

Knowledge Management Tools and Techniques Used in the Australian Construction Industry

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Abstract

Knowledge is considered as a unique asset and its significance is becoming increasingly appreciated by scholars and, more recently, practitioners. Many research studies were carried out in order to understand how to efficiently benefit from this asset. Knowledge management (KM) aims to organise knowledge through six main aspects, which are: (1) Creation; (2) Identification; (3) Storage; (4) Capturing; (5) Transfer; and (6) Mapping. Each of these six aspects consists of several KM tools/techniques (T/Ts) which can be used to achieve their purpose. Through a detailed review of the previous literature on the topic of KM, a list of major T/Ts used in each of these aspects were identified and used as a framework for further investigation. This research aimed to present an investigation on the use of those KM T/Ts in the Australian construction industry (ACI) context by identifying the extent of use and effectiveness of those T/Ts and outlining the key barriers to their implementation. This was achieved through an organised research method which included the use of questionnaire surveys of construction firms around Australia, and interviews with senior representatives of construction firms. The findings from the quantitative phase of this research identified the top five T/Ts used among the sampled companies; these are: (1) Softcopy databases; (2) Office automation systems; (3) Internet for research purposes; (4) Hardcopy databases; and (5) Project reports. The qualitative section of the research provided support and explanation to the results from the quantitative survey. More importantly, the qualitative phase identified the key barriers in the implementation of KM T/Ts, which were categorised into three main factors: (1) resources; (2) time; and (3) organisational culture. Based on these findings, the paper provided a number of practical implications regarding the use of KM T/Ts in the industry, aiming to overcome the barriers and enhance the use of those T/Ts.

Keywords

Australia, Barriers, Construction, Knowledge Management

1. Introduction

Knowledge is the instrument that is implemented to provide a useful outcome of a given set of data and information (Beijerse, 2000). Knowledge is starting to be more attractive to organisations and considered more important than other traditional sources of economic power (Carrillo et al., 2004). Knowledge is considered to be a unique type of asset that is hard to transfer or imitate (Venzin et al., 1998), and it needs to be managed and implemented in the firm's strategy correctly and by the right means. Generally, there

are two types of knowledge – tacit and explicit (Nonaka and Takeuchi, 2004). When an individual learns and gains a new sort of knowledge, it is then stored in his/her mind and that type of knowledge is considered to be tacit (or implicit). If the person writes down that knowledge, then it is transferred to explicit knowledge which is the form where the knowledge is accessible. Each of these types needs to be managed in separate means. Knowledge management aims to create, organise, store, transfer, protect and make use of knowledge. These are considered to be life cycles of KM where Egbu (2005) lists six aspects (or life cycles): Identification; Capturing; Storage; Mapping; Dissemination; and Creation. Each of these aspects of KM has several KM T/Ts that can be implemented to achieve its purposes.

As the construction industry is considered to be a knowledge-based industry with most of the knowledge gained during projects; it is essential to understand how KM is perceived from its extent of use and effectiveness. When implementing new technology, it is common to face some difficulties and challenges; but it is important to understand those barriers that affect the implementation of KM strategies and try to come up with solutions. Since there has been a lack of research in the field of KM in the ACI; this research provides an investigation of the issues mentioned. Specific objectives of this research include:

1. To understand the practise of KM in the ACI in carrying out engineering activities.
2. To determine the current extent of KM T/T utilisation and perceived effectiveness of these T/Ts within the industry.
3. To identify key barriers to the implementation of KM T/Ts.

2. Theoretical Background

2.1 Knowledge Management Overview

Knowledge is the tool used to produce a beneficial outcome of the collected data and information (Beijerse, 2000). This means that if a person has some information and data regarding a particular issue, the ability to use that information and data to produce an outcome is considered as knowledge. Thus, knowledge is considered as a valuable strategic asset in the form of the organisation's capacity and potential to influence future actions. Knowledge is also considered as a type of asset that when utilised by the organisation could result in giving that organisation a high advantage over its competitors. From another strategic point of view, knowledge is described as an acceptable belief that if used can produce a more effective organisation (Nonaka and Takeuchi, 2004). Knowledge is divided by some scholars into two types, tacit and explicit (Nonaka and Takeuchi, 2004). Tacit is when the knowledge obtained is not openly expressed. This is mainly because the individual considers this knowledge to be personal and does not feel the need to share it with other members of the team or the organisation. Explicit knowledge on the other hand is more clearly and formally expressed and can be used by other members.

