, Tuckman and Jenson revised this model and proposed a new model of team development, with the addition of the adjourning stage that occurs after the performing stage (see Figure 5-1). Moreover, by addressing the issues untouched by Tuckman (1965), several other researchers have also identified different team development models. These models include; five faces model [11], two barriers model [12] and integrated team development model [13]. Amongst aforesaid team development models, the model of Tuckman and Jenson remains more appropriate for the construction context since it is based on the fundamental assumption that teams have a finite life.

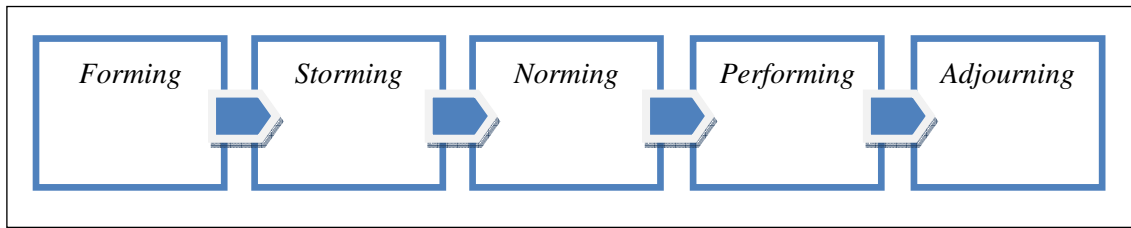


Figure 5-1- Tuckman-Jenson model (1977) Source: Rickards and Moger [13]

However, Winch [14], highlighted that members in construction teams are lacking mutual accountability and a mutual objective. Some researchers have identified that the teams in construction are virtual in nature since they have to work together from many different locations over the life of the project [1] [15]. Further, Cornick and Mather [1] and Walker [16] suggest that since construction project teams comprise members from different organisations, it can also be regarded as an inter-organisational team. In addition, there is sufficient evidence in the literature regarding construction teams to argue that the construction team is a cross-functional team [16].

When reviewing the construction related literature, it was evident that little consideration has been given to the issues relating to team development. By looking at the characteristics of construction teams it is evident that it deviates from the ideal team definition of Katzenbach and Smith [2]. Therefore, team development models that have been developed in the general organisation perspective cannot be solely applied in the construction context. However, if the construction team leaders are knowledgeable about the issues relating to nature and types of teams and team development in construction, they are in a better position to determine what types of resources and support will be most helpful to the team, based on the specific challenges they are facing at each stage. Thus, this research intends to fill the research gap by studying how the concept of team and team development is applied in the Sri Lankan construction context.

5.2 Method of Study

The empirical study consisted of cases studies of three building construction projects namely projects A, B and C which are operating under the traditional procurement method with re-measurement contracts and, whose construction duration is more than one year. Data collection was mainly undertaken by conducting semi-structured interviews with five key participants of the construction project team: the client or his representative, contractor's site manager, architect, structural consultant and the cost consultant (quantity surveyor). The data gathered from the interviews was analysed by code-based content analysis with the assistance of computer soft ware called N-vivo. At the same time, cognitive maps were developed in order to enhance the data displaying capabilities of the findings. Finally, conclusions about the overall research problem were drawn by critically analysing the findings.

5.3 Research Findings

The findings reveal the nature of the team, types of teams and team development with regards to the Sri Lankan construction context. These are discussed in detail in the following sections.

5.3.1 Nature of the construction team

The nature of the construction team is discussed in terms of disciplines of the members, team leader, accountability, interdependencies, consistency of the members and objectives of the members as illustrated below.

Disciplines of the members

Case studies had identified that the construction team consists of the members from various disciplines. Projects selected in this study were either very large projects or very complex ones. Project A and Project B have high contract sums. Project C has the lowest contract sum (170 million Rupees) was a very complex project. Therefore, it can be argued that these issues contributed significantly to the existence of members from various disciplines.

Team leader

The empirical data disclosed that in construction teams, the leader's role is significantly governed by the contractual conditions. For example, the structural engineer of the project C indicated *"the leader did not have much work to do rather than just as a facilitator or a coordinator. We all have obligations and responsibilities under the contract and there were penalties set up in case of breach of those obligations. Therefore, we all know what is expected from us and there was not much need for the leader to supervise us."* Therefore, it is evident that in construction teams, the leader's role was substituted by the contractual obligations to some extent and hence, leadership positions as of lesser importance.

Accountability

The case study findings revealed that in most of the situations the accountability within the team was at the organisation level. Most of the members were from different organisations and each organisation's accountability was clearly documented in the contractual conditions. Therefore, most of the time mistakes by each member were treated based on the contractual obligations. For example, the Architect from Project C stated *"since, there were several organisations, they are accountable at organisation wise. Accountability of each party is specified in the contract documents. Therefore, each member's mistake is treated based on that"*.

Interdependencies

Most of the interviewees disclosed that they have to depend on other team members to a higher extent when performing their tasks. As explained earlier, projects within the case study sample

were either very large projects or very complex ones, hence, various people with various expertise are required to handle such projects. However, the tasks of these members were interrelated and each member needs inputs from other members to carry out their functions. Therefore, a higher level of interdependency among members was evident in Sri Lankan construction project teams.

Consistency of the members

Case study data revealed that most of the construction project teams were not consistent throughout the life of the project in terms of parties. The projects selected in the study were adapting the traditional (separated) procurement method. Because of that, some team members came into the team at various stages and some had completed their work and went away prior to the project completion. But, if the integrated (design and build) method was adapted some kind of consistency of parties can be expected as only one party carries out both design and construction (design and built contractor). In addition, with this method, the design and built contractor is selected at an early stage in the design process.

Objectives of the members

The case study findings showed that the objectives of most of the members were in line with the project objectives. However, there were some situations where the contractors have experienced some conflict between their business objective and the project objective. When compared to the jobs undertaken by the other members the contractor's job is somewhat riskier than the others. Therefore, their financial objective is quite strong and that objective is sometimes found incompatible with the project objectives. The contractor's site manager from Project C explained this, *"normally our main objective is to fulfill the client's requirement which is the objective of the project. We also have another objective to have a reasonable profit for the works we executed. But, there were some situations, where we felt that we were not paid enough for our work especially, during variations. In such situations, those two objectives clashed a bit."*

5.3.2 Types of teams in construction

The types of teams in construction are discussed in terms of virtual, cross-functional and, inter-organisational teams.

Virtual teams

As per the definition given by DeSanctis and Poole [17], geographically, temporally, and/or organisationally disperse and, the communication through information and communication technologies can be seen as the main features of virtual teams.

The empirical data revealed that construction team members were from different organizations, thus, the teams can be regarded as organisationally dispersed. Further, since most of the

members were from different organisations and they were also involved in various projects simultaneously, they have to work from different locations. Therefore, teams can be viewed as geographically dispersed. In addition, despite the fact that they were geographically dispersed, the team members managed to meet each other at least once a week. Therefore, those teams can also be viewed as temporarily dispersed.

Since, the construction teams were geographically dispersed; they used information and communication technologies such as telephone, e-mail and fax to maintain communication between them. Therefore, by looking at all of above empirical findings the construction teams can be viewed as virtual teams.

Cross-functional teams

As per Ford and Randolph [18], cross-functional teams usually work together for a limited time, team members are also members of other teams and members have reporting relationship to functional managers as well as to multiple team or project leaders.

The majority of the interviewees admitted that they were involved in various projects simultaneously. Further, due to the fact that the construction teams consisted of members from different organisations, in addition to reporting to the project leadership they also has to report to the management in their parent organisation. For example, the quantity surveyor of Project A indicated “In my organisation I have to report to the chairman and in the project I have to report to the project leader.” Therefore, it is evident that they had multiple reporting relationships.

Because of this and due to the fact that construction teams have a finite life, the construction teams can be regarded as cross-functional teams.

Inter-organisational teams

Inter-organisational team refers to the team which is made up of representatives from various organisations involved together in producing the results [8].

The case study findings revealed that almost all the team members were from different organisations. Further, it is obvious that those team members were drawn together to produce a result (get the project done). Therefore, the construction team can also be considered as an inter-organisational team.

Based on the findings in the sections ‘Nature of the construction team’ and ‘Types of teams in construction’, the definition for the ideal team given by Katzanbach and Smith [2] can be altered in the Sri Lankan construction context as follows.

“The construction team is a collection of two or more people with complementary skills, who come from different disciplines and organisations to perform a common objective, but with individual objectives and, operating from different locations with multiple reporting

relationships, whose accountability and leadership are significantly governed by the contractual arrangements.”

5.3.3 Team Development

The issues relating to team development with regards to Sri Lankan construction teams, were identified by testing the Tuckman and Jenson model (1977). This model was selected after an extensive evaluation process due its high compatibility with construction teams. The ‘feelings and thoughts of the members’ and ‘observable behaviour of the members’ at different stages of team development as suggested by Tuckman and Jenson were questioned during the interviews to learn about their existence of each stage.

The empirical findings disclosed that Forming and Storming stages were not experienced by the construction team members to the same extent, as suggested by Tuckman and Jenson. However, Norming, Performing and Adjourning were almost identical to the Tuckman and Jenson model. The Observed feeling and thoughts of the members; and , Observable behaviour of members at each stage of team development are illustrated in Table 5-1 and Table 5-2 respectively.

The interviewees were in general agreement that aforesaid stages occurred in sequence as Forming-Storming-Norming-Performing-Adjourning in the selected projects. They further mentioned that when the team was at the performing stage, it has undergone some conflicts. Therefore, the team had fallen again into the storming stage and then has to follow the same sequence to become an effective team. This scenario happened in several occasions and led to creation of several cycles within the team development process. For example the architect of the project A stated that:

“it has this leaner sequence. But, some times when the team is functioning as an effective team it went through some conflict situations. Then it followed the same sequence to become an effective team. This created several cycles between stages.”

Most of the members perceived that the conflicts occurred when the new members joined the team. For example the client’s project manager of the project C stated that:

“this happened mainly due to the arrival of new team members at different stages. For example, when a subcontractor joined the team at latter stages, it is very difficult to maintain coordination between them since they were not familiar with the existing way of working. It was a very significant issue in this particular project as there were about twelve subcontractors and they were responsible for almost half of the work.”

However, some members indicated that conflicts occurred when the team is transferring from design to construction or from one trade of works to another. For example, the client’s representative of the Project B noted:

“it happened normally when the existing way of working changed. For example, when the team is transferring from design to construction stages or when scope is changing from structural work to finishes or from finishes to services.”

