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MANAGING CONSTRUCTION WORKERS AND THEIR TACIT KNOWLEDGE IN A KNOWLEDGE ENVIRONMENT: A CONCEPTUAL FRAMEWORK

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ABSTRACT: Within the construction industry, it is increasingly being acknowledged that knowledge management can bring about the much needed innovation and improved performance the industry requires. Nevertheless, sufficient attention is still to be received for the concept of the knowledge worker and their tacit knowledge within construction industry. Yet, proper understanding and management of this resource is of immense importance for the achievement of better organisational performance. Hence, this paper aims to devise a theoretical framework for managing construction knowledge worker and their tacit knowledge based on review and synthesis of literature. Paper stresses the importance of construction knowledge worker and tacit knowledge through review of literature and highlights prevailing gap due to lack of attention and recognition given to the tacit knowledge in the construction industry. Based on identified gap research aim, objectives and hypotheses are devised. As the specific research methodology, the social constructionism stance in terms of epistemological undertakings and idealistic approach under the ontological assumptions with value laden purposes are suggested. Further, it recommends the deployment of multiple exploratory case studies approach with triangulation techniques.

Keywords – Construction Industry, Knowledge Worker, Knowledge Management, Tacit Knowledge

1. BACKGROUND

There has been a surge of interest in managing knowledge during last few decades, leading to considerable changes in the business environment. As a consequence, there is increasing concern in organisations' efforts to deliberately manage knowledge in a systematic manner. Work by Polanyi (1958), Nonaka and Takeuchi (1995), divided knowledge into tacit; which is stored in people's heads and is acquired through experience, and explicit knowledge; which could be documented and therefore physically stored. Accordingly, Knowledge Management (KM) discussion has focused into two principal camps. One is rooted in the Information Technology (IT) perspective (Explicit knowledge) where authors focus on IT tools to deliver KM solutions (Bair and O'Connor, 1998; Gottschalk, 2000; O'Leary, 2001), and the other on the human resource (Tacit knowledge) perspective that relies on the people aspect to provide KM solutions (Harman and Brelade, 2000; Egbu et al., 2001). Yet, human resource perspective of KM still considered to be relatively unexplored and not fully understood (Zack, 1999) compared to work on IT perspective (Leonard and Sensiper, 1998; Holtshouse, 1998).

It is argued (Egbu et al, 1999, Carrillo et al, 2000; Kamara et al, 2003) that the main drivers behind the increased interest in KM amongst organisations operating in the UK construction industry are the Government's prerequisite to achieve industry-wide improvements and the desire of individual organisations to seek competitive advantage. This has been further emphasised in a survey by Management of Knowledge and Innovation Research Unit (Egbu et al, 2003) of the Open University, which highlighted the move towards the change initiated by the Latham (1994) and the Egan (1998) reports as the mostly

cited driving force behind KM within the UK construction industry. Yet, the term 'Knowledge Management' is relatively new to construction organisations (Carrillo et al, 2000), nevertheless, a growing number of organisations within construction industry (Kamara et al, 2003) now perceive KM as an integral part of their competitive strategy for providing long term benefits for the organisation. The emphasis on KM reflects the growing realisation that it is a core business concern, particularly in the context of the emerging knowledge economy, where know-how of a company is becoming more important than the traditional sources (capital, land etc) of economic power (Drucker, 1992; Scarbrough et al, 1999).

However, despite the interest and the effort put into KM by many leading companies, the discipline is still in its infancy in the construction industry and is at an embryonic stage in UK construction (Robinson et al., 2001; Carrillo, 2004). This is evident with dearth of academic research and inadequate empirical studies done on KM in construction industry and even the limited number of studies that have been conducted, focused heavily or solely on explicit knowledge (Egbu et al, 2003) and on the role of IT (Carrillo et al, 2000). However, any KM approach that is purely based on IT is bound to be less successful because people issues, which are not readily solved by IT systems, would need to be resolved (Kamara et al, 2002). Further, in the context of the knowledge economy, what people do with their knowledge, termed as tacit knowledge, is considered to be the real driver for the performance of the industry (Quintas, 2005). As such, the people-centred view of KM is increasingly being viewed as of critical importance for organisations wishing to retain competitive advantage and to achieve better performance. Hence, as a labour intensive knowledge based industry, there is an emerging importance placed on effectively managing the construction knowledge worker and their tacit knowledge to achieve best value for the industry.