It is discussed that knowledge has three characteristics: information, a capacity and an attitude. Information is considered as a system-bound knowledge which is also called explicit knowledge. Capacity and attitude on the other hand are considered as people-bound knowledge or implicit knowledge. Knowledge in the explicit form can be expressed in terms of words (formally) or numbers which make it possible to be transferred and spread between individuals; on the other hand, implicit knowledge is located in the individual's head and collecting that information is not physically possible. Thus, to make knowledge reproductive and usable by the organisation, it is more appropriate to transform the implicit knowledge which is held by the individual into explicit knowledge (information) that can be used by the rest of the organisation's members (Beijerse, 2000; Tserng and Lin, 2004).

Spender (1996) has a slightly different approach in categorising the explicit and tacit (implicit) knowledge. He divides knowledge into four types, individual's explicit knowledge, individual's tacit knowledge, organisation's social explicit knowledge and organisation's social tacit knowledge. The

individual's explicit knowledge and tacit knowledge explained by Spender are similar to how Beijerse (2000) explains explicit system-bound knowledge and implicit knowledge. As for the organisation's social explicit knowledge, it represents the retrieved information that is stored in the organisation's data base. Social tacit knowledge covers all knowledge from the social and institutional performance, procedures and culture (Spender, 1996). Explicit knowledge can be expressed formally or transformed into a physical asset (documented or recorded), whereas tacit knowledge is complex and cannot be documented in formally. The difference between those two types is significant since each of them need to be managed in a different way using separate KM T/Ts (Tserng and Lin, 2004).

2.2 Knowledge Management in an Organisation

An organisation, as it has always been explained, is a group of individuals who come together in order to achieve a certain common goal. In order for an organisation to be successful, certain crucial elements must be known and kept in mind. As explained by Beijerse (2000), there are four crucial means that give the ability to organise, which are strategy, structure, culture and systems. After defining and describing an organisation, KM is therefore the instrument used in guiding the strategy, structure, culture and system towards a productive use of the explicit and implicit knowledge available or gained in the organisation and the individual.

Resources are one of the main factors in an organisation which can lead to productive outcomes and results. Having a resource that is rare can give the organisation an advantage against its competitors. Thus having a resource that is unique and hard to transfer or imitate such as knowledge (Venzin et al., 1998), is very well needed in an organisation in order to obtain that advantage. That being said, there are KM T/Ts which are used to obtain a beneficial outcome of knowledge and are categorised into different KM aspects. As Illustrated by Egbu (2005), there are six aspects (or life cycles) in knowledge management: these are: (1) Knowledge Identification; (2) Knowledge Capturing; (3) Knowledge Storage; (4) Knowledge Mapping; (5) Knowledge Dissemination; and (6) Knowledge Creation. Table 1 presents a summary of KM T/Ts found in the literature, with respect to the six KM aspects.

Table 1: KM Tools and Techniques

KM Aspect	Tools and Techniques	References
Identification	<ul style="list-style-type: none"> • Databank of employees • Community of practice. • Workshops/seminars • Publications • Interview • Clients • Suppliers • Colleagues • Brainstorm • Project report • Post-project reviews • Testing a range of attitudes and behaviour in the work place • Identification of best practises • Carrying out of case studies 	Egbu et al. (2005); Beijerse. (2000); Ribeiro and Bettiol, (2006); Carrillo el al., 2004); Mohamed and Anumba (2006)
Captured	<ul style="list-style-type: none"> • Personal web page • Exit interview • Knowledge discovery in database 	Egbu et al. (2005); Liao. (2003)
Stored	<ul style="list-style-type: none"> • Project Data base • Hard copy data base: • Filling cabinet • Training material • Libraries 	Egbu et al. (2005); Liao. (2003); Mohamed and Anumba (2006)
Mapping	<ul style="list-style-type: none"> • Visual thinking networking • Mind mapping and brainstorming. 	Egbu et al. (2005)
Dissemination	<ul style="list-style-type: none"> • Conferences and seminars • Desktop publishing imaging and web publishing 	Egbu. (2005); Ribeiro and Bettiol. (2006);

