

# Management of Knowledge among Construction Firms in South Eastern USA

**Kamalesh Panthi, PhD and Syed M. Ahmed, PhD**

East Carolina University

Greenville, North Carolina

Knowledge Management has been recognized as a vital resource for improving the efficiency of several different sectors. While this fact also applies equally to project-based industries such as the construction industry, researchers agree on the fact that for the project-based industries capturing tacit knowledge gleaned from the past projects and retaining and reusing it for the purpose of increasing efficiency of the future project is a great challenge. In order to investigate how knowledge management is viewed and applied by the construction firms from the South Eastern United States is the major purpose of this research. This research paper forms the foundation for further research to be carried out to formulate a knowledge management model for the use by the construction firms.

**Keywords:** Knowledge Management (KM), Construction, Strategies, Project

## Introduction

Knowledge Management (KM) is “the process through which organizations generate value from their intellectual and knowledge-based assets. Most often, generating value from such assets involves codifying what employees, partners and customers know, and sharing that information among employees, departments and even with other companies in an effort to devise best practices. Retaining knowledge is a major challenge in project-based industries such as the construction industry as these projects are short-lived. KM has been treated for years in an implicit way; everybody knows it is necessary, everybody knows it is important, but there is no explicit methodology that addresses its many facets. Because of its importance, if managed effectively, knowledge can be used to reduce project time, cost, and improve quality and therefore, improve the project success (Adenfelt, M. and Legerstrom, K.; 2006). However, the management of those intellectual assets or knowledge assets (physical, financial, human and intellectual) is not that simple. Such management requires a concerted effort by the company to look into all aspects of its operations and be willing to change if necessary.

The main objective of this research project is to study and evaluate how the knowledge assets, perhaps the most important but at the same time the most forgotten value in a construction company, are managed. Collecting the experiences in the construction industry, and relating them to theoretical data will allow us to develop a knowledge management model. It is expected that this study will be highly valuable and beneficial for the construction industry, as it has the potential to provide knowledge related guidelines; how to produce it, count it, store it, retain it, and manage it in any part of the company. The goal is to improve productivity of the construction company by minimizing “knowledge loss”. Hopefully, this will be translated to cost and time reductions for the construction company and an improvement in customer/client relations.

## Literature Review

Ribeiro (2009) looked at ways knowledge and expertise is managed in project-based firms in Portugal. Based on three case studies on companies already using KM, they provided an empirical finding that utilizing interdisciplinary organizational structures would help in sharing knowledge and expertise. Chen and Mohamed (2009) provided empirical evidence for the stronger strategic role of tacit KM in comparison to explicit KM. Using a questionnaire survey and interviews in Hong Kong, they found that effective implementation of organizational policies would facilitate human interactions of tacit KM and would ultimately help the business performance of an organization in the long run.

Bigliardi et. al (2010) investigated the process of knowledge creation and transfer in project-based organizations within six construction companies in Italy to identify the most effective KM strategies in construction industry. Using a case study methodology on the selected company they found the phased approach in KM to be a promising means of enhancing the management and transfer of new knowledge. Shokri and Chileshe (2014) conducted an in-depth KM research of Australian contractors to identify some major barriers in capturing lessons learned. They found that the top-3 barriers to the effective capturing of lessons learned were “lack of employee time”, “lack of resources” and “lack of clear guidelines”. Some of the other notable studies and their findings in the area of KM in construction firms are summarized in Table 1.

