Australian Journal of Basic and Applied Sciences, 6(6): 138-145, 2012
ISSN 1991-8178

The Current State of Information Management and Knowledge Management in the Malaysian Construction Industry

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Abstract: The construction industry generates a vast amount of information and knowledge that may need to be organized more efficiently to facilitate dissemination and utilization by the communities of practitioners. The objective of this paper is to explore the state and extent of information management and knowledge management in the Malaysian construction industry. This research was carried out by fielding survey questionnaires to personnel of construction companies, consultancies, and project management firms. Based on survey results, some aspects of information management are discussed. The article concludes with recommendations on requisites that should be in place prior to implementation of knowledge management in construction companies.

Key words: *information management, knowledge management, and construction organizations.*

INTRODUCTION

Failure to capture knowledge or loss of knowledge acquired in a construction project represents an unnecessary waste of assets. This knowledge may still be present in the organization but may be immersed in documents which are not filed systematically or is no longer available because of personnel leaving the organization (Carillo, 2000). Construction organizations are beginning to follow organizations in other industries to invest in knowledge management initiatives as knowledge is recognized as a powerful asset and an important competitive element in improving business performance (Robinson, 2001).

The construction industry is highly fragmented with specialized components each with their own objectives, drivers, enablers, practices and procedures. The efficient flow of information and knowledge is crucial at every stage of the project to ensure that the project achieves necessary coordination and effective communication between all its participants (Ahuja *et al*, 2007). A great challenge for managers in construction project management is how to handle, store, organize and disseminate effectively all the information needed to design and build a major facility, and it is believed that more efficient information management is a primary prerequisite for the construction industry to enhance its performance, productivity and perception (Becerik, 2004). The impact of out-dated, lost or conflicting information, causing delays, mistakes and expensive reworks on overall construction cost can be damaging to the financial position and reputation of a construction organization (Bjork, 2001).

The construction industry is becoming more complicated, dynamic and interactive and the need to speed up reflective decision-makings on time is fulfilled by utilizing construction information and knowledge which are amongst the most important resources contributing towards managerial decision-making (Tupenaite, 2008).

The objective of this study is to explore the current state of information management in the Malaysian construction industry.

The Malaysian Construction Sector:

The size of current Malaysian construction market is indicated by the 10th Malaysian Plan, a Government master plan which covers the period between and inclusive of 2011 to 2015. In this period, the Government plans to develop RM 138 billion (USD 46 billion) of physical construction works and the private sector is expected to carry out another RM 200 billion (USD 67 billion) of works in the same period (Mansur, 2010).

Figures from Construction Industry Development Board (CIDB) of Malaysia shows that in 2011, a total of RM77 billion (USD 26 billion) of construction works were carried out, 24% of which was by the public sector. As of the end of 2011, there are 62,636 construction companies registered with CIDB with 4,470 in the top-most Grade 7 category. Of these Grade 7 companies, 43 have their shares traded on the Malaysian stock exchange, Bursa Malaysia.

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Information in Construction Industry:

A construction project's phases include initiation, funding, design, statutory approval, tender bid, construction, completion, and transfer. At each phase, a vast amount of information undergoes "creation, representation, organization, maintenance, visualization, reuse, sharing and disposal" (Hicks, 2007; by Larson, 2005). The information is normally dynamic, it changes continuously as it is being utilized and manipulated by professionals from all relevant disciplines throughout the duration of the project. Depending on the nature of the project, the cycle of creating, storing, manipulating, transmission, reformatting, application and revision can be very short (Scott, *et al*., 2003). Exchanging, sharing and collaboration of project information have to be carried out in effective manner.

For a contractor, his first encounter with construction project information is when he purchased the tender document. The important and crucial components of the tender document are the drawings, the specifications and the bills of quantities. The process of submitting a bid requires data and information inputs in the form of costs and compliance to the requirements of the client. If the project is won, a project management team is set up; the vertical component of which comprises the project director, the project manager and the construction manager. At the work site, the construction manager establishes a horizontal team structure consisting of site engineers managing clearly defined by boundaries of job scopes. From a contractor's point of view, the starting block from which the project commences is the information from the tender documents. The process of information flow begins from the project manager to all members of the team and from that moment onwards the amount of information increases and the directions of its flows become multi-lateral.