In this context, the paper discusses the theoretical framework developed to manage knowledge worker and their tacit knowledge to achieve better performance within the construction industry. The paper is broadly divided into five sections. Initially, it discusses the importance of knowledge worker and their tacit knowledge with specific to the construction industry. Secondly, paper explores the theoretical basis of managing tacit knowledge and its link to organisational performance. Aim, objectives, research questions and hypotheses are explained within section three and section four introduces the conceptual framework of the study. Finally, paper concludes with discussion of the specific research methodology for this study.

2. IMPORTANCE OF KNOWLEDGE WORKER IN CONSTRUCTION

It is argued (Robinson et al, 2001; Egbu & Robinson, 2005) that the construction industry, although known for its highly tangible products such as buildings and other structures, is increasingly now recognised as a provider of services, placing more emphasis on knowledge. Hence, construction industry has already entered into a knowledge economy where it is perceived as one of the knowledge based value creating sectors of the economy [Refer Pathirage et al (2005a) for a complete synthesis]. Moreover, people are known to be the key to success in a knowledge economy, whom are termed as knowledge workers. There are a wide range of professionals involved in construction industry, working as an interdisciplinary team in delivering the construction products. People are recognised as possessing knowledge, skills and know-how, having the ability to create knowledge and value, and collectively retaining organisational memory. What people do with their knowledge is the real driver for competitive advantage in the knowledge economy (Quintas, 2005). As highlighted by the UK Government's Competitiveness White Paper (DTI, 1998), one of the two distinct tasks envisaged for organisations within the knowledge driven economy is to

encourage and support employees in developing their skills and qualifications on a continuous basis. The UK construction industry employed 19,130 workers per £1 billion output (total of 1,599,000 workers) in 2003 (Green et al, 2004), hence considered to be one of the labour intensive sectors of the economy. People are an organisation's most valuable asset and this is especially true in relatively low-tech, labour intensive industries such as construction.

The increased awareness of the importance of employees' knowledge coincided also with a popularisation of the idea of the 'knowledge worker'. This is based on the notion that certain types of work are more knowledge intensive than others, and it is this knowledge intensive work that is growing within the economy (Quintas, 2005). The importance of the construction worker is highlighted by the fact that industry relies on skill and on the capacity to bring different skills together effectively (Drucker & White, 1996), thereby the concept of the knowledge worker has long been important to construction organisations (Green et al, 2004). In recent years, with the growth of the service sector, this emphasis placed on the construction knowledge worker has gradually increased. Further, construction employs an extremely diverse range of people from a wide array of occupational cultures and backgrounds, including people in unskilled, craft, managerial and professional positions, which makes it difficult to manage knowledge workers effectively to ensure organisational success. Much of this individual knowledge is unknown to others and unmapped and unrecorded. As Sheehan et al (2005) asserts in construction;

- Some 80% of the useful knowledge is tacit and cannot be written down
- The CI is characterised by a wealth of experiential knowledge, yet employees retire or leave the organisation, potentially taking tacit knowledge and a potential source of competitive advantage with them

As Rezgui (2001) cited, there are few key reasons that limit current approaches of KM in the construction industry. Among the key factors for these limitations are;

- Much construction knowledge, by necessity, resides in the minds of the individual working within the domain.
- The intent behind the decisions is often not recorded or documented.
- The individuals who have knowledge about the project are likely to left for another project at the end of the construction stage; hence their input is not captured.

All these three limitations indicate the direct correlation with the human factor in the construction industry and stress the importance of the concept of knowledge worker which has long been central to construction industry performance. Further, both Sheehan et al (2005) and Rezgui (2001) stress the point that much knowledge possessed by construction knowledge workers are considered to be tacit in nature. Accordingly, the following section outlines the importance of the tacit knowledge and its presence in construction as a knowledge based industry.