	<ul style="list-style-type: none"> • Team based activities and training sessions • Group collaboration • Groupware • Intranet • Office automation systems • Word processing 	<ul style="list-style-type: none"> • Electronic calendar • Desktop database • Journal articles • Job rotation • Technical bulletin board • After project get together • Peer mentoring 	Carillo et al. (2004)
Creation	<ul style="list-style-type: none"> • Project experiences • Research collaboration • Industry expertise • Debriefing • Internet, Intranet • Training 		Ribeiro and Bettiol. (2006); Beijerse. (2000); Carillo et al. (2004)

2.3 Implementation of Knowledge Management in the Construction Industry

Implementing KM as part of the construction organisation's strategy will encourage and support innovation and give the ability for enhancement of the construction procedures and methods (Dave and Koskela, 2009). Implementing KM means utilising its aspects and using KM T/Ts to enhance the performance of the organisation. Prior to implementing KM in the construction industry, it is important to understand the barriers involved in such a strategy. In a study conducted in the construction industry in the UK, which consisted of KM and its implementation, Carrillo et al. (2004) have concluded the main barriers in the industry based on large, medium and small sized companies. The top three barriers from the results found in the study were: lack of standard work processes; not enough time; and organisational culture. "Lack of standard work processes" was ranked the highest by the companies as lack of "post-project reviews and project documentation" (Carillo et al., 2004). This could be because some organisations grow very quickly, and no standards or procedures are adapted to the different approaches (Carrillo & Chinowsky, 2006). "Not enough time" was rated second in the study. It is discussed that some employees may want to share their knowledge but due to the tight project schedule in the construction environment, it is hard to implement a knowledge sharing culture.

The construction industry mainly uses hard copy documents including contracts, standards, specifications, drawing, etc. Transferring this material into an electronic version in order to simplify its dissemination can be time consuming (Tserng & Lin, 2004). As for the third ranked barrier "organisation culture", Carillo et al. (2004) defined it as a key barrier to KM. Employees tend to isolate themselves due to the difference in culture with their colleagues, thus resulting in a lack of communication between members of the organisation (Carrillo et al., 2004). It is preferred that companies tailor their KM approach to suit their culture.

3. Method

3.1 Questionnaire Design and Sample

The questionnaire consisted of three pages, which were mainly made up of a cover page and two pages of survey questions. The cover page contained contact information of the researcher and the supervisor, a statement introducing the researcher and some details about the research including the purpose and benefits of the research. The survey consisted of short and simple questions to make it easier for participants to complete and was divided into two sections. The first section asked the participants to rate their opinions based on the given scales for the list of 26 KM T/Ts developed from key KM aspects as shown in Table 1. Two types of rating scales were used in this survey to evaluate these KM tools and

techniques: the extent of use scale and the effectiveness scale. The former was used for the respondents to rate the extent to which KM T/Ts were used in their firm whereas the latter focused on the effectiveness of such tools/techniques perceived by the respondents.

A five-point Likert type rating was used for both scales. In the questionnaire, explanations of both rating scales were provided and the scales were placed in two columns (A and B) next to the list of KM T/Ts. In addition, there were two questions asking the participants to provide their opinion on the barriers they face when implementing those tools/techniques and whether there are other T/Ts that are used or can be used in their firms. The second section asked the participants to provide some background information about them and the size of the firm.