The integrity, quality and timing are important attributes of information and knowledge. Inaccurate, unverified, unrefined, or delayed information will lead to ineffective decision-making resulting in quality failures (Love and Irani, 2003). With the introduction of quality, safety, health and environment (QSHE) systems on projects, the complexity of information production, storage, retrieval, processing, transfer and dissemination becomes manifold, thus presenting greater challenges to effective management and good decision making practices. Besides the contractor, other participants in the project namely the client, architect, engineer, subcontractors and suppliers, face similar issues, situations and challenges with regards to information and knowledge in the construction sphere. The knowledge gained in a project gives an additional or alternative perspective that presents an advantage in the inception, formulating and planning future ones.

Knowledge in Construction Industry:

Personnel in construction companies prefer to perform their tasks in project management based on past experience and advice passed down from mentors rather than on written standard procedures or textbooks or established analysis (Tupenaite, 2008); tacit knowledge rather than explicit knowledge is utilized. Knowledge in construction industry is therefore mostly in the heads of knowledgeable workforce and is lost when the workforce relocates or retires. Furthermore, construction industry is not known for valuing its employees for their contributions (Carillo, 2000) and this hinders knowledge sharing.

The best practices in construction project management over the decades have been codified as *A Guide to Project Management Body of Knowledge* (PMBOK Guide, 2008). This illustrates an example of "knowledge" as "a set of organized statements of facts or ideas, presenting a reasoned judgment or an experimental result, which is transmitted to others through some communication medium in some systematic form" (Thompson, 2004; by Bell, 1973). However, over-emphasis on conversion of tacit form of knowledge to explicit form (Nonaka, 1991) has been cautioned against since "deprived of their tacit coefficients (personal to the individual), all spoken words, formulae, maps and graphs are meaningless" (Thompson, 2004; by Polanyi,1967).

In construction industry each project is unique and is implemented by a temporary "virtual" team that disbanded after project completion. The knowledge gained from a project may be utilized to create a template for project management of a future project but the template may not be able to take into accounts variations in conditions and situations in the new project environment and the use of such template may bring only limited success. However, knowledge required for certain activities of a project can be utilized repeatedly. Shiau *et al* (2002) leveraged on information technology to standardize and enhance the knowledge of estimating, price assessment, bidding, price comparison, construction management, price calculation, payment request, and cash flow management. Similarly, the PMBOK Guide recognizes nine knowledge areas that are typical of almost all projects (PMBOK Guide, 2008), namely integration management, scope management, time management, cost management, quality management, human resource management, communications management, and procurement management.

Information Management and Knowledge Management in Construction Industry:

Efforts taken by construction organizations to organize their intellectual assets often take the forms of a mixture of both information management (IM) and knowledge management (KM). De Long, Davenport & Beers (1997) pointed out six differences between the two: (a) KM put emphasis on value-added for users while IM emphasizes on delivery and accessibility of information, (b) KM backs operational improvement and

innovation while IM backs existing operations, (c) KM adds value to contents by sorting, re-generating and interpreting while IM disseminate available content with limited value added, (d) KM needs continuous contributions and feedback from practitioners while IM prioritizes one-way transfer of information, (e) KM puts balanced emphasis on technology, human and cultural issues in creating impacts while IM emphasizes heavily on technology, and (f) in KM, variance in input precedes automatic capture process but IM assumes information capture can be automated.

The objective of information management is to make certain that valuable information is obtained and utilized to the fullest extent (Hicks, 2007). Functions of information management include "creation, representation, organization, maintenance, visualization, reuse, sharing and disposal of information" (Hicks, 2007; by Larson, 2005 & Treasury Board of Canada, 2005). Through management, information is organized, arranged, sorted and stored for retrieval; the exchange, sharing and collaboration is managed and controlled to prevent waste.