When the team is transferring from design to construction the contractor came into the scenario. Further, when the team is transferring from one trade of works to another such as structural to finishes or from finishes to services new subcontractors came into the team. Therefore, it can be argued that those conflicts were due to the entrance of new members more than anything else.

Quite a high proportion of team members indicated that the changes to the existing scope of work such as variations also gave a reasonable contribution to such conflicts. For example, the contractor’s project manager of project B indicated that:

“these conflicts mainly arose when the existing scope of the project changed. For example, if the client requested a huge variation, then it was difficult to rearrange the works, agreeing to a rate and agreeing for time extensions, etc., those things normally led to conflicts.”

Table 5-1- Observed feelings and thoughts of the members at each stage of team development during the case studies

Stage	Forming	Storming	Norming	Performing	Adjourning
Feeling and Thoughts of the Members	<ul style="list-style-type: none"> Optimistic and full of anticipation Pride in being chosen for the team 	<ul style="list-style-type: none"> Confusion and loss of interest on the team Fluctuations in attitude about the team 	<ul style="list-style-type: none"> Sense of belonging to a team High confidence Feels a new ability to express criticism constructively Acceptance of all members in the team General sense of trust Assured that everything is going to work out okay 	<ul style="list-style-type: none"> Freedom to express and contribute High commitment Fun, excitement and creativity General sense of satisfaction Continual discovery of how to sustain feelings of momentum and enthusiasm Empathy for one another Trusting friendships with others 	<ul style="list-style-type: none"> Think about life after the project Pride about your contribution for the team Sadness about losing relationship with the other team members.

Table 5-2 Observable behaviours of members at each stage of team development during the case studies

Stage	Forming	Storming	Norming	Performing	Adjourning
Observable Behaviours of Members	<ul style="list-style-type: none"> Attempts to define tasks, processes and how it will be decided Politeness Orienting with others personally 	<ul style="list-style-type: none"> Arguing among members Differences in points of view and personal style Lack of progress Establishment of unrealistic goals Concern over excessive work 	<ul style="list-style-type: none"> Agreeing processes and procedures Attempts to make consensus decisions Focus and energy on tasks Setting and achieving task milestones Shared problem solving Developing routines Comfort with relationships Effective conflict resolution skills 	<ul style="list-style-type: none"> Functioning fully as team Clear and interdependent roles Ability of the team members to organise themselves Flexibility and well-functioning individually Better understanding of each other's strengths and weaknesses and insights into group processes 	<ul style="list-style-type: none"> Recognising and celebrating accomplishments of team Seeking to learn from mistakes of the team Expressing appreciation for each other's contributions Evaluating results Preparing to move on.

Life of the team after adjourning Stage

The case study findings revealed that the majority of the team members were involved in various projects simultaneously. Therefore, they continued with those projects after the adjourning stage. Further, since all the team members were permanent employees in their respective organisations they were assigned to new jobs and they were engaging on those as well. Since, the team in project B was repeatedly used in next two phases of project B, they were involving in those two phases. However, members from the other two projects mentioned that there was no formal arrangement in their projects to get long-term benefits from the team.

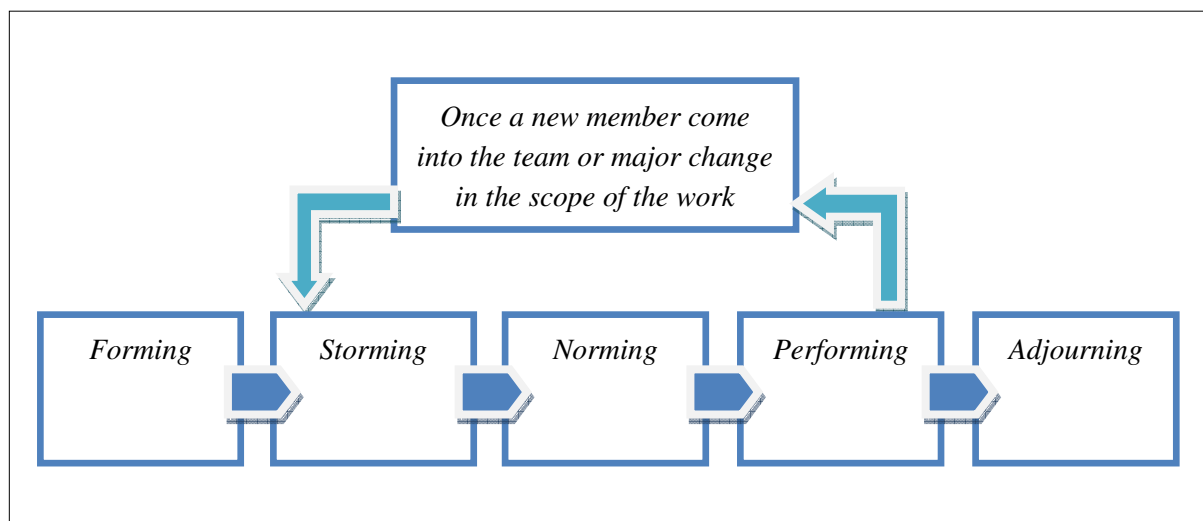


Figure 5-2 - Revised Tuckman and Jenson Model in construction context

Based on the findings of the empirical study, Tuckman and Jenson Model (1977) has been altered in the construction context as shown in Figure 5-2. This can be presented as a new model of team development with regards to Sri Lankan construction teams.

The model represents the cyclical nature of the team development process through the backward link from performing to storming. Conclusions drawn from this study will be discussed in the next section.

5.4 Conclusions

It is clear that construction teams are fairly different from the ideal teams mainly due to the lack of mutual accountability and common objective. Further, it was also evident that most of the key issues relating to construction teams such as leadership and accountability were significantly governed by the contractual conditions. In addition, construction teams possess characteristics of virtual, cross-functional, and, inter-organisational teams.

Construction teams undergo a team development process fairly similar to the process suggested by the Tuckman and Jenson Model (1977). However, the forming and storming stages were not experienced by the team members to the same extent, as suggested by the Tuckman and Jenson. The basic linear sequence of the team development stages was identical with their Model. However, within this linear

sequence, several cycles existed due to the conflicts that occurred when the team was at the performing level.

In the model suggested by this study, it is important for construction team leaders to have better allocation of resources and leadership support for the team based on the specific challenges that the team faces in each stage of team development.

It was also identified that progression through team development process has a strong positive relationship with team learning. Thus, after carrying out this research it seemed appropriate that further research may focus on team learning in the Sri Lankan construction context.

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6. Post Disaster Housing Reconstruction: Comparative Study of Donor Driven vs. Owner Driven Approach

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Abstract

In addition to human casualties one of the most visible and striking effects of any major disaster is the destruction of homes. The construction of houses will be a major activity in the reconstruction phase of any disaster. The quickest and the most effective way to rebuild homes after a disaster is to employ what is known as the “Donor Driven” approach. In this approach the government or an external agency funding the project will lead the reconstruction process with the help of consultants and contractors procured for the project. The major limitation of this approach is that it may lead to housing that does not respond to the need of the victims. As an alternative, the so called “Owner Driven” approach has been used by some donor agencies as well as the government in many disaster situations. In this approach the disaster victims reconstruct their homes themselves. The role of the external agency is limited to the provision of financial and technical assistance.

Past research on the suitability of these two approaches in various disaster situations is limited to very few cases. The massive reconstruction programme implemented in Sri Lanka after the Indian Ocean Tsunami used both these methods with varying degrees of success. Therefore, lessons learned in Sri Lanka would be a useful contribution to this growing body of literature on different approaches to post disaster housing reconstruction.

This paper aims to contribute to this discussion through a questionnaire survey conducted among beneficiaries of the Tsunami housing programmes in the Matara District of Sri Lanka. The study found that owner driven approach has a number of advantages over donor driven approach. Nevertheless, the donor driven approach cannot be totally dismissed as unsuitable because it has scored very highly on some important parameters relevant for disaster situations.

6.1 Background

Disasters cause a substantial amount of damage around the world every year [7]. In recent years several major disasters have occurred in coastal areas worldwide. On the 26th of December 2004, a major Tsunami occurred in the Asian region killing nearly 250,000 people around the Indian Ocean. The Joint Report of the Government of Sri Lanka and Development Partners [3] issued, in December 2005, highlights that the Tsunami on 26th December 2004 killed 35,322 people and destroyed US\$ 900 million worth of assets and infrastructure in Sri Lanka.

One of the major challenges after a disaster is how the redevelopment activities should be undertaken. To rebuild the nation after a disaster, Governments adopt different reconstruction strategies. Different reconstruction strategies give different outcomes. Serious decisions must be made on how risks could be reduced to acceptable levels and these decisions have to be reflected in the reconstruction and recovery strategies that should be adopted. Identifying the most suited and applicable strategy for each situation is of utmost importance in order to provide better assistance to the victims and to avoid possible future vulnerabilities and environmental degradation.

Therefore, the aim of this research is to analyze the strategies used in post Tsunami reconstruction work in Sri Lanka. The main objective of the research is to identify the post Tsunami housing reconstruction strategies used, their applicability to Sri Lankan context and their level of success.

6.2 Disaster Management & Reconstruction

6.2.1 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 occurrence hence we can to some extent reduce the impact of damage though we cannot reduce the extent of the damage itself. This demands the study of disaster management in a methodical and orderly approach [5].

Disaster management has a different emphasis in different disciplines. According to Central Emergency Relief Organisation [2], disaster management is a collective term encompassing all aspects of planning for and responding to disasters, including both pre-disaster activities 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 steps as: Emergency Response and Relief; Recovery and Reconstruction; Mitigation; and Preparedness [8].

6.2.2 Reconstruction strategies

According to Kishore [6], any reconstruction programme has to meet a range of complex and often conflicting needs of affected people. The i-Rec Conference held in 2004, has identified that reconstruction programmes often fail to take in to account the desires of the disaster affected populations. If proper attention is not given to the needs of affected people there is a possibility that the newly constructed facilities become obsolete from the day the construction is complete. Therefore, reconstruction strategies should be implemented after studying the desires of the affected people.