The sampling frame was developed from Australian Dun and Bradstreet's who's who database. The main criterion used for the selection of the target sample was that firms must be from the construction industry and must be construction contractors. It was planned in the beginning to involve 80 sample firms selected from the database for the survey. However, 12 of these firms either were closed down or changed their addresses without updating the details in the database or in their websites. Therefore only 68 sets of questionnaire were sent.

3.2 Interview

The method of interviewing the personnel involved in the industry was employed to compliment the data from the survey by providing more insights into how KM T/Ts were utilised. The interviews were conducted with two candidates, one of which was involved in an earth and civil work contracting with a general/project manager position. The number of employees in the firm was between 21 and 50 employees. The second interviewee was the project manager from a property development and construction contracting company with the number of employees less than 20. The interview consisted of questions about the use of KM T/Ts and their thoughts on the usage of those T/Ts.

4. Analysis and Results

4.1 Survey Results

A descriptive analysis method was used where the mean rate for the results was calculated for each T/T. Figure 1 ranks the T/Ts according to their extent of use. The bars on the right (coloured in blue) indicate the extent of use and the bars on the left hand side (coloured in red) show the effectiveness of each T/T. From Figure 4.1, it can be observed that the KM T/T mostly used by the participated firms was softcopy databases whereas social networking sites were the least commonly used. Softcopy databases, office automation systems, internet for research purposes, hardcopy databases, project reports and employee database were the top six KM T/Ts mostly utilised with ratings over 3.3. On the other hand, the least six KM T/Ts used, that scored less than 2.0, were research collaboration, exit interviews, carrying out of case studies in the organisation, testing a range of attitudes and behaviours in the work place, technical bulletin boards and social networking sites. Section 4.4 will elaborate more on these KM T/Ts.

After finding the extent of use and effectiveness of each T/T, the mean scores were aggregated to represent their respective KM aspects (see Figure 2). These aggregated scores of the extent of use and effectiveness for the KM aspects were ranked according to their extent of use. The bars on the right hand side indicate the extent of use whereas those on the left indicate effectiveness. It can be seen that the most commonly used aspect was storing and the least was capturing. Further results from the open-ended section of the questionnaire also highlight a number of barriers to KM T/T implementation, which included: implementation costs, time of implementation, monitoring compliances, managers not taking the time to implement tools properly, and resistance to change from some employees.