Knowledge Management has been defined in many ways. It has been described to be "an umbrella term for a wide variety of interdependent and interlocking functions consisting of: knowledge acquisition; knowledge valuation and metrics; knowledge mapping and indexing; knowledge transfer, storage and distribution; and knowledge sharing" (Tupenite, 2008; by Coleman, 1999) and also as the "organizational optimization of knowledge" to achieve improved business operation and output through the use of a range of methods and techniques (Kamara *et al*, 2002). Knowledge management is a strategic initiative increasingly seen as a source of competitive edge and it is expected that organizational spending on knowledge management activities will increase significantly over the years. However, construction organizations, known for being laggards in adopting new technologies and mechanisms, are often not willing to invest in new approaches such as knowledge management, citing low return on investments (Robinson, 2001).

The construction industry is only now slowly realizing that failure to capture knowledge acquired in a project represents a waste of assets and efforts (Carillo, 2000). The transition to a knowledge economy is driving construction organizations to begin investing in knowledge management systems as knowledge is being recognized as a valuable asset (Robinson, 2001). However, since the project-oriented, short-term, task-focused work culture found in construction organizations may inhibit continuous learning, cultural considerations should be given top priority when planning knowledge management for construction organizations (Tupenaite, 2008; by Egbu and Botteril, 2001).

Management of information and knowledge in construction industry, which has always relied on and enabled by advances in information technology is now made more effective and expansive by the advent of web technology or the internet. Web-based information management utilize web browsers, data handling devices, and other information technology tools to create a network aimed at sharing and synthesizing information and explicit knowledge in a way that assists construction project managers make informed decisions to achieve the goals of completing their projects within time and budget. Dikbas *et al* (2000), Scott *et al* (2003) and Becerik (2004) note how elements of project information such as basic data, reports, schedules, and progress can be uploaded onto an intranet or internet server and members of the project team can access and share by permission using internet browser from virtually anywhere and at any time. An individual construction project can set up a similar network called extranet and access to it is can be given to limited personnel involved in the project for purposes of project control, monitoring and information management.

While acknowledging information system's role as a key enabler, knowledge management's heavy focus on delivery of technological solutions in the eighties has now shifted to a more balanced emphasis on both cultural and technological issues (Carillo, 2000). Employee motivation is central to acceptance of change in an organization; implementation of knowledge management will bring changes, the rate of which is determined by the pace that the top management decides. In a survey, Robinson (2001) found that the top motivating factors for implementation of knowledge management are (1) distribution and delegation of best practices to key personnel, and (2) retention of tacit knowledge of key personnel.

Research Methodology:

Stratified random sampling was adopted in order to select the study sample. Stratified sampling is a method of sampling procedure where the target population is first divided into jointly exclusive, homogeneous segments (strata) where a simple random sample is selected from each segment (stratum), and then the various strata are then combined into a single sample (Daniel, 2011).

The primary information was gathered though a survey questionnaire which was conducted to obtain a feedback about the current state of information management in the Malaysian construction industry. The list of construction industry consultants, developers and contractors were acquired from the Malaysian Construction Industry Development Board (CIDB). Before determining the sample size, a pilot test and content validity were conducted with 20 selected participants from elected development organizations, contracting organizations and consultant firms in Kuala Lumpur.

The questionnaire's items were adapted from Sheriff (2011) by incorporating the necessary adjustment of the phrases. The instruments were found suitable for obtaining data from respondents in order to measure the current state of management of construction information in the Malaysian construction industry.

A total of 174 properly completed questionnaires were received from 450 sent out, representing a response rate of 38.6%. In total, 182 responses were received, but 8 were not properly completed and therefore discarded. The data were analyzed and coded utilizing IBM SPSS Statistic Software Version 19.0 for Windows. All data and information from the questionnaires were entered into IBM SPSS program for statistical analysis in order to obtain mean score and standard deviation. Data obtained from questionnaires responses were presented in the form of table, bar chart, pie chart to generate the final findings.