3. TACIT KNOWLEDGE IN CONSTRUCTION

Within construction, the type of knowledge varies considerably, yet tacit knowledge attracts an increase concern as a labour intensive industry. In the context of construction, examples of tacit knowledge include estimating and tendering skills acquired over time through hands-on experience of preparing bids, understanding the construction process, interaction with clients/customers and project team members in the construction supply chain, as well as understanding tender markets (Egbu & Robinson, 2005). Specially, Engineers, Architects and

other professionals within the construction industry are not in a position to ‘cut and paste’ best practice (Kamara et al, 2003) from the past due to the unique and the complex nature of the construction projects. They have to draw on the past to find solutions for the future. Tacit knowledge evolves from these shared practices and experience which need to be managed for the project and the organisational success. According to Wetherill et al (2002), knowledge in construction domain can be classified into three categories as illustrated in Table 1, which further highlights the emphasis placed on knowledge worker and tacit knowledge.

Table 1: Classification of Knowledge in construction domain (Wetherill et al, 2002)

Domain Knowledge	The information available to all companies and is partly stored in electronic data bases
Organisational Knowledge	Company specific and intellectual capital of the firm which also comprises knowledge about the personal skills, project experiences of the employees
Project knowledge	Which includes both project records and the recorded and unrecorded, memory of processes, problems and solutions

By taking a different stance Stahle (1999) suggests organisations into three-dimensional system i.e. mechanistic, organic and dynamic nature, depending on the different challenges presented for management of knowledge. Mechanistic part deals more with explicit knowledge whilst organic nature helps the organisation to work flexibly with a people-centred orientation and involves the management of tacit knowledge. The dynamic nature facilitates continuous improvement and innovation. Wetherill et al’s classification reflects the organisational hierarchy and when one moves from domain knowledge to project knowledge the concentration on knowledge too moves from explicit to tacit nature, which further highlights the knowledge worker concept in construction. Stahle’s suggestion indicates both the management and the production of the knowledge. In a similar sense Moodley et al (2001) contend that the tacit knowledge is developed through the individual or project teams, while the explicit knowledge is created through process, procedures and other routines that can be codified. Whatever the classification, tacit knowledge of the workers has been highlighted in much research carried out in the construction industry. A research carried out within structural design firms (Al-Ghassani, 2003) showed that about 80% of knowledge used during concept design stage is tacit compared to about 20% of explicit knowledge. As such, managing tacit knowledge more effectively offers construction organisations a possible mechanism for improving their performance in times of greater competition. Having discussed the importance of construction knowledge worker and their tacit knowledge, succeeding section explores more into tacit knowledge and its management.

4. TACIT KNOWLEDGE MANAGEMENT

Several researchers (e.g. Nonaka and Takeuchi, 1995; Stahle, 1999) consider that success of an organisation is formed by the interaction between individuals and several types of knowledge. However, as highlighted by Koskinen (2003), in many organisations the bipartite nature of knowledge, i.e. tacit and explicit, has probably not yet been sufficiently understood. Thus, one organisation might need more tacit knowledge than another, yet more attention is often directed on codified material only. Thereby, the fact that a great deal of the know-how required in implementation of a task is tied to knowledge that is not written but realised through understanding of the personnel, is not taken into consideration as a whole (Koskinen, 2003). Tacit knowledge is the unarticulated knowledge that resides in human beings, which is

obtained by internal individual processes like experience, reflection, internalisation or individual talents (Herrgard, 2000). Therefore it cannot be managed and taught in the same manner as explicit knowledge. An organisation's core competency is more than the explicit knowledge of 'know-what'; it requires the more tacit 'know-how' to put 'know-what' into practice (Brown & Duguid, 1998). Even if coded knowledge is easier to diffuse, the role of tacit knowledge is often essential for being able to use coded knowledge. Yet, an understanding of what constitute 'tacit knowledge' is central to its effective management. Hence, the succeeding section introduces the nature of tacit knowledge and factors which effects its utilisation.