According to Asian Disaster Reduction Center [2], post disaster reconstruction is a complex issue with several dimensions. Government, non-governmental and international organisations have their own stakes in disaster recovery programmes and links must be established among them, as well as with the community. SMEC Group of Companies [8] mentioned that, reconstruction is one of the most demanding forms of activity after a disaster, because it operates in conditions of uncertainty, often in remote locations and within severe time constraints. Therefore, proper planning is of utmost importance to reduce future vulnerabilities and to improve long-term sustainability. A good housing reconstruction strategy will take into account the social need together with long-term disaster mitigation and sustainability. Barenstein [9] has studied these strategies following the earthquake that hit Gujarat in India on 26 January 2001. Barenstein [9] identified five approaches, namely; 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, that were used during the reconstruction. The author compared these five approaches and discussed the issues related to implementation of each of these methods.

The Indian Ocean Tsunami provides an opportunity to study the different approaches used in housing reconstruction, their success and related issues. According to Wegelin [10], Indonesia's Reconstruction Master Plan for post Tsunami reconstruction set two core standards for tsunami victim household support. Each surviving household would be entitled to a grant of US\$3,000 per home to

rebuild the house if it needed to be rebuilt from scratch and US\$1,000 for damaged houses that could be renovated. Unlike in Gujarat, Sri Lanka used only two distinct approaches in housing reconstruction; they are, the Donor Driven approach and Owner Driven approach [10].

The Donor Driven reconstruction programme is handled completely by the donor agencies as relocation of affected families within the buffer zone from the buffer zone became a necessity. All affected families were entitled to a house built by a donor agency in accordance with Sri Lankan government standards, in a new location. In addition, the donor provides all common infrastructure for the new settlement, while the Sri Lankan government provides the services up to the relocation site [10].

Houses that were damaged partly or fully outside the buffer zone were included in the Owner Driven reconstruction programme. The Sri Lankan government provided a cash grant to the affected homeowners for the reconstruction of their houses at the same site. The owner of a partly damaged house received a cash grant of Rs.100,000 and the owner of a fully damaged house received a cash grant of Rs. 250,000 [10]. The Owner Driven approach enables the affected communities to undertake construction work themselves with external financial support and technical assistance.

6.3 Methodology

Firstly a comprehensive literature review was carried out on disaster management and reconstruction strategies by referring to books, reports, journals and research publications. The Tsunami, which hit Sri Lanka on the 26th of December 2004, has been selected as the case study for this research. A detailed documentary survey was carried out on post-Tsunami reconstruction activities in order to identify the different housing reconstruction strategies adopted. Also 100 newly constructed or repaired houses have been inspected in the District of Matara in order to get a clear idea of issues such as buildability, sustainability, etc.

Both structured and unstructured interviews were conducted among officers of 11 Governmental and 6 non-Governmental Organisations, to collect information on post Tsunami housing reconstruction strategies, their suitability and applicability. A questionnaire survey has been administered among 531 Tsunami victims in the District of Matara, to identify the level of satisfaction of the housing they obtained. The profile of the sample used in the questionnaire survey is given in Table 6-1.

Table 6-1 Profile of the sample

Category	No. of Dwellers	%
Donor Driven Housing Relocation Programme	261	49 %
Owner Driven Housing Resettlement Programme	255	47 %
Received only Temporary Housing	21	4 %
Total	537	100%

6.4 Results

With all the findings from the questionnaire survey, unstructured interviews conducted among Tsunami victims, together with observations of the researcher and the views of officers of the relevant Governmental and Non Governmental Organisations, the success of the housing reconstruction programme has been measured separately for the Donor Built Programme and Owner Driven Programme using the parameters given below.

- Coverage
- Adequacy and sufficiency of the relief received
- Timeliness
- Overall satisfaction of the victims
- Other issues based on the observations of the researcher (Buildability, Sustainability, Extendibility)

6.4.1 Coverage

According to the statistical information 74.3% of the housing units have been completed and 18.63% of the housing units are still in progress by September 2007 [11]. The tsunami housing reconstruction progress in Sri Lanka is therefore at a fairly successful stage when considering the total planned duration of 3-5 years period. Beyond this, the present housing coverage in Matara district has been summarised below under two housing reconstruction strategies, in order to identify the degree of success of the housing reconstruction programme.

In the case of donor driven housing programme in Matara district a total of 62 sites were assigned for relocation of which 48 sites have been completed. However, 10 sites are currently still in progress and 8 have not commenced yet. When concerned with the number of houses required for Matara, it had planned 1,678 units and already 1,856 housing units have been completed. In addition, 371 housing units are still in progress and 423 houses have not begun as originally schedule at the decision making stage. In conclusion it can be said that more than 100% of total housing requirement have been achieved at present in donor driven housing programme in Matara district, with an excess of 178 housing units [11].

Up to end of September 2007 96.7% of all housing units, including fully and partly damaged housing unit in owner driven housing programme, have been completed in the district of Matara. The remaining 2.7% is in progress and 0.6% of housing units are yet to begin. In the case of owner driven

housing programme housing progress in fully and partly damaged housing units are summarised separately, as follows, in Table 6-2.

It can be seen that 89% of fully damaged houses have been completed and 99% of partly damaged houses have been completed. However, the money disbursements do not inevitably denote that the reconstruction of the housing units are completed from the Rs. 250,000/= given to fully damaged house victims in 4 installments and Rs. 100,000/= given to partly damaged house victims in 2 installments. It was observed that when dwellers failed to show progress of the work within the stated requirements then the victims have been unable to collect the next installment according to disbursement schedule. They then had to wait for further money arranged from top up grants, loans and other assistance from third parties to complete their homes. This had less of an affect in owner driven housing programme especially in fully damaged houses.

Table 6-2 - Progress in Owner Driven Housing Programme

	Fully Damaged Houses		Partially Damaged Houses	
	No. of Houses	%	No. of Houses	%
Completed	1250	89%	4821	99%
In Progress	142	10%	25	0.50%
Not Started	11	1%	25	0.50%
Total	1403	100%	4871	100%

6.4.2 Timeline

To carry out the research across several parameters a scale has been used as “very satisfied”, “somewhat satisfied”, “somewhat dissatisfied”, and “very dissatisfied”. As shown in Table 6-3, the greater proportion of victims were in the categories of “somewhat dissatisfied” or “very dissatisfied” scales in both housing reconstruction programmes. It is not certain whether this issue is due to the fact that reconstruction has been designed to complete within 3-5 years of timeframe and still it has only taken nearly 3 years.

Furthermore, when concern about the views of the victims on the timeliness of the delivery of permanent houses that the Table 6-3 shows a fairly satisfied response to owner driven housing programme when compared to donor driven houses. In the case of owner driven programme it has taken less time to arrange the financial assistance and other aspects. However, the donor driven programme has taken more time than the owner driven due to the need to acquire lands, design, establish the contractual arrangements and the actual construction - the whole procedure needed due to the large scale of housing projects.

Table 6-3 - Satisfaction level regarding Completion Timeline

Reconstruction Strategy	Very Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Very Dissatisfied
Donor Driven	0%	7%	42%	51%
Owner Driven	5%	25%	43%	27%

6.4.3 Dwellers view on their permanent residence

One of the most visible and outstanding effects of any major disaster is the devastation of homes which destroys livelihoods, protection and privacy. So that, without reference to the timeline and cost of the reconstruction activities it is essential to evaluate the dwellers' views to gain an overall satisfied output. Under this heading, the dwellers' views were gained on their permanent residences while covering the nine salient factors and conditions generally assembled with housing programmes in both donor driven and owner driven, which are mentioned at the beginning of this chapter. The scale used was the previous one used in the above, that of "very satisfied", "somewhat satisfied", "somewhat dissatisfied", and "very dissatisfied".

6.4.4 Quality / strength / durability

As shown in Table 6-5, in the case of donor driven programme, only 5% of the dwellers were very satisfied and 15% were somewhat satisfied while 47% were somewhat dissatisfied and 33% of the dwellers were very dissatisfied. For many reasons the dwellers were not satisfied with the strength, arrangement of structure, quality of materials used, improper land fillings and cuttings and bad construction of the houses. Also, due to increase in the number of intermediate dealers, each transactions has resulted in minimising the amount of money for a single housing unit. Finally, it was also affected by the contractors' duty to reduce cost targets, which reflected in them to selecting low costs and poor quality materials, offensive method statements, etc. Most observed projects ranged from small to several defects and some houses were left. In most case the dwellers involvement to construction activities was less and the 5% who were very satisfied had succeeded mainly due to the dwellers participation.

Throughout the survey 55% of the dwellers of the owner driven programmes were very satisfied and 34% were somewhat satisfied. Dwellers in owner driven houses argued that high level of quality standards can be achieved from inception to completion when this is done with the participation of the resident. Most often the owners have recognized that better design and structural stability, with superior quality maintenance of their new residence, is important to their future vulnerability. Financial assistance gained from the state was reinforced by the top up grants provided by the private donors in most of owner driven programme plus further money recovered from loans, own money, relations and friends assistance, etc. So comparing the outcomes of the survey it should be noted that the owner driven programme gained a better result than donor driven programme in respect to quality, strengthen and durability of their permanent residences.

6.4.5 Functionality

In the case of functionality, according to Table 6-5 the majority of the donor driven programme (41%), was very satisfied and according to Table 6-6 majority of owner driven programme (52%), was somewhat dissatisfied. Most of design in donor driven houses was done by the qualified architect concerned with Sri Lanka's culture on basic amenities. Some of international participant involvement caused restriction in local complimentary designs. It is a common intention when constructing a house by the owner to try to achieve a better quality of house with the present finances, with basic amenities or less and retain part to be done in the future after it is occupied. It is what that has been observed in most owner driven houses.

6.4.6 Space availability

According to the survey results, it is recognised that an equally fair distribution can be seen in Table 6-5 in donor driven programme, in the case of space availability, as this depends on several aspects such as members in a family, livelihood pattern and living standards. According to Table 6-6 the majority of the owner driven programme (59%), were very satisfied due to most of dwellers have identified their requirements with sufficient space for the number of family members. Most fully damaged houses in owner driven programme have been observed as two storey houses by providing a better space in a vertical arrangement. Inadequately financed home owners have constructed their houses with less amenities and allocating insufficient space, which has resulted in 15% of dwellers in the somewhat dissatisfied category.

6.4.7 Aesthetics

As shown in Table 6-5, the majority, which is 52% of the dwellers of donor driven programme were somewhat satisfied and 22%, were very satisfied. In the case of owner driven programme 31% of dwellers were somewhat satisfied and 34% were very satisfied, while 34% were somewhat dissatisfied according to Table 6-6. In both cases, it has been observed that some middle class people were not satisfied, as they lived in better quality houses before the tsunami. In most cases, it has been identified that donors have got better looking houses which were designed by the qualified architect. However, most owners have designed their houses according to their own concept of better appearance.