Data Analysis and Discussion:

Respondents' Years of Work Experience:

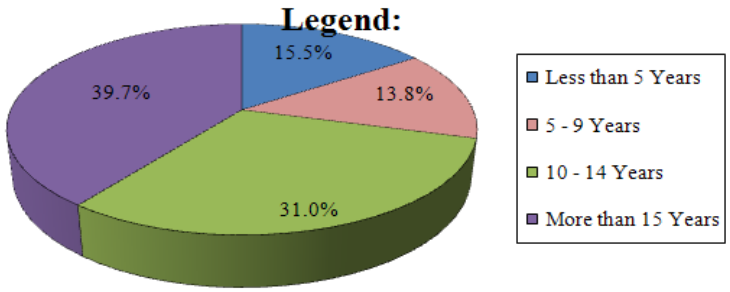

Fig. 1: Distributions of the Respondents by Number of Years of Working Experience.

The years of working experience reflects the maturity and wisdom of respondents in handling information and knowledge. Arrangement of information in organization's repository is generally better if implemented by personnel with more experience since s/he has a better grasp of the organization's history of decision making. A longer working experience is associated with having more knowledge and deeper understanding of knowledge. A large majority (70.7%) of the respondents have more than 10 years of working experience, and out of this, more than half have experience exceeding 15 years (Figure 1).

Respondents Position:

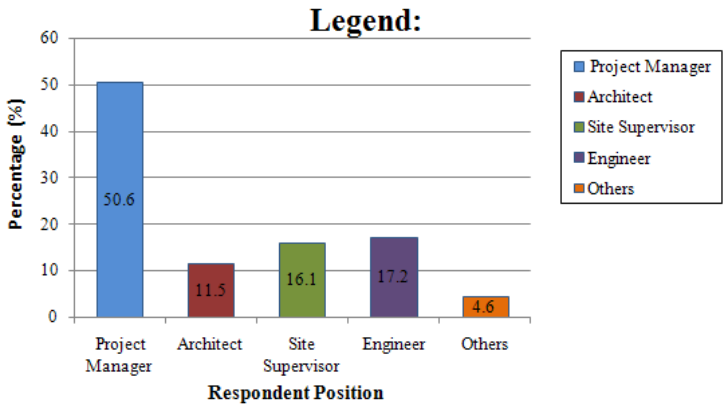

Fig. 2: Respondents Based on Position Level of Organization in the Malaysian Construction Industry.

To understand and appreciate the importance of matters relating to information and knowledge in construction environment, the personnel has to be working in that environment. The backbone of construction industry are the disciplines of Project Management, Engineering, and Architecture and these disciplines may come from the either the client's or the contractors' side. Slightly more than half (50.6%) of the respondents in this study are Project Managers while other professionals namely Engineers and Architects comprise 17.2% and 11.5% of the respondents respectively (Figure 2). Together, they form 79.3% of the respondents. In the "others" group, respondents listed their designation as Senior Executive, Project Director, Chief Executive Officer and

Managing Director, amongst others. In terms of functional responsibility in a project environment, the cross-section of construction personnel in the industry is well represented by the respondents.

Ease of Current State Of Information & Knowledge Management:

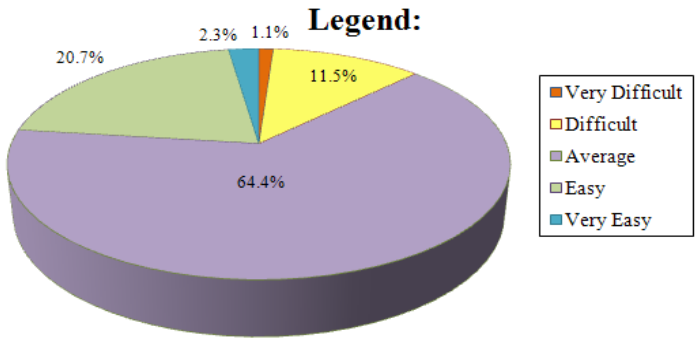

Fig. 3: Ease of Finding Information in to do a job in Malaysian construction industry.

When starting to do a job or an assignment, it is essential that the required information is can be easily located, accessed, and retrieved. The way information is organized in a construction firm is important as misplaced information means loss of man-hours used in the search for it. The survey shows that 64.4% (Figure 3) of the respondents put the ease of finding information to carry out their job as "average", meaning it's not easy but it's not difficult either. A group forming 20.7% of the respondents finds it easy to locate the information they need, this group may belong to the "tech savvy" generation. Only 12.6% of the respondents find it difficult and very difficult to look for the required information. The difficulty may arise from unfavourable method of storing the information making retrieval difficult or the personnel does not know how to use the computer, which is the main tool used to access digital information and digital explicit knowledge.