4.1. Tacit Knowledge & Its Utilisation

As Herrgard (2000) and Empson (1999, 2001) contended, organisations' knowledge resources can be described as an iceberg. The structured, explicit knowledge is the visible top of the iceberg, which is easy to find and recognise and therefore also easier to share. Beneath the surface, invisible and hard to express, is a momentous part of the iceberg. This hidden part applies to tacit knowledge resources in organisations. Individuals are the primary repositories of tacit knowledge that due to its transparent characteristics is difficult to communicate. While highlighting the importance of tacit knowledge, Tiwana (2000) defines it as know-how that is stored in people's heads which is personal, acquired mainly through education, training and experience. In a similar sense, Saint-Onge (1998) describes tacit knowledge as an individual's intuition, beliefs, assumptions and values, formed as a result of experience. It is from these beliefs and assumptions, which make up an individual mindset that decisions are made and patterns of behaviour developed. Thereby, in working life one can easily find many examples of tacit knowledge such as intuition, rule-of-thumb, gut feeling and personal skills, all based on individual experiences. When synthesised, tacit knowledge could be classified into two dimensions knowingly the technical and the cognitive dimension (Herrgard, 2000, Hussi, 2004). The technical dimension encompasses information and expertise in relation to 'know-how' and the cognitive dimension consists of mental models, beliefs and values (Gore and Gore, 1999), in short conception of reality.

Nevertheless, the factors which affect the utilisation of tacit knowledge in organisations can be categorised into internal and external factors. Internal factors are either possessed or under control of an individual which influences both technical and cognitive dimension of tacit knowledge. As suggested by Koskinen (2003) the internal factors can be further categorised into different groups which are called memory, communication, and motivational systems. Memory systems include experience, mental models, and intuition, in other words factors which function as constructs and manifestations of memory (and tacit knowledge) of an individual. Communication systems include interaction, language, and proximity, in other words factors which affect the communication of data, which is then interpreted to become knowledge. Motivational systems include commitment and trust. Commitment is a manifestation of the motivation of an individual, and the trust between the people involved motivates them to share and receive tacit knowledge. In a similar sense, Butcher et al (1997), introduced the term "Meta Abilities" defined as personal, acquired abilities that underpin and determine how and when knowledge will be practiced within the organisation. Meta abilities introduced by Butcher et al (1997) underpinned the very similar factors suggested by Koskinen (2003) under the internal factors. The external factors are called situational systems and they include leadership style and organisational culture, which defines the situation in which tacit knowledge is utilised. Thereby, this highlights that management of tacit knowledge is intrinsically concerned with both internal and external factors. Thus, tacit

knowledge management strategy of an organisation should address both these facets to be effective. The following section further explores this issue.

4.2. Management Strategy

As Harman and Brelade (2000) contended, KM to be effective, must encapsulate the idea that it is through the acquisition of knowledge by individuals and their willingness to apply their knowledge for the benefit of the organisation that competitive advantage is achieved. Davenport (1998) further highlights this issue by asserting “the most dramatic improvements in KM capability in the next ten years will be human and managerial”. Invariably, the management of tacit knowledge is intrinsically linked to the management of people (Egbu et al., 2001) and to the processes that facilitate knowledge generation, distribution and sharing between related individuals and workgroups. As highlighted in internal and external factors of tacit knowledge utilisation, this further stresses very similar two aspects or dimensions in tacit knowledge management;

- Recognising and managing people or the knowledge workers with the right human resource policies (Internal factors)
- Ensuring knowledge supportive and conducive environment or culture within the organisation to support knowledge processes (external factors)

An increase number of individuals do work which is knowledge based and the concept of knowledge worker needs to embrace these individuals who can be found at the all levels within organisations. A major aspect of managing tacit knowledge in a knowledge-based economy is giving to knowledge worker the power that arises from the ability to solve the critical contingencies facing the organisation. It means that knowledge worker will increasingly be able to determine that they are managed in ways acceptable to them. As suggested by Tyson (1995), for managers this will involve a paradigm shift to see themselves as facilitators rather than controllers. This highlights the necessity of managing knowledge worker with flexible, employee centred approaches based on consensual models (Harman and Brelade, 2000). Yet, Construction as an industry which has a reputation for its dominant culture of command and controls consistently emphasises and correlates with the hard model of human resource management. Also the culture of subcontracting and self employment marginalises the importance of people management and thereby reflects and reinforces the dominant industry receipt of hard human resource management. The ignorance of the knowledge worker within the construction context has contributed to a great extent to the under performance of the industry as lamented by many authors (Cooke-Davies, 2001; Nesan & Holt, 1999). As Egan (1998) asserted;

“...much of construction does not yet recognise that its people are its greatest asset and treat them as such. Too much talent is simply wasted, particularly through failure to recognise the significant contribution We understand the difficulties posed by the fragmented structure of the industry, but construction cannot afford not to get the best from the people” (para 17: 14).