6.4.8 Flexibility to make any changes in the future

As shown in Table 6-5 and Table 6-6, the majority, which is 54% of the dwellers of the owner driven programmes, were somewhat satisfied and the majority of donor driven programme amounting to 56%, were somewhat dissatisfied with the flexibility to make necessary changes in the future. It has been noted that most of the dwellers in donor driven programme do not have any intention to change it presently as the original deeds had not been handed over to them. In some cases also the allowable land area is not enough to increase horizontally or that the design of the vertical alignment would not allow further developments.

6.4.9 Agreeing to change the design as required

In the case of the agreeing to change the design as required, in owner driven programmes 45% of the dwellers were somewhat satisfied and 33% were very satisfied, while donor driven programme 56% of majority were somewhat dissatisfied. Dissatisfaction of dwellers in the donor houses were high due to that involvement of victims in the design stage could not be seen throughout the survey. Only in a few projects had the victims been allowed to inspect their houses at the construction stage and that they couldn't support any change to the design. So in conclusion it has been noted that owner driven programmes provide a high satisfactory level compared to donor driven programme in respect to the support given to change the design.

6.4.10 Land size

In the case of land extent, the majority of donor driven programme (47%) was very dissatisfied and the majority in owner driven programme (52%) was very satisfied. It has been observed that the larger number of people who have moved to donor driven houses were not satisfied, as they had lived with an adequate size of land area before the Tsunami. Now, however, the majority of donor's housing area provided ranges from 6 to 12 perches – which is tiny when compared with pre tsunami owned land. Also there were no ground areas to most donor driven houses, which have been granted to multi storey housing schemes but with some common area for social activity. It is obvious that most of the owners were satisfied with regards to their previous land extend, but a few cases have been identified as restricted areas to construction activities because of the buffer zone concept.

6.4.11 Location

According to Table 6-5 and Table 6-6, the majority (66%) of dwellers of the owner driven programmes, were very satisfied and majority of donor driven programme (41%), were very dissatisfied with the case of location. Most of the people in the Matara district who were affected to the tsunami were occupied in the fishing industry and most of their livelihood activities are based around the sea. The majority of owner and donor dwellers responded as it was a major opportunity to be located near to the sea. Yes, some of middle class people in both owner driven and donor driven programme observed that the relocation to inland villages is better than the previous coastal location, considering social and cultural issues.

6.4.12 Overall facilities provided (electricity, water connection and sanitation)

The results of the survey demonstrated that overall the facilities available in the donor driven programme and owner driven programme are in better position. These are shown in Table 6-4 categorised into three basic services (electricity, water connection and sanitary facilities).

Table 6-4 - Services in the house

Services	Donor Driven		Owner Built	
	No. of Houses	%	No. of Houses	%
Water	246	94.25	253	94.12
Electricity	231	88.51	234	91.76
Sanitary	210	80.46	210	82.35

Although the above facilities are connected to both programmes in adequate manner, for several reasons the dwellers satisfactions for those facilities are not the same. According to Table 6-5 and Table 6-6, it shows the satisfactory level of two different housing programmes in the case of the overall facilities. In the owner driven programme 41% of the dwellers were very satisfied and 39% were somewhat satisfied, while in the donor driven programme 39% were somewhat dissatisfied. It has been observed that at the beginning the facilities are connected to donor house, but the outputs malfunctioned due to various issues and unexpected conditions.

Furthermore Table 6-7 specifies the percentage of dwellers, under each category on the two reconstruction programmes that the majority (40%) of the dwellers of donor driven programme were somewhat dissatisfied and 31% were very dissatisfied. In the case of owner driven programme 50% of dwellers were somewhat satisfied and 33% were very satisfied. It is understandable that the dwellers, who were under donor driven programme were not happier with their permanent houses than the dwellers, who were under owner driven programme in the district of Matara.

Table 6-5 - Satisfaction of the Dwellers – Donor Driven

Factors	Very Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Very Dissatisfied
Quality/ durability	5%	15%	47%	33%
Aesthetics	22%	52%	23%	3%
Functionality	26%	41%	24%	8%
Space availability	20%	26%	29%	25%
Agreed to change the design as required	4%	18%	56%	22%
Flexibility to make any changes in the future	4%	23%	56%	17%
Location	16%	20%	23%	41%
Land size	6%	15%	32%	47%
Overall facilities provided	23%	28%	39%	10%

Table 6-6 - Satisfaction of the Dwellers – Owner Driven

Factors	Very Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Very Dissatisfied
Quality/ durability	55%	34%	11%	0%
Aesthetics	34%	31%	34%	1%
Functionality	13%	26%	52%	9%
Space availability	59%	24%	15%	2%
Agreed to change the design as required	33%	45%	20%	2%
Flexibility to make any changes in the future	22%	54%	19%	5%
Location	66%	19%	13%	2%
Land size	52%	26%	20%	2%
Overall facilities provided	41%	39%	20%	0%

Table 6-7 - Dwellers' Total Satisfaction regarding their Permanent Resident

Reconstruction Strategy	Very Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Very Dissatisfied
Donor Driven	12%	17%	40%	31%
Owner Driven	33%	50%	15%	2%

6.5 Conclusions

The recent increases in frequency and magnitude of natural disasters have raised issues of increasing vulnerability of communities. The impact in terms of human, structural and economic losses has risen in recent years. The reconstruction process has very much depended on the administrative, political, social, economic and cultural context that coupled with many other unforeseen factors will affect the speed and coverage of the recovery programmes. In order to derive a better conclusion, the research mainly focused on the degree of success of post tsunami housing reconstruction programmes based on two strategies, namely, donor driven and owner driven.

The main outcome from this survey is that dwellers in owner driven housing programme are more satisfied than the dwellers in donor driven housing programme when concerning various parameters. In other words, it can be concluded that the owner driven housing programme is more successful than the donor driven programme concerning the dwellers' view. According to the research, it has been argued that the owner driven housing programme has been 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, those which are superior in terms of owner driven, have proved that the dweller involvement throughout inception design to construction stage resulted better success in owner driven housing programme than those who were under the donor driven housing programme.

But contrast with the owner driven housing programme, the donor driven housing programme has been more superior in term of: aesthetics and functionality. Furthermore, it has identified that the two main reasons behind this are that the donor houses have 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 in the future.

Reconstruction process should be considered as development opportunities and should open the access of different types of innovative solutions. These innovations should lead to vulnerability reduction, and should enhance human and other activities security in long term. By providing the buffer zone the government has identified the vulnerable area for future disasters and emphasised a need to categorised the post disaster housing reconstruction programme into the two strategies discussed above. However, the donor relocation programme started later than owner resettlement programme, although progress in the district of Matara in the donor driven housing 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' view on timeliness to delivery of permanent houses to the donor driven and compensation to owner driven house have been identified by a smaller number. That was seriously shown in donor driven programme. Although, there is an excess amount of donor driven houses at the present, still there are victims living in temporary houses. Also the assistance given to sub families' victims could be seen as erroneous and after 3 years most of the sub families still live in the temporary housing, yet there are larger numbers of donor houses still vacant.

It has also been observed that the dwellers' view on the State assistance throughout the housing reconstruction programme is fairly high in the owner driven houses, but view on the NGO assistance throughout the housing reconstruction programme has been fairly low compared to those donor driven ones.

By evaluating the overall information on the post tsunami housing reconstruction programme, the success of the process as well as the victims' view of two different reconstruction strategies will be helpful to decision makers to get comprehensible idea regarding their applicability and drawbacks.

6.6 References

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7. The Role of Knowledge Management in Post Disaster Housing Reconstruction

Thanurjan R. Seneviratne I.

Abstract

A disaster is a serious disruption for the operation of a society, causing extensive loss to life and property. Since construction activities are highly knowledge-intensive, knowledge management (KM) practices will encourage continuous improvement, distribute best practices, quick respond to beneficiaries, share valuable tacit knowledge, reduce re-work, improve competitiveness and innovations and reduce complexities in post disaster housing reconstruction. Therefore, this research aims to study and explore the degree to which the KM is involved in post disaster housing reconstruction and the effect that (KM) has on it (post disaster housing reconstruction) in the Sri Lankan context.

This study was undertaken through systematically reviewing the literature in Knowledge (K), KM to highlight the basic principles. Data collection mode for the study was close end questionnaires and semi structured interviews. Data was collected from donor and consultancy organisations involved in post disaster housing reconstruction in Sri Lanka.

Findings of the study revealed that most of the donors and consultancy organisations carry out permanent disaster housing reconstruction for tsunami devastation. Further, the study reveals that organisations use competences and repositories as the main sources of knowledge internal and external to the organisation. Project reviews, task teams, face-to-face interactions, and electronic mail systems were used highly to support KM. Even though the performance of the work was improved through KM, lack of compiling and synthesising the accumulated data, information and knowledge, storing and organising data would be the main challenge faced by these organisations. However, this study is limited to the donor and Sri Lankan construction consulting organisations, involved in the post disaster housing reconstruction in Sri Lanka due to natural disasters.

7.1 Background

7.1.1 An overview of disaster

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 can be classified as sudden or slow (according to onset speed), or natural or man-made (according to cause). Disasters are often named by the hazards that cause them [2]. A disaster occurs when the hazards impact badly upon a community, which is susceptible to that hazard. There are several hazards like floods, tsunamis, tropical storms, landslides, drought, high wind, rock falls, etc. that affect Sri Lanka from time to time.

Natural disasters attack the poor at three levels: they interrupt income, reduce personal assets and destroy essential public infrastructure (World Bank, 2000a cited [3]). The World Bank estimates that losses due to natural disasters are 20 times greater (as a percentage of GDP) in developing countries than in the industrialised nations [4]. According to National Construction Association of Sri Lanka [5], a joint study by donors in January 2005, disasters damaged over a US\$ 1 billion worth of infrastructure (about 4.5 percent of GDP), but the replacement costs were estimated to be between US\$ 1.5 billion to US\$ 1.6 billion (7.5% of GDP). Further, Ofori [4] states that disasters have a greater impact on the built environment of developing countries than industrialised ones.

7.1.2 Post disaster housing reconstruction

Reconstruction means the action of constructing new buildings to replace buildings, which have suffered damage, or repair of damaged buildings (UN, 2006 cited [6]). Reconstruction stage develops after the rehabilitation stage and aims to provide proper permanent housing for the victims in a short period of time [7]. The stakeholders of post disaster projects are the government, donors, lending agencies, beneficiaries, contactors, and social, environment and religious groups.