Sharing Construction Information:

Table 1: Means and Standard Deviations for Sharing Construction Information in the Malaysian construction industry.

Instruments	Rank	N	Mean	Std. Deviation
I share information within my group	1	174	3.9023	0.87131
I share information with Other groups	2	174	3.0230	0.87320
I share information with external clients	3	174	2.4943	0.77346
I share information with external partners	4	174	2.3793	0.85668
Total Sharing Construction Information		174	2.9497	0.84366

Sharing and exchanging information is the basis of activities in any business entity, including construction organizations and it is expected to occur on daily basis. In the survey questionnaire, the frequency of sharing information is coded thus: 1 for never, 2 for less than monthly, 3 for monthly, 4 for weekly, and 5 for daily or almost daily. From Table 1, based on the mean value of 3.9023 (rounded to 4), respondents share information within their own groups on a weekly basis; with other groups on a monthly basis (mean = 3.0230, rounded to 3); with external clients and external partners at even lower frequencies, namely on a less than monthly basis (2.4943 and 2.3793 respectively, both rounded to 2).

Based on the survey results, in Malaysian construction organizations, information sharing at its most frequent, occurs on a weekly basis. It also appears that respondents are active in sharing information with colleagues in the same work group but not much information exchange takes place with other groups or external entities or personnel.

Sharing Construction Information:

Table 2: Means and Standard Deviations for sharing construction knowledge in the Malaysian construction industry.

Instruments	Rank	N	Mean	Std. Deviation
I share knowledge within my group	1	174	3.3333	0.69126
I share knowledge with Other groups	2	174	2.9138	0.82486
I share knowledge with external clients	3	174	2.3793	0.79364
I share knowledge with external partners	4	174	2.1092	0.67544
Total Sharing Construction Knowledge		174	2.6839	0.7463

Sharing of knowledge in construction organizations may occur in formal meetings and presentations. Participants are normally already occupied with project management to have ample time to have other forms of formal knowledge exchange. In the survey questionnaire, the frequency of sharing knowledge is coded thus: 1 for never, 2 for less than monthly, 3 for monthly, 4 for weekly, and 5 for daily or almost daily. From Table 2, based on the survey result, sharing of knowledge within own groups (mean = 3.3333, rounded to 3) and with other groups (mean = 2.913, rounded to 3) occur on a monthly basis; and with external clients and external partners (mean = 2.3793 and 2.1092 respectively, both rounded to 2) take place on less than monthly basis. Exchange of knowledge within own organization occurs on a monthly basis and with external organizations on a less than monthly basis.

Method of Naming Files in the Malaysian Construction Industry:

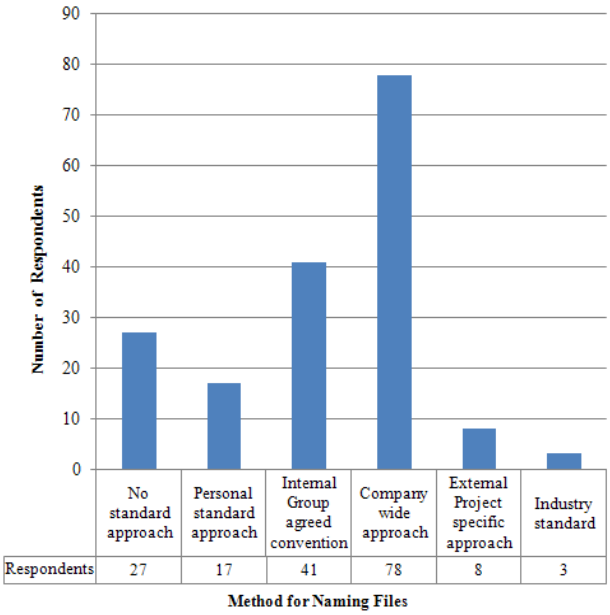

Fig. 4: Method of naming files in the Malaysian construction industry.