Soft human resource management policies based on empowerment and commitment are much more prevalent within organisations orientated towards creativity (Green et al, 2004). As such it is an urgent matter for the construction industry to move towards the softer approach based teamwork from hard model of human resource management to enhance the collective efforts. The second facet of the management strategy is concerned with creating a

proper knowledge supportive culture with appropriate techniques for knowledge processes. This will be discussed further in the next section.

4.3. Processes and Techniques

Processes like knowledge production, dissemination and sharing are considered to be important facets of a knowledge economy (Egbu & Robinson, 2005). Hence, the KM environment needs to reinforce the acquisition, use and sharing of individual tacit knowledge. Therefore, significant effort should be directed towards exploiting non-IT techniques such as communities of practices, brain storming sessions, action learning, post project reviews etc to facilitate person-to-person and person-to-organisation interactions. Several authors (Augier and Vendelo, 1999; Koskinen, 2003) have repeatedly highlighted the importance of interaction, integration and involvement of knowledge workers through social networking within an organisation. Social interaction of employees cultivates a knowledge sharing culture based on shared interest, thus encouraging continuous knowledge generation through the evolution of a community of practice. Within the community of practice, tacit knowledge may be shared in non-codified forms (Brown & Duguid, 1998). According to Koskinen (2003), in such kind of knowledge environment manager could support the acquisition and sharing of knowledge and expertise by;

- Encouraging individuals to use their knowledge and expertise
- Facilitating innovation and creativity and encourage new ideas
- Representing the interests of the individual/ team to the organisation

This will involve an understanding of individuals and teams and a willingness to be open to new ideas and personal development. As such, managing tacit knowledge in a knowledge environment, corporately through right human resource policies and techniques will be judged by its ability to encourage and enable individuals to apply their knowledge for the benefit of the organisation.

4.4. Organisational Performance

The determination and the establishment of benefits and the impact on the organisational performance are of utmost importance for a business to justify the implementation of KM initiatives. As Grant (1996) asserts in his knowledge-based theory of strategy, the source of competitive advantage in dynamic environments is not knowledge that is proprietary to the organisation (explicit knowledge), because the value of such knowledge erodes quickly due to obsolescence and imitation. Rather, sustained superior performance is determined by non-proprietary knowledge in the form of tacit individual knowledge. Tacit knowledge can form the basis of competitive advantage because it is both unique and relatively immobile. Yet, because that knowledge is possessed by individuals and not the organisation, a critical element of sustained competitive advantage is the ability to integrate the specialised and tacit skills of the individuals, as highlighted in the previous section. Grant's approach can be considered as an outgrowth of resource based thinking and indicates the importance of tacit knowledge towards organisational performance and in achieving competitive advantage when developed and managed properly. Having established the theoretical basis for managing tacit knowledge, following section describes the aim, objectives, questions and hypotheses devised for this study.

5. AIM, OBJECTIVES AND HYPOTHESES OF THE STUDY

As emerged from previous sections, the main aim of this study is to explore and investigate into tacit knowledge management in the construction industry and its relationship to organisational performance. Justification for the study is done through highlighting the importance and its necessity to manage tacit knowledge in construction industry and due to dearth of published literature and inadequate empirical work done [Refer Pathirage et al (2005b) for a complete argument]. The broad aim stated above will be achieved by four objectives. First: by exploring into current KM practices and usage of business performance models within construction organisations. Second: by determining the role and the importance of tacit knowledge and factors which influences the generation and utilisations of tacit knowledge. Third: by investigating the strategy and techniques to be followed in managing tacit knowledge. Finally: by exploring the relationship between tacit knowledge management and organisational performance in the construction industry. Based on the understanding gained from the literature review and synthesis, hypotheses and research questions are developed as explained below.

RQ1: What are the current KM practices and business performance models used within the construction organisations?

H1: There is a lack of attention given to tacit knowledge management within the construction organisations, when compared with emphasis given to management of explicit knowledge within the industry.