Whilst relying on routine processes proved adequate in many ways for these small-scale disasters, a higher level of coordination and management would be needed for programmes of reconstruction following a larger disaster [8]. Further, Gunasekera [9] added that all the phases and activities of a project done under normal conditions have to be done when managing projects after a disaster and all phases and activities need to balance with the time factor. Most of the time, this is done at a cost, because there is a minimum quality level and scope requirement that each project has to achieve [9].

As per Barenstein and Pittet [10], one of the most visible consequences of many disasters is the widespread devastation of houses. Quarantelli (1995 cited [11]) proposed four stages of housing 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 few years).

Post disaster housing reconstruction is considered by many experts as one of the least successful sectors in terms of implementation [10]. Further, a lack of effective information and knowledge dissemination can be identified as one of the major reasons behind the unsatisfactory performance levels of current disaster management practices [12]. According to Banerjee (2005 cited [12]), a lack of prior knowledge and proper point of reference have made most of the recovery plans mere guessing games, eventually failing without adding appropriate values to the recovery attempts. Therefore, applicable external knowledge support based on actual recovery processes can play a crucial role in promoting post disaster recovery [13]. However, in case of the Sri Lankan construction industry, there has not yet been any appropriate research done in this area. Thus, little is known about how knowledge is managed in Sri Lankan post disaster reconstruction works.

7.2 Knowledge Hierarchy

7.2.1 Data, Information, Knowledge

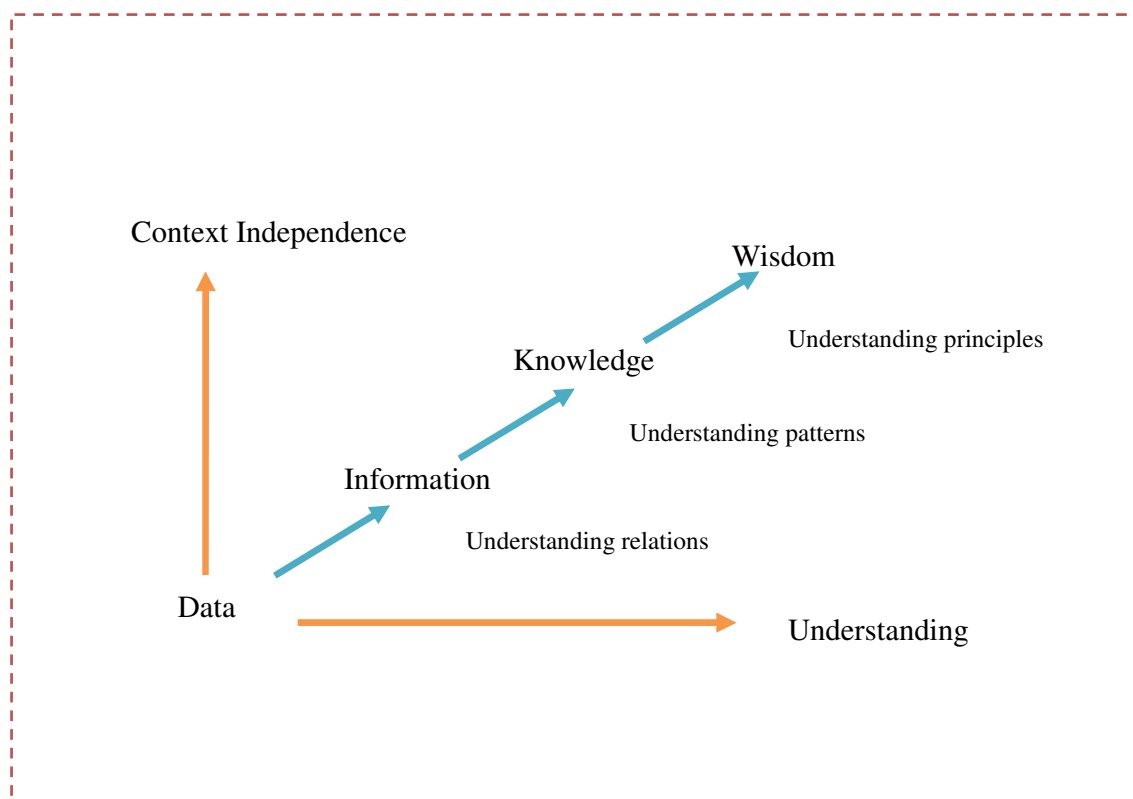


Figure 7-1 The relationship for data, information, knowledge and wisdom Source: Gene Bellinger (cited [14]) -

A common theme in the KM literature is that data is combined to create information, and information is combined to create knowledge [15]. Information is data that has been interpreted, verbalised, translated, or transformed to reveal the underlying meaning and context [16]. For example, when a disaster occurs, different types of information might come from different sources, such as the disaster field, remote sensors, public information centres and the World Wide Web [17]. Knowledge 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 [18]). According to Siemieniuch and Sinclair (1999 cited [18]), various classifications of knowledge include: formal (explicit) and tacit (expertise) knowledge; foreground and background knowledge; classifications with respect to the role of knowledge for business relevance (e.g. knowledge of business environments), or with respect to the functional roles within an organisation (e.g. knowledge for control activities). One of the most practical distinctions is that between tacit and explicit knowledge (Nonaka and Takeuchi, 1995 cited [19]). As per King [16], tacit knowledge is the personal knowledge resident within the mind, behaviour and perceptions of individual members of the organisation. On the other hand, explicit knowledge is the formal, recorded, or systematic K that can easily be accessed, transmitted, or stored in computer files or hard copy [16]. Knowledge sources, in this context, mean the ‘reservoirs of knowledge’, which a knowledge-worker has to fall back on in fulfilling his/her responsibilities [20]. As per Egbu, et al., [20] there are two main categories of knowledge sources, i.e. sources internal to the organisation (other individuals, team(s), routines, competences, and repositories) and sources

external to the organisation (other individuals, communities of practice, other networks, repositories, and knowledge gate-keepers).

7.2.2 Knowledge management (KM)

Knowledge Management: 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 [16]. However, the KM is not only limited to human centered asset but also extended to intellectual asset. While some definitions specify the management of intellectual assets, it also spells out the benefits of KM. However, the parameters to be managed, has been fairly addressed by some academics like Huber (1991 cited [21]), King [16], and Robinson et al., [22].

Organisations who are successful in leveraging knowledge, normally witness increased efficiencies in operations, higher rates of successful innovations, increased levels of customer service, and an ability to have foresight on trends and patterns emerging in the marketplace [23]. The lack of common knowledge has been known to impede the flow of knowledge, resulting in failures to stimulate innovation and creativity in the organisation (Simonin, 1999; Szulanski 1997 cited [23]).

7.2.3 Knowledge management (KM) sub processes

The KM sub process has been identified as locating and accessing, capturing and storing, representing, sharing, and creating [20]. Knowledge acquisition is the process that involves imbibing information including making meaning of situations and other stimuli from the internal and external business environment [21]. Nonaka and Takeuchi (1995) defined knowledge production as a continuous, social process, which is a never-ending spiral of tacit and explicit knowledge through knowledge conversion, socialisation, externalisation, combination and internalisation [SECI] (Sverlinger, 2000 cited [20]). This is quite true when it comes to post disaster housing reconstruction, where the participants have to act according to the situation, which will have the above triggers and leads to knowledge production. According to Kululanga and McCaffer [21], knowledge sharing encompasses thinking, speaking and perceiving and is not merely 'transferring' knowledge and such a process is called 'creative sharing'. The National Disaster Management Division [24] suggests that in order to enhance the information sharing and management of the knowledge generated in these institutions, it is essential to closely knit the organisations and moreover the people. Storage of knowledge involves the keeping of intellectual assets in a form that promotes its preservation, retrieval and utilisation (Walsh and Ungson, 1991; Miyashiro, 1996 cited [21]). Knowledge 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 [25].

7.2.4 Knowledge Management tools

Anumba et al., [26] distinguishes between KM tools, the terms 'KM techniques' and 'KM technologies' are used to represent 'non-IT tools' and 'IT tools' respectively.

Table 7-1 - A comparison between KM techniques and technologies Source: Anumba et al., [26]

KM techniques	KM technologies
Require strategies for learning	Require IT infrastructure
More involvement of people	Require IT skills
Affordable to most organisations	Expensive to acquire/maintain
Easy to implement and maintain	Sophisticated implementation / maintenance
More focus on tacit knowledge	More focus on explicit knowledge

7.2.5 Knowledge management in post disaster housing reconstruction

KM initiative has been thoughtfully envisaged as a tool to store, retrieve, disseminate and manage information related to disaster management [24]. Furthermore, Johnson et al., [27] states that organisations, such as governments in continuously disaster prone countries need the ability to act as learning organisations and channels of information as well; however they do not seem to take advantage of this opportunity. The value of KM is that it provides senior management with a rationale to support the creation and maintenance of repositories of project histories [28]. In order to improve housing reconstruction projects we need to look back at past experiences and the processes that created them. The demand for efficient KM to help the agencies make post disaster housing is widely recognised.

7.3 Research Methodology

Since the main objectives of this study was to identify and explore several parameters related to KM, ‘what’ type of question was more suitable for the study and therefore, the structured questionnaire survey was carried out. A randomly selected sample of seventy-five was chosen – of which of forty-five donors, and thirty consultancy firms were used for questionnaire survey. Semi-structured interviews were conducted to identify the KM sub processes involved in post disaster housing reconstruction. Twelve semi-structured interviews, six from donors and six from consultancy organisations were conducted to achieve the above objective. While the relative importance index (RII) was being used as an analysis technique for questionnaire survey, the semi-structured interviews were analysed using data matrix.

7.4 Research Findings

The total number of targeted respondents for the research was 75 organisations consisting of 45 donor organisations and 30 consultancy organisations. The total response rate was around 74.67%. The largest respondents were from donor organisations constituting 53.57% of the total respondents, whereas the other 46.43% of the respondents were from the consultancy organisations.

Post disaster housing reconstruction was undertaken in Sri Lanka for several disasters such as draught, rock falls, tropical storms, fires, landslides, high wind, floods and tsunami. However, according to the survey, it was found that in Sri Lanka, most of the post disaster housings were constructed for the tsunami affected communities through donors and construction consultancy organisations.

In this study, the sources of knowledge were categorised as internal to the organisation and external to the organisation. Table 7-2 indicates the list of sources of knowledge internal to the organisation in descending order of ‘usefulness’ as perceived by the respondents.