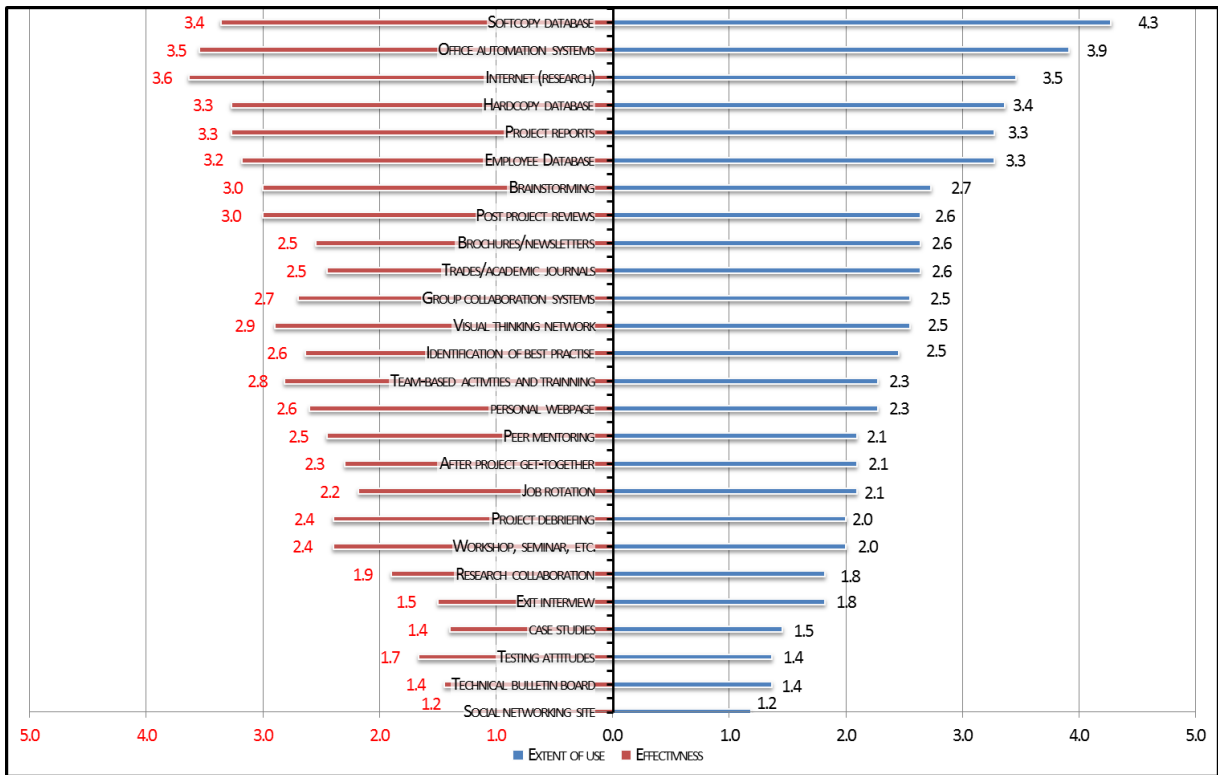


Figure 1: Ranking of KM T/Ts according to the extent of use

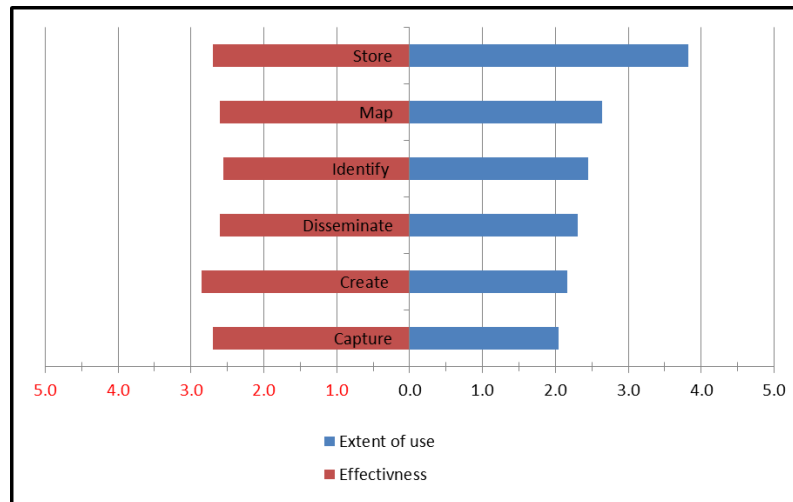


Figure 2: Ranking of KM T/Ts based on KM aspects

4.2 Interview Results

The research included two case studies based on interviews with key senior staff from two different construction contracting companies as part of its research method. Both cases are summarised below.

Case 1:

The interview was conducted with a project manager of a property development and construction contracting firm with fewer than 21 employees. It was found that the firm mainly utilised KM T/Ts that were related to storing knowledge, such as hard and soft copy databases, at a very high extent and they were perceived to be very effective. As for the T/Ts related to the identification of knowledge, the extent

of use was very low similar to the creation of knowledge. For the dissemination of knowledge, brochures, training sessions and office automated system which included word processing and web publication were used. When sharing knowledge, word of mouth and telephone calls were the main techniques used and were found to be moderately effective. The interviewee commented that when they find a T/T to be effective, they tend to use it more often and the main barriers they faced when applying new T/Ts were that some employees are “old school” and prefer using traditional ways and that some T/Ts do not seem to be relevant to a small sized firm.