RQ2: What are the key factors which determine the generation and utilisation of tacit knowledge for construction knowledge workers?

H2: The tacit knowledge generation and utilisation processes are very complex involving internal cognitive processes of human beings, rather than simple, due to various internal individual factors and external, group, organisational and industry factors.

RQ3: What is the most appropriate strategy for managing tacit knowledge within construction industry?

H3: Tacit knowledge management strategy should encourage managing knowledge workers with trust and commitment than command and control, and should ensure knowledge supportive environment with non IT techniques than Information Technologies, and should address both these aspects than any one of them.

RQ4: How tacit knowledge can be shared and disseminated among construction knowledge workers?

H4: Tacit knowledge could be shared and disseminated, through interaction, integration and involvement by use of techniques like communities of practices, brain storming sessions and action learning, than through coding by use of Information Technologies.

RQ5: What is the impact towards constructional organisational performance when tacit knowledge is managed?

H5: When factors effecting tacit knowledge generation and utilisation are identified, knowledge workers are managed with trust and commitment, and through interaction by use of non IT techniques, there will be a positive impact towards the organisational performance than a negative impact.

These hypotheses are shown in the conceptual model as described next.

6. CONCEPTUAL FRAMEWORK

The conceptual model (Refer Figure 1) shows the process of managing tacit knowledge and its constituent parts based on the theoretical understanding gained from review and synthesis of literature. The core of the model represents the tacit knowledge generation process i.e. cognitive process within human beings. This generation process and the utilisation of the tacit knowledge are influenced by several internal and external factors as represented in four layers. Internal factors are at the individual layer which influences the generation process and utilisation of tacit knowledge. External factors will be at group, organisational and industry level. The second layer represents the group level which is influenced by group factors. The third layer denotes the organisational level, which is influenced by Organisational factors and the final outer layer represents the industry level which is influenced by industry factors (Indicates with H2). These factors in terms of four layers are denoted within the model by use of a triangular which also shows the direction of impact. Arrows which crosses four layers indicates different categories of tacit knowledge.