Further, Figure 7-2 illustrates the repositories used internal to the organisation. The majority of the respondents stated that they have used project-monitoring documents (87.50%) more often than other repositories. Reports (82.14%) were the second mostly used repositories.

Further, Table 7-3 suggests that the most significant external source of knowledge related to post-disaster housing reconstruction in Sri Lanka was repositories. Moreover, the knowledge gatekeepers were the least significant external knowledge source.

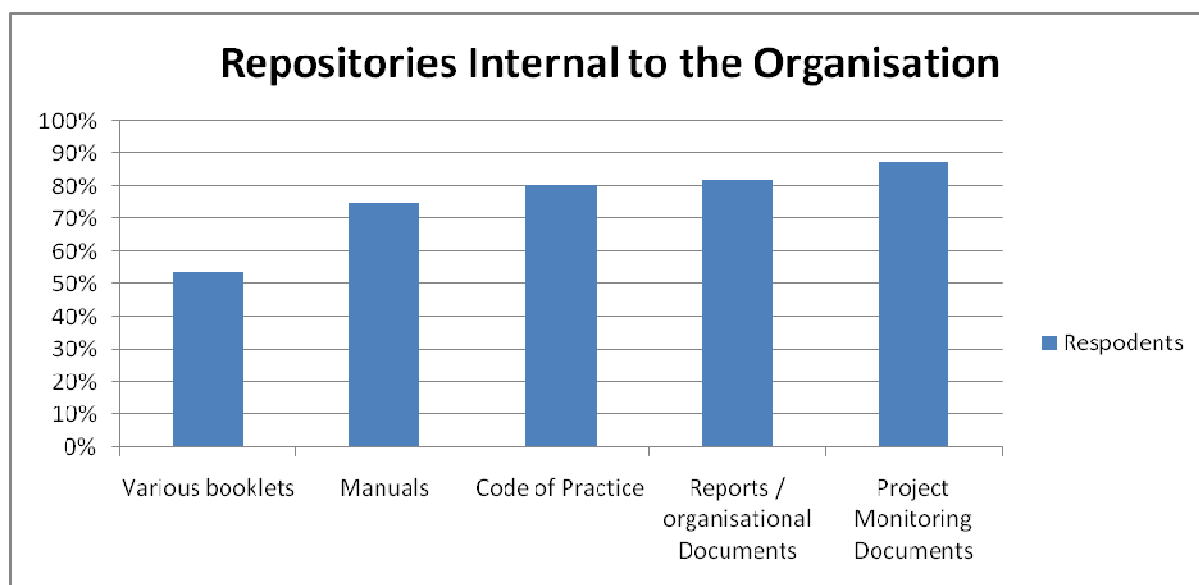


Figure 7-2: Repositories – internal to the organisation

Table 7-2: knowledge sources – Internal to the organisation in descending order of use

Competences
Lessons learned
Repositories
Team(s)
Other individuals
Routines

Table 7-3: knowledge sources – External to the organisation in descending order of use

Repositories
Communities of practice
Other individuals
Other networks
Knowledge gatekeepers

Table 7-4 stipulates that the e-mail system was the highly-useful KM technology used in post disaster housing reconstruction by donors and consultants. The next most significant tool was the costing and cost management system. According to

Table 7-5, the face-to-face interactions, task teams, and project reviews were the most significant non-IT based tools in post disaster housing reconstruction.

Table 7-4: KM Technologies

IT Based Tools in descending order of usage	
1. E-mail system	9. Skills Yellow Page
2. Costing and cost management system	10. Groupware
3. Document management system	11. Technical call centre
4. The central project file	12. Web based application
5. Intranet	13. Taxonomy/Ontology
6. Knowledge bases	14. Extranet
7. On-line project management	15. On-line procurement system
8. Data and text mining	16. On-line KM system

Table 7-5: KM Techniques

Non-IT Based Tools in descending order of usage	
1. Project reviews	9. Seminars
2. Task teams	10. Training
3. Face-to-face interactions	11. Communities of practice
4. Formal meetings	12. Focused group sessions
5. Brainstorming	13. Knowledge gatekeepers
6. Site liaison initiative	14. Apprenticeship
7. Quality circle	15. Share fair
8. Recruitment	

While lack of compiling and synthesising the accumulated data, information and knowledge, storing and organising was the most significant challenge, conflicting priorities between KM and other business functions was the least significant challenge to KM in post disaster housing reconstruction (Table 7-6).

Improved performance was the key benefit that the respondents gained through KM and the other benefits such as effective monitoring of initiatives, efficiently and effectively use available resources were some of the highly rated benefits among respondents (Table 7-7).

Table 7-6: Challenges to KM

Challenges to KM in descending order	
1. Lack of compiling and synthesising the accumulated data, information and knowledge, storing and organising	10. Organisational culture
2. Lack of systematic collection of standardised data	11. The difficulties associated with communicating the benefits of KM
3. Lack of documentation of knowledge and application of lessons learned and best practices for decision-making	12. Poor IT infrastructure
4. No validation mechanism	13. Bureaucracy associated with KM
5. Lack of measure to value the performance of knowledge assets	14. People's fears
6. Unstructured KM approach	15. Conflicting priorities between KM and other business functions
7. Overload of information in the form of reporting	16. Change management
8. Changing people's behaviour	17. Employee resistance
9. What knowledge should be managed	18. Lack of top management support

Table 7-7: Benefits of KM

Benefits of KM in descending order	
1. Improved performance	11. Innovation
2. Effective monitoring of initiatives	12. Organisation can retain tacit knowledge
3. Efficiently and effectively use available resources	13. Dissemination of best practice
4. Improved decision-making	14. Increased intellectual capital
5. Improved reconstruction project delivery	15. Risk minimisation
6. Improve effective acquisition, sharing and usage of information within organisations	16. Lower cost in managing the projects
7. Reliable, useful, up-to-date and timely knowledge can be created and shared	17. Promoting fair practices among the disaster management community
8. Can avoid repeating past mistakes	18. Creates competitive advantage
9. Better valuation of resources and services	19. Increase profit, market share, market size and reduce cost
10. Respond very quickly to client needs and external factors	

Most of the KM sub processes were practiced by the donors and consultancy organisations, but in an informal way. The respondents believed that the knowledge capturing is important to function effectively, work quicker, plan better, reduce cost, give good out put to beneficiaries, get more resources (attract new donors), carry out future disaster reconstruction, give good solution, learn from, and have a win-win situation. Further, the importance of knowledge creation or production was to improve performance, motivate staff, increase organisational asset, etc. While knowledge sharing was vital in order to grow knowledge; get best decisions, avoid duplication, save time and energy, share correct and timely knowledge, improve relationships; knowledge storing was essential to get accurate information future, reduce cost, justify and accountable to donors and communities, and to show

transparency. Moreover, the significance of knowledge transferring was to learn more, increase effectiveness and efficiency of the work force, reduce cost, change the quality of construction, capacity building for local technical people, get timely advice, and disseminate knowledge.

7.5 Conclusions

This research has investigated the concept of KM in the post disaster housing reconstruction in Sri Lanka. Mostly, the construction industry has relied on expertise of key members of staff. 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 the most of the donors and consultancy firms, who do housing reconstruction, have got involved in tsunami housing reconstruction work compared to other disasters. Further, the respondents were mostly focussed on permanent housing reconstruction rather than other types of disaster housings. While competence was the most significant internal knowledge source to the organisation, repositories were the most significant external knowledge source to the organisation. Analysis of the sample revealed that 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 tool for KM. This was further supported by the semi-structured interviews. The findings suggest that lack of compiling and synthesising the accumulated data, information and knowledge, storing and organising was the major challenge in managing the knowledge faced by the donors and consultants who undertake post disaster housing. 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 knowledge creation, store knowledge on local technical people, carry out future disaster reconstruction, change the quality of construction, disseminate knowledge, grow knowledge, get best decisions, get more resources (e.g. attract new donors), give good output to beneficiaries, improve performance, improve relationships, increase organisation asset, plan better, reduce cost by avoiding repetitive tasks, save time and energy etc.

Even though the study presents most of the elements of KM, most of the organisations have not implemented KM formally into post disaster housing reconstruction. Although, it can be concluded that the awareness of KM is there in the industry to implement KM in post disaster housing reconstruction to improve performance. During the course of research, the researcher came across some interesting research opportunities. They are, study the same research question with additional unit of analysis, i.e. with donor, owner, consulting, and contracting organisations, study the each KM sub processes individually to deeper scope with regard to disaster reconstruction, study the role of KM in disaster management, and studying the procurement arrangement in post disaster housing reconstruction.

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8. Practising Energy Efficient Design for Commercial Buildings in Sri Lankan industry

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Abstract

The building industry is constantly expanding with consequences on energy expenditure. Similar to most countries, in Sri Lanka too the building industry is the most energy consuming industry. In recent years there has been much discussions regarding energy conservation techniques to mitigate the demand side of the energy sector. Building design directly affects the energy performance of the building. The emphasis on energy conservation has therefore, to begin at the design stage and control throughout the life cycle (Design, Construction, Operate and Maintenance) of the building project.

Buildings, energy and the environment are the issues that the building professionals have to address in current day projects. This is partly due to the increased public awareness on 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 expanded design team collaborates in early design stages to generate many alternative concepts for building forms, envelope and landscaping, focusing on minimizing peak energy loads, demand and consumption.

Purpose of this study is to find 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 was quantitative, within that questionnaires were used for detailed survey. A pilot study was conducted by telephone interview prior to the detailed survey.

Through this research it is found that there should be mandatory energy guidelines enforced for the designers. In addition, designers' lack of knowledge on life cycle benefit; available technology; available energy efficient techniques; and non- usage of energy analysis tools are major hindrance to proceed to the energy efficient design.

8.1 Background

In most countries, the building industry is the most energy consuming industry and it is constantly expanding with consequences on energy expenditure. The last twenty years of research effort has produced a consensus understanding of the impacts of energy consumption and the approaches to reduce this impact by using energy efficiency and the deployment of renewable energy technologies. In particular, the Building Energy Efficiency codes have been developed in many countries and almost all developed countries have enforced them [1]. Further the building energy simulation tools are in rapid development and are now been increasingly used in building designs [2]. Therefore, to achieve the energy efficiency goal, architects and building designers need to develop energy conscious designs in their relevant discipline. Hence this research is aimed to find what extent energy conscious design has been applied by the designers in today's buildings in Sri Lanka.