Methods of naming files are a way of storage and organization of information in physical files for ease of retrieval for reference and decision making. Methods employed in naming files reflect how construction organizations prioritize information and file naming practice is an element of information management practice. Most major organizations establish regulations and standards on file naming and labelling to maintain uniformity across the different divisions throughout the company. The respondents were asked whether any standard approach was practised in their organizations for naming of files. Figure 4 shows that a majority of respondents, 130 out of 174 follows a certain form of standard that was not personally set. Slightly less than half (78 respondents) uses norms applied throughout the company to regulate the naming of files. Slightly less than a quarter (42 respondents) follows conventions established by their groups. Eight respondents follow external project-specific standard and three follow the industry standard. On the other end of the scale, 27 respondents do not follow any standards and 17 follow own personal standards in naming files. The importance of organized information as opposed to cluttered information is realized and recognized by construction organizations and this is reflected by the high proportion of respondents that utilizes company-wide and group-wide standards in naming their files.

Preferred Medium to Find Construction Knowledge in the Malaysian Construction Industry:

The internet provides the opportunity for construction knowledge workers (k-workers) the access to information and knowledge relevant to their jobs. The respondents were asked on their preferred method of searching for information on the internet. Free text search refers to keying in texts in search engines such as Google while web-browsing refers to keying in the names of web-pages in a browser window. More than two-thirds (69.7%) prefers to use both free text search and web-browsing while about a quarter (25.3%) of respondents like to use only free text search. Very few (5.7%) prefer to use only web-browsing.

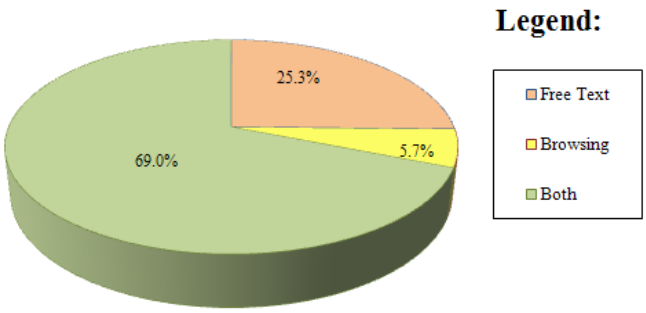

Fig. 5: Preferred medium to find construction knowledge on the internet.

Recommendations:

The survey results indicate that elements of information management and knowledge management are practiced in Malaysian construction organizations and these elements are enabled by information technology and the internet. The nature of information management elements implemented may be tactical and expedient and not as a strategy for capacity building of the company. It is quite clear that management of construction information and knowledge in Malaysian construction industry is open to considerable improvements. The industry should move forward cautiously and begin to implement knowledge management strategies in its organizations. However, there are some issues that could have deep implications in the development of such strategies in construction organizations, as touched upon by Robinson *et al* (2001) and Carillo *et al* (2000). Some the issues are mentioned as follows.

First, there is a need to evaluate the capability of the organization to manage changes. This is necessary to identify resources needed to overcome cultural resistance and reluctance to change that Carillo *et al* (2000) attributed to lack of time, trying to solve too large a problem, difficulty in converting knowledge, diverse disciplines of teams, etc.

Second, an appraisal system needs to be established to assess the benefits of knowledge management initiatives in monetary terms. Construction organizations, as other business entities can only be motivated to implement knowledge management by knowing the resultant cost savings that translate into monetary profits (Davenport, De Long & Beers, 1997).

Third, an incentive and reward system linked to knowledge management exercises need to be created because relying on personnel to voluntarily contribute time and knowledge to the initiative will not work. The personnel are already occupied with project management and therefore need incentives to contribute to knowledge management initiatives. Furthermore, construction industry does not have good records of valuing contributing employees and sharing knowledge is never the norm (Carillos *et al*, 2000).

Conclusion:

This study presents the results of a survey investigating some aspects of information management and knowledge management in construction organizations in Malaysia. The result shows that elements of information management are being practiced albeit without clearly thought out strategy, and information technology infrastructure and the internet are being utilized in handling information. The management of construction knowledge is open for considerable improvement. However, implementation of knowledge management initiatives in construction organizations should be preceded with putting in place change management procedures, a benefit assessment system and an incentive and reward system.

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