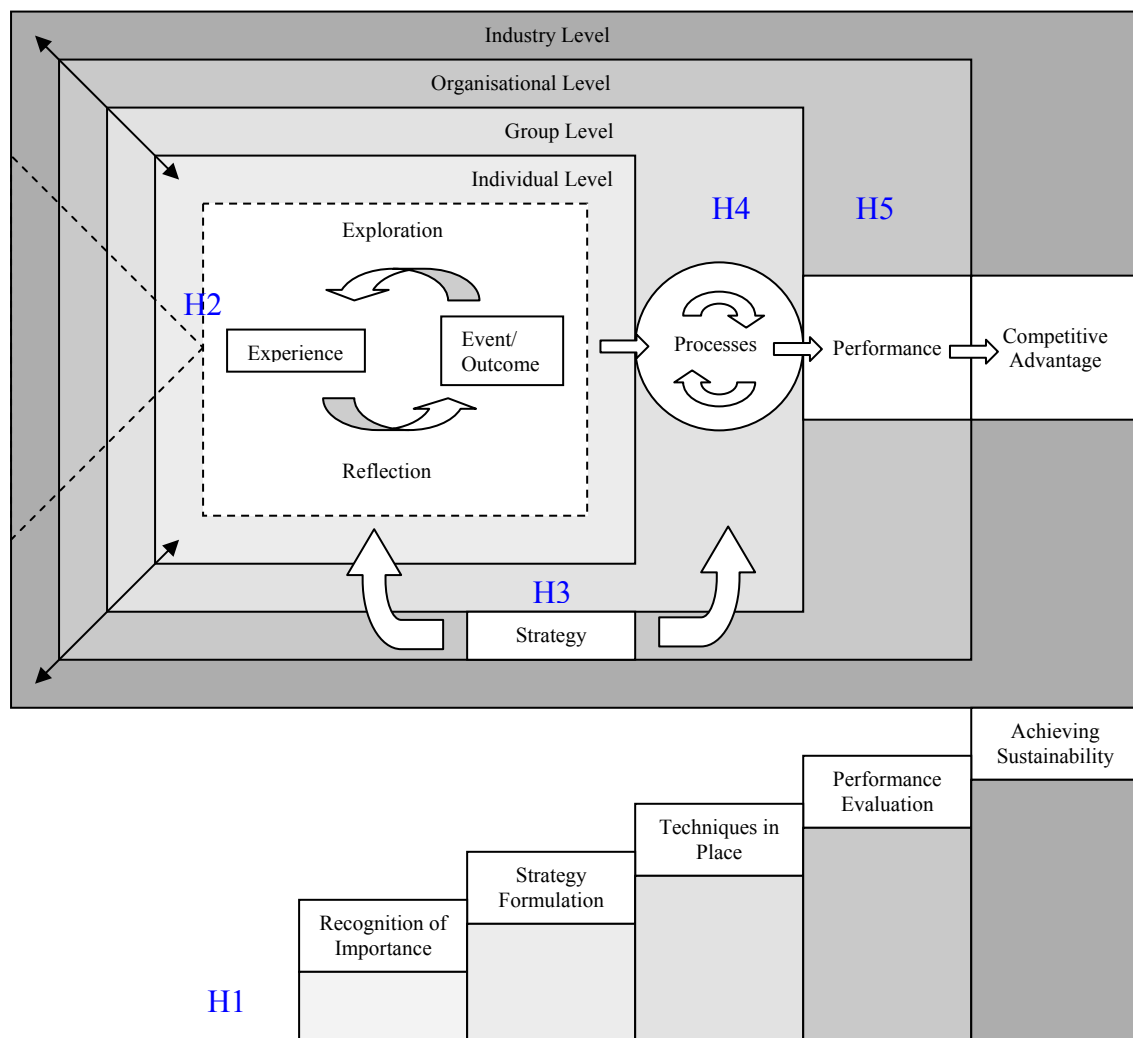


Figure 1: Tacit Knowledge Management Model (Conceptual Framework)

This tacit knowledge needs to be shared and disseminated, through interaction, integration and involvement by use of techniques like communities of practices, brain storming sessions and action learning which is represented at group level (Indicates with H4).

Hence, tacit knowledge management strategy needs to address both, factors which influence the tacit knowledge generation and utilisation, and group level techniques (Indicates with H3). Outcome of this process is linked with the performance at the organisational level and in achieving competitive advantage which is at the industry level (Indicates with H5). Finally, this total process of tacit knowledge management is reflected in five maturity levels, which indicates the stepwise progress to achieve sustainable competitive advantage within the industry. Further, this maturity stages will map out the position of an organisation in term of tacit knowledge management progress, which highlights the attention given by a particular organisation (indicates with H1). Having identified the aim, objectives, hypotheses and the conceptual framework to be used for this study, succeeding section explores the summary of the specific research methodology proposed for empirical data collection and analysis.

7. RESEARCH METHODOLOGY

This study uses the ‘nested approach’ (Kagioglou et al, 1998) which nests the philosophy, approach and techniques of the research. Figure 2 depicts the intended deployment of each of these elements in this study and succeeding discussions will explore the application of these philosophical paradigms, approaches and techniques for this research [Refer Pathirage et al (2005c) for a complete analysis of research methodology].

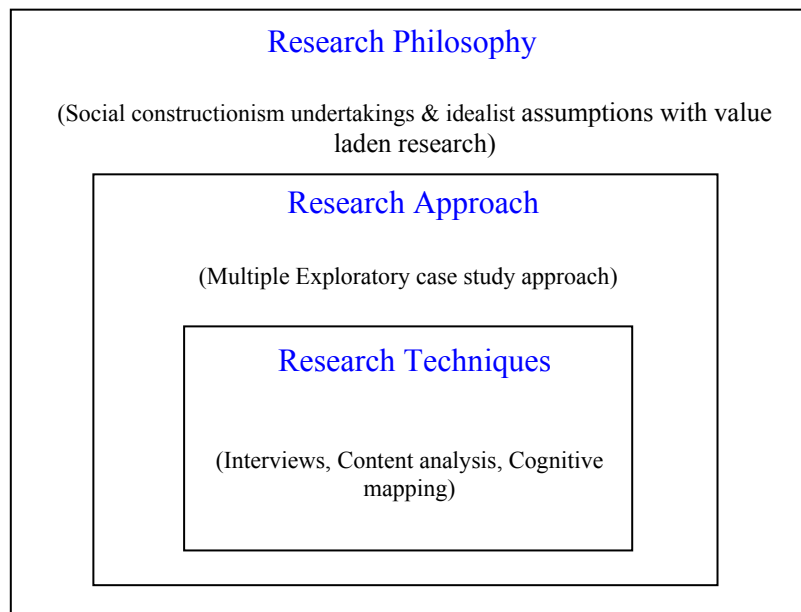


Figure 2: Nested Approach (Kagioglou et al, 1998)