In Sri Lanka, the demand for electricity is rapidly increasing. In the year 2004, electricity demand growth rate varied between 7%-8%. Average electricity consumption per capita was 348Kwh/person at the same period and it has grown by 8% from previous year [3]. It was forecasted that electricity demand would quadruple in the next 15 years. However the last few years have seen the power generation of the country gradually shifting more towards thermal power generation. In 2004, gross

power generation increased by 5.68% but gross generation of hydropower plants were reduced by 13.63% for the same period [4]. It is estimated that by 2014, 82% of the total electricity demand will be met by thermal power generation [5]. At the same time, authorities are finding it very difficult to construct thermal power plants in the face of rising opposition from the local people on economic and ecological grounds.

In Sri Lanka the main sectors of energy consumption are industrial, transport, household and commercial and others (religious organisations, etc.). According to the Energy Conservation Fund (ECF) [6] for 2003, percentage of consumption of Household and Commercial sector was 51.10% when compared to the other two sectors at Industry and Transport that 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. Due to this, the present annual electricity consumption in commercial buildings, which is approximately 1000GWh, is expected to increase by 28% of total electricity demand [5].

According to the demand side management, the energy demand in this sector could be reduced by applying various energy conservation techniques throughout the life cycle of the building. Passive cooling, shading and sun control, efficient day lighting and heating, ventilation and air conditioning (HVAC) systems, active solar and photovoltaic system are some of the main energy conservation technique. As per the ECF, domestic and commercial sector have 12% of conservation potential from the total annual consumption, which could potentially save Rs 2.4 billion annually [6]. The UK Department of Energy estimates that, the better design of new buildings could produce energy consumption reductions of 50% and that appropriate design intervention in the existing stock of buildings could result in a 25% reduction in energy consumption ([7]). The electricity cost in most of the high rise buildings in Sri Lanka are generally 50% of the monthly operating budget [8]. Any reduction in energy cost will have greater impact on per square feet cost of the building. This will enable the building owners to reduce their office rentals. That will provide them a competitive advantage, especially when competing with smaller office buildings these overheads are comparatively low.

Therefore, to achieve resource conservation and efficient energy management in this area requires effective retrofit and innovatory design measures. By effective implementation of such measures, the commonly agreed and achievable target reduction is around 30%, with more optimistic expectations - up to 70% - for buildings incorporating advanced technology features [9]. However, such strategies and technologies have not yet been widely adopted by the construction industry. The majority of buildings are still being designed without energy-related considerations beyond those enforced by energy codes. One reason for this is that practitioners do not have the means to assess the impact of new strategies and technologies during the design stage.

Sustainable development has become a global focus in present day industry. Buildings, energy and the environment are issues that the building professionals have to address in current day projects. This is partly due to the increased public awareness of environmental issues related to building developments. Therefore, to achieve the energy efficiency goal, architects and building designers need to design energy conscious designs in their relevant discipline.

8.2 Sustainable Design

Sustainable design is the thoughtful integration of architecture with electrical, mechanical, and structural engineering. In addition to the concern of 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 Rocky Mountain Institute [10] outlines five elements for sustainable design:

- Planning and design should be thorough. Sustainable design is "front loaded" compared to traditional design. Early decisions have the greatest impact on energy efficiency, passive solar design, daylighting, and natural cooling.
- Sustainable design is more of a philosophy of building than a prescriptive building style. Sustainable buildings do not have any particular look or style.
- Sustainable buildings do not have to cost more, nor are they more complicated than traditional construction.
- Integrated design, that is design where each component is considered part of a greater whole, is critical to successful sustainable design.
- Minimising energy consumption and promoting human health should be the organising principles of sustainable design. In addition to the above elements for sustainable designs are energy saving architectural features, energy conserving building envelope, and energy-efficient and health-promoting mechanical, electrical, and plumbing systems.

The main objectives of sustainable design are to avoid resource depletion of energy, water, and raw materials; preventing environmental degradation caused by facilities and infrastructure throughout their life cycle; and to create built environments that are livable, comfortable, safe, and productive.

8.3 Energy conscious design in Sri Lankan context

To achieve sustainable development, one of the major contributions is given through designing energy efficient buildings. Therefore practicing and developing the energy conscious enhance design to produce more energy efficient buildings. This research aims to find the practice of energy efficient design in the building industry in Sri Lanka. Due to the broad scope of energy efficient design, this initial research is focused on identifying energy conscious design discipline of architectural and services designers from the building sector and considers mainly commercial building in the Sri Lankan industry. The aim of this research will be addressed:

- To identifying the energy conservation techniques and design tools and other measures to achieve energy conscious design.
- To identifying the measures taken to achieve the energy conscious design and their impediments.
- To investigate the level of consideration on the energy efficient design by the designers.
- To recognise what areas should be developed in the industry towards crafting energy efficient buildings.

8.4 Research Methodology

The research methodology adopted for this study was quantitative. Initially the pilot study was conducted by telephone interview to find out the designer’s consideration to the energy efficient design and the usage of energy analysis design tools. Then the detailed survey was conducted within that closed questionnaires used. It includes fixed responses option in the Likert scales. This was used to identify to what extent energy conscious design has been practised and what level it has reached in current context. The unstructured interview was not suitable since the scope of study is limited to find the level of practised and not in detail in depth as case studies. A structured questionnaire survey was conducted with selected thirty samples included in the pilot study sample. Fifteen professionals related to Architectural design had been interviewed and the rest of the fifteen professionals were interviewed in services design such as the electrical and air conditioning disciplines.

Descriptive statistical method was used for the analysis of data collected from structured interviews. The levels of responses incorporated with the statements were given weightings to convert this ordinal set of data to numerical figures. Further for descriptive statistical measures, viz. the minimum, maximum, median and the quartiles were used in analysis. A graphical box diagram as given in following example is used to present these parameters for easy comprehension (Figure 8-1):

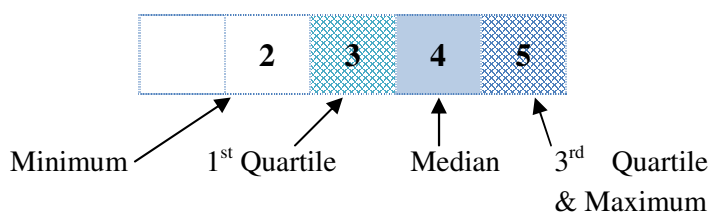


Figure 8-1 -What do you think about energy efficient design? The box diagram

This box diagram can be interpreted as, 50% of the responses have considerable knowledge of energy efficiency design. Less than 25% of the designers have some idea and at least one of the designers would have heard about the energy efficient design. Further there were some designers who have thorough knowledge in the energy efficient design.

Further, Mann-Whitney U Tests have been used to identify the significant differences between two independent groups of sample such as architects and services engineers.

9. Research Findings

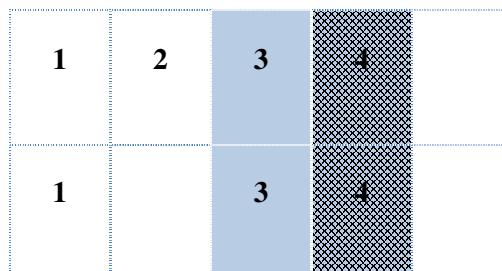
9.1 Results from the designers

The analysis of the responses of the designer revealed the following results.

- Q1 What do you think about energy efficient design?
- Q2 Do you think that is practical to achieve?
- Q3 To what extent client consider throughout the design phase?

	2	3	4	5
		3	4	5
1		3	4	5

- Q4 Does the client allocate sufficient funds for energy efficient designing?
- Q5 Do you think that clients are not sufficiently aware of issues such as renewable energy and energy efficient buildings?



According to the diagram Q1, it can be seen that at least 50% of the designers have some idea regarding energy efficient design and 25% of the designers have considerable more knowledge on that. Every designer has at least heard about energy efficiency design and there are designers who have thorough knowledge of it.

Q2 shows that all the designers somehow believe that it can be practically achieved and 50% of designers have confidence that energy efficiency can be achieved frequently at operational stage than would be anticipated in the design stage.

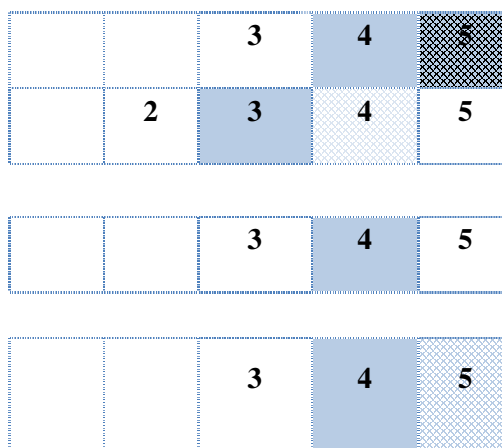
According to Q3, 50% of the designers believe that somehow clients consider energy efficiency measures throughout the design phase without concerns at the initial stage.

Q4 shows that, more than 50% of the designers reflect that the client rarely allocates sufficient funds for the energy efficient design at the design stage and at least 25% of the designers state that client never allocate sufficient funds for energy design.

From above diagram Q5 demonstrates that more than 50% of the designers respond that only some of the clients do not have average awareness on issues such as relevant to energy efficient designing and renewable energy. Of particular note is that none of the designers said that all the clients do not have sufficient knowledge on energy related issues. This can be interpreted as most of the clients have considerable awareness related to the energy efficient issues.

- Q6. Do you think that the followings will be required to insist clients and designers to consider the energy efficient designing?

- a. New building regulations or legal enforcement are required.
- b. New mechanisms and incentives are required to encourage clients to invest in energy efficiency measures.
- c. Provide sufficient information and knowledge to client and designer regarding the energy efficiency.
- d. Provide enough access to the resources, products, information and skilled assistance regarding energy.



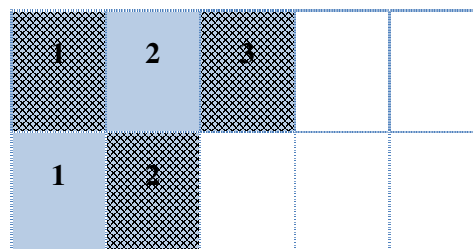
- e. Provide training and education to state and local officials, private industry, and consumers.