Case 2:

The second interview was conducted with a general/project manager of an earth and civil work contracting company with between 21 and 50 employees. When asked about using an employee database for knowledge identification, it was found that they did utilise it but not because it was effective, but rather because it was a requirement for quality assurance purposes. Brainstorming was also used in order to identify knowledge available collectively from the project team prior to initiating a project. As for storing knowledge, hard and soft copy databases were used, with the softcopy being more utilised. Internet (for research purposes) was said to be used in order to create knowledge as well as training sessions, which were used only to enhance qualification. Office automated systems were used in the firm mainly between operators and administrators, rather than between operators themselves. This means they were mainly used for information sharing rather than knowledge sharing. The actual knowledge sharing between operators and operators was mainly conducted through informal verbal communication. For knowledge mapping, brainstorming was used during meetings prior and during projects to identify where to find the person with the right understanding of a particular issue. The interviewee highly recommended the use of online servers to share information and knowledge where all members involved in the same project, even if they were from different disciplines, could share detailed documents which can be accessed by the rest of the team. The interviewee commented that although they found this technique to be effective, it was not used in their firm just because their size is not large enough to be economically justified, and using T/T such as this would not be relevant.

5. Discussion and Conclusion

The primary aim of the research presented in this paper was to examine the current use and perceived effectiveness of KM tools and techniques within the context of Australian Construction Industry. The findings highlighted the top six KM T/Ts used by the firms, including: softcopy database; office automation systems; internet (research); hardcopy database; project reports; employee database. The highest used KM T/T was softcopy database which as per the comment of one of the interviewees is easier to use and move around. The use of hardcopy databases, ranked fourth, was found favourable mostly by employees who prefer using traditional techniques. It was also found that the rating of the extent of use was associated with the rating of its effectiveness. From the theory of reasoned action discussed by Liker and Sindi (1997), the attitude of an individual to perform a certain task depends on the belief the person has on the outcomes of that action. This is the case with the ratings found from the survey, when an individual finds a certain T/T to be effective he/she tends to utilise that T/T to a higher extent and vice versa.

Furthermore, the KM aspects were ranked based on the mean scores of the extent of use as: (1) Storing; (2) Mapping; (3) Identification; (4) Dissemination; (5) Creation; and (6) Capturing. The T/Ts for knowledge storing were found to be utilised the most whereas the least were those for knowledge capturing. The lack of the use of knowledge capturing indicates that the firms did not tend to utilise the tacit knowledge available or gained from projects which is mostly found in projects and are in people's minds (tacit) due to the nature of the construction industry. If the knowledge gained by the employees is not captured, when those employees at some stage leave the firm, their knowledge which they gained during their work at the firm will leave with them.

From the interviews and the survey comments it was found that several issues affect the implementation of KM T/Ts which can be divided into three categories: resources, time and organisational culture. Cost and the ability to be compliant in monitoring the process and performance of the KM strategy are due to the resources available in the organisation. Some T/Ts are costly and also need to be monitored and managed by certain employees, which means that the firm needs to assign extra tasks on employees or employ more individuals. The attitudes of managers and employees towards the implementation of KM T/Ts are affected by the culture of the organisation. Lack of support from head managers in the organisation to the adoption of KM T/Ts could be due to their insufficient understanding of KM and its benefits to the organisation. The lack of time to initiate KM strategy is always considered to be a major problem (Carrillo et al., 2004). However, this is associated with the employees not understanding the benefits of KM and thus not communicating them efficiently (Carrillo and Chinowsky, 2006). If employees understand the beneficial outcomes of KM and the implementation of T/Ts to them and their organisation, they will be keener to implement those T/Ts. The barriers found in the ACI are not unique and are similar to what Carrillo et al. (2004) found when conducting a survey in the construction industry in the UK, which was also correlated to the results from another survey conducted on the American construction industry (Carrillo and Chinowsky, 2006). In order to overcome these barriers, the following are recommended:

- Education of the employees regarding the benefits of KM T/Ts to their work process and the achievement of organisational goals would improve their perception of the technology and would motivate them in implementing the T/Ts more efficiently and would reduce the amount of time needed in making use of the T/Ts.
- The head managers of the firms also need to be educated on the subject of KM and would be required to provide support and motivation to their employees to make beneficial use of the KM T/Ts.

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