As this study attempts to explore the tacit knowledge mainly grounded in knowledge workers, which gains its orientation from the management research paradigm, it disproves the likeliness of comfortably fitting to the positivist paradigm. Hence, based on the capability of a socially constructed reality in building up the understanding of the phenomenon, social constructionism stance is preferred as the underpinning epistemological undertaking in this research. Further, as the nature of the problem being investigated in this study is of explorative type and due to the unstructured character of the subject being examined, this research closely resembles with the idealist assumption in terms of ontological positioning. Also it is expected that different observers to come up with different view points, due to the subjective, value laden nature of the researcher, which highlights the axiological purposes of

the research. Hence, in summary research is mainly driven towards social constructionism stance in terms of epistemological undertakings whilst taking an idealistic stance in positioning under the ontological assumptions with value laden purposes in terms of axiological endeavours.

Further, in terms of research approach, the necessity for a descriptive, context specific research without the researcher's intervention together with the exploratory type research questions defined, justifies the case study approach for this research. As aim and objectives of this research are more of exploratory with 'What', 'How' questions, explorative case studies were favoured. Since, the phenomenon in study is not a critical, unique, typical or a rare case (Yin, 2003), multiple cases were preferred. The use of multiple cases in this research underlines the complexity of the topic under study and develops the empirical evidence to support the theory building.

Data will be mainly gathered via interviews, direct observations and through document reviews. Interviews will be carried out at three different levels of staff in construction organisations i.e. senior manager (strategic level), middle manager and worker level. Open-ended key informant interviews will be carried out with senior managers, whilst semi-structured focused interviews are preferred with middle managers, following a certain set of questions derived from the case study protocol. Interviews with construction workers will entail more structured questions, along the lines of a formal survey. As this study deals with the tacit knowledge of the intellectuals, analysis of documentation will be of very limited use. Yet, direct observations and review of documentation will be done in view of gaining a clear understanding of the context and the phenomenon of the case being studied.

Several techniques can be employed to analyse data in case studies to improve the rigour in analysis. This study is mainly driven towards theoretical propositions, as reflected in research objectives, questions and hypotheses of the study. Yet, rival explanations too will be sought out with the aid of intended theoretical replication logic. In terms of specific data analysis techniques, to enable the rigor of structuring, organising and analysis of multiple sources data, and to maintain the richness of data, the study undertakes cognitive mapping and content analysis approaches. Also several software packages like Decision Explorer and NVivo will be used to analyse and codify qualitative data, which belong to the domain of Computer Aided Qualitative Data Analysis (CAQDAS). Hence, open ended and semi-structured interviews will be analysed using these content analysis and cognitive mapping techniques. The results from the structured survey will be examined using factor analysis and correlation analysis to further validate the findings from cognitive analysis. Finally, outcome of data analysis will either verify or falsify the hypothesised phenomenon of this research.

8. CONCLUSION

The early focus on knowledge management resulted in technological solutions with a bias towards the use of Information Technology, however, many of these were not successful because they ignored the people required to make them work in construction. More recent work has focused on the importance of human resource in knowledge management, but these have yet to be developed in terms of concepts and frameworks. Hence, this paper introduced a conceptual framework to manage construction knowledge worker and their tacit knowledge based on review and synthesis of literature. Further, it highlighted the importance of the concept of knowledge worker and tacit knowledge within construction and set out research aim, objectives and hypotheses based on the identified gaps from the literature. A specific research methodology for the empirical stage was identified based on the nested approach which suggested social constructionism stance in terms of epistemological undertakings and

idealistic approach under the ontological assumptions with value laden purposes are suggested together with the deployment of multiple exploratory case studies approach and triangulation techniques.

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