According to this diagram Q6 represents, that 75% of the designers agree that new building regulations or legal enforcement; provide sufficient information and knowledge; increase the availability of the energy efficient products; provide training and education will be required often to insist to consider energy efficient designing. Further, 50% of the designers expressed that new mechanism and new incentives often insist the client and designer to go for energy efficient design.

Every designer expressed that these above factors are needed much to insist to clients, as well as designers, to proceed with the energy efficient designs. Most of the designers expressed that statutory requirements will help level the playing field for developers and builders as energy-conscious designers and building professionals will not have to compete with others who achieve construction cost savings by eliminating or ignoring energy-efficient features in their design. Some architects believe that mandatory standards limiting the design freedom and innovations if the Building Energy Standards are not comprehensive and flexible enough.

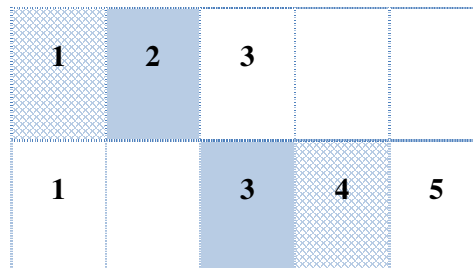
- Q7 Do you think that time taken for design is high for achieve clients energy efficient requirement?



- Q8 Do you think that design cost is high for achieve clients energy efficient requirement?

According to the diagram Q9 and Q10 it shows that, only 25% of the designers state that design time is never long enough for energy efficient designs and when compared with design costs more than 50% of the designers stated that design cost was never high enough. And none of them states that design cost and time duration of the energy efficient design were always high.

- Q9 Do you think that time taken is long for constructing energy efficient buildings?



- Q10 Do you think that integration design process by using in-house professionals will enhance the energy efficient design?

According to the diagram, Q10 shows that 25% of the designers state that construction time is never long enough and 50% of the designers expressed that rarely was time increased for construction of the energy efficient buildings.

Q11 shows that 50% of the designer’s state that the integration design process by using in-house professionals will sometimes enhance the energy efficient design. Only 25% state that it often enhances the energy efficient design. Further it is found that, some of the designers described that it depends on the availability of communication modes in the organisation. Even though the professionals are separated the design process will be enhanced by proper communication system between these professionals.

Q12 Do you set energy performance goal?	1	2			
Q13 Do you follow any checklist to achieve this goal?	1	2			
Q14 Do you use any technique to evaluate energy efficient design?	1	2			
Q15 How often the proposed alternative designs has been agreed by the client?	1		3	4	5
Q16 How often the proposed alternative designs has been agreed by the other design professionals?	1			4	5

From the box diagram Q12, Q13 and Q14 shows that the responses are similar responses for all three facts. Whereas more than 75% of the designers do not use any check list to achieve energy efficient design goal; do not set energy performance goal and do not use any technique to evaluate their design.

Q15 and Q16 above illustrate that 75% of the designers states the alternative designs proposed by them have been agreed by other professionals but it is 50% in case of client. In the case of energy efficient designs the client has the most influence in the decision making process, in the case of alternating the proposed designs.

9.2 Results from the Engineers and Architects

1. Do you think that there is sufficient energy saving technologies available in the current market?

Architects	1		2		3	4	
Engineers	1			3		4	5

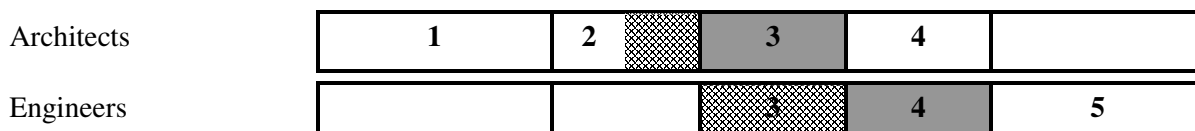
According to this diagram, more than 50% of the architects state that the energy saving technologies are rarely available in the current market. However, 50% of engineers state that energy saving technology is often available in the market. Some of the engineers state that there are always sufficient energy saving technologies available in the market but none of the architects mentioned it.

2. To what extent have energy efficient requirements of the client succeeded?

Architects	1			3	4	
Engineers			3	4		5

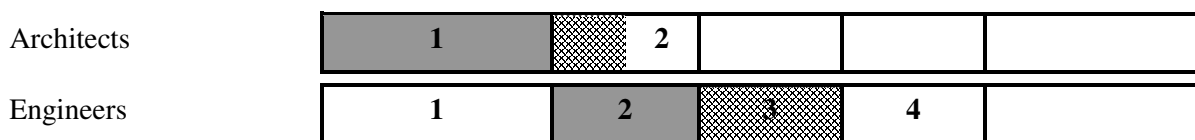
According to the above diagram, more than 75% of the architects state that clients succeed with his requirement very often. But there were no architects who respond that it has always succeeded. In the case of engineers it was found that more than 25% of respondents state always the client succeeds with his initial requirement. At least every engineer is confident that energy efficient design was met with the client's initial requirement.

3. Do you think that construction cost is high for energy efficient buildings?



From the above diagram it shows that 50% of architects state that sometimes the construction cost is high for the energy efficient building. At the same time, the engineers stated at on some occasions the construction cost is high.

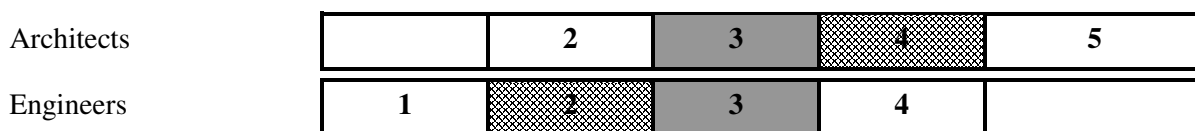
4. Does the designer follow any guidelines to achieve energy efficient designs?



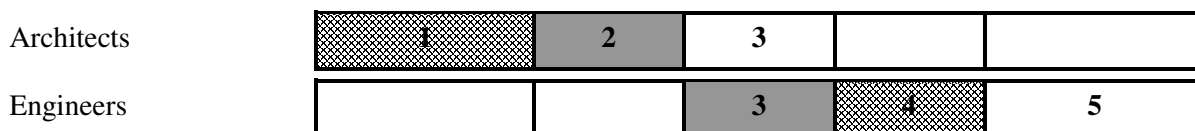
From the diagram it can be found that more than 50% of the architects have never followed any guidelines related to energy efficient design. At the same time, 50% of the engineer has sometimes followed guidelines such as the Energy Efficient Building Code (EEBC) in their design. During their questioning it was found that EEBC was not popular among the design professionals, especially architects.

5. To what extent do designers use the following techniques to achieve energy efficient building?

a. Incorporate solar passive techniques in a building design to minimise load on conventional systems.



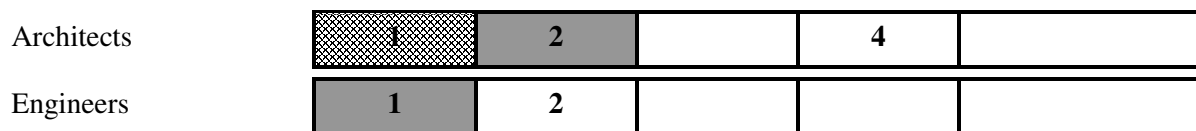
b. Design energy efficient lighting and HVAC systems.



From above diagrams it clearly shows that architects and engineers have different levels of knowledge on techniques used to achieve energy efficient buildings. It is clear that more than 50% of the architects have some idea that solar passive techniques in a building design can minimise load on

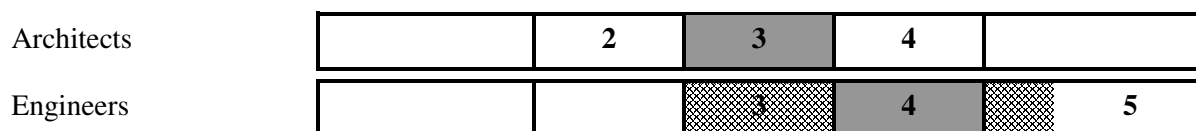
conventional system, compared with the engineers, who have less than 25%. It is vice versa in the case of designing an energy efficient lighting and HVAC system. From this it is obvious that the engineers have considerably higher knowledge of HVAC system.

c. Use low energy materials and methods of construction & reduce transportation energy (reducing embodied energy)



When we consider the technique of using low embodied energy materials to achieve energy efficiency in a building, none of the professionals have thorough knowledge of it. 50% of the architects have little knowledge on it as opposed to the engineers who have no idea about it.

d. Use renewable energy systems (solar photovoltaic systems/solar water treating systems) to meet a part of building load.



The above diagram indicates that over 50% of the engineers have considerable knowledge on the use of renewable energy systems to achieve energy efficient in the buildings. However, more than 75% of architects have some knowledge of it.

9.3 Conclusions

This study was conducted to identify the designers concern towards energy responsive design in the building industry. Nowadays the world focuses on sustainable development. Hence the designers are focusing more on sustainable design with respect to the construction industry. Awareness regarding energy efficient design is very important in the present day design scenario. Most of the designers should consider it not only by thinking of the benefit of the clients but should also consider society’s benefit 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 the year 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 that mandatory guidelines are needed to construct more energy efficient buildings in the future. They further expressed that the present EEBC needs to be updated and revised before it is practiced as a mandatory guideline. This should be implemented as soon as possible. This will encourage more designers and engineers to craft their design as energy conscious design in future.

Furthermore clients have been very reluctant to go for energy conscious design, because most have a misconception that construction cost was high for energy efficient construction, by only considering the initial cost. However this is not real in the present scenario. When considering the long run of the building it is found that energy efficient building is more economical than the traditional energy non-

conscious buildings. Some designers have considerable knowledge on life-time benefits of the energy efficient design and they have a high responsibility to convince clients to go for energy conscious design.

In the Sri Lankan building 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 very familiar among designers. Moreover it is found that techniques to achieve energy efficient buildings, by using low embodied energy material, are not well-known among the designers. Most of the designers state that non-availability of material and technologies in the market is one of the main obstacles in going for energy conscious design.

However, in general most of the designers are not considerably concerned in relation to energy efficient designs in their design discipline. In addition to that, the knowledge regarding energy analysis tools is also lacking within the designers. Most of the designers believe that it is not practicable for use in the Sri Lankan context. Providing education and training and other measures to familiarise the energy conscious designer will be much more effective in the present day industry. In addition to the designers, the stakeholders such as local officials, private and public clients and consumers also need to be aware of more energy efficient aspects in order to save energy and provide vital economic and ecological benefit to a country like Sri Lanka.

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