*Table 1: Notable studies on knowledge management in construction*

<b>Published Year</b>	<b>Author(s)</b>	<b>Key Findings</b>
2013	Forcada,N.; Fuertes, A.; Gangoellis, M.; Casals, M.; Macarulla, M.	Their findings demonstrated that changes in organizational culture were critical to successful KM. The survey also revealed some distinctions between the KM perception of design firms and that of construction firms in Spanish Construction firms.
2012	Kale, S., Karaman, E. A.	An evaluation model is introduced built on the concepts of benchmarking, KM models, importance-performance analysis map and comparative performance analysis map so as to enable construction firms to evaluate and improve their KM practices.
2010	Kanapeckiene, L.; Kaklauskas, A.; Zavadskas, E.K.; Seniut, M.	From survey of current models, a new original Knowledge Based Decision Support System for Construction Projects Management (KDSS-CPM) has been developed. Using the accumulated information and the models, the Knowledge Based Decision Support System for Construction Projects Management can automatically generate up to 100,000 combinations of construction project alternatives.
2009	Dave, B.; Koskela, L.	Collaborative knowledge management is a core competency for construction industry, and it should be integrated within company's business strategy.
2009	Esmi,R; Ennals, R.	Sharing knowledge and systematic KM in construction companies in the UK is incomplete and fragile. ‘Knowledge Management’ describes an aspiration, rather than reality, for even a major construction company.
2008	Senaratne,S.; Sexton ,M.	Different forms of knowledge are created during the project change process within construction projects. However, this knowledge remains largely tacit and does not disseminate to the wider organization due to imbalanced codification and personalization strategies existing in such settings.
2007	Ruikar,K; Anumba, C.J.; Egbu,C.	Most organizations do not adopt a structured approach for selecting KM technologies and techniques. The use of KM techniques is more evident compared to KM technologies. There is also reluctance among construction companies to invest in highly specialized KM technologies.
2005	Chen, Z., Li, H., Kong, S. C. W., Xu, Q.	Presents prototype for knowledge-driven Environmental Management in project construction that utilizes a dynamic EIA process to be implemented in a construction lifecycle
2005	Herbert, R.; Carillo, P.; Anumba, C.; Al-Ghassani, A.	Construction organizations are likely to be successful in implementing KM if appropriate considerations are given to strategy formulation, implementation issues addressed and the link between KM and business strategy is strengthened.
2004	Carillo, P., Robinson, H., Al-Ghassani, A; Anumba, C.	The main reason for implementing a KM strategy was the need to share the tacit knowledge of key employees and to disseminate best practice. Also, significant resources in terms of staff time and money were being invested in KM, but the main barrier to implementing a KM strategy was the lack of standard work processes.
2002	Kamara, J.M.; Augenbroe, G.; Anumba, C.;	Effective KM requires a combination of both mechanistic and organic approaches in an integrated approach that incorporates both technological and organizational/cultural issues.

	Carrillo, P.	
2001	Rezgui, Y.	The paper introduces the characteristics of current technology solutions used in industry, description of current as well as emerging technologies that can provide potential solutions to managing information and knowledge in the industry. Techniques identified include electronic document management, product data technology, groupware systems, advanced information-management systems, decision-support systems and data-warehousing solutions.

## Methodology

### *Questionnaire Survey*

Questionnaire survey was used to assess the current state of KM in various construction companies located in the South Eastern USA. The questionnaire focused on four clusters of information on the surveyed company and their KM. These clusters are:

*Section 1:* Respondents details (type of firm, job title)

*Section 2:* KM awareness and application (understanding of KM, application, quantification, knowledge transfer)

*Section 3:* KM strategies and tools (knowledge priority area, tools)

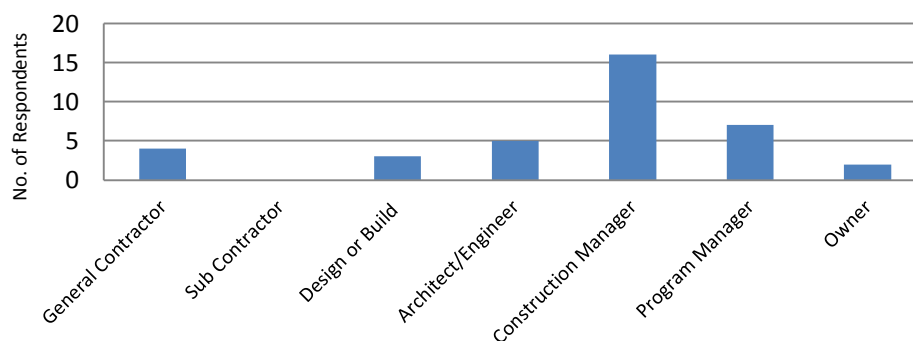
*Section 4:* Company policies and procedures (knowledge storage, security)

## Results

Results of the survey are presented in this section and a more elaborative statistical analysis is performed and discussed later in the section. In order to gain a general understanding of the companies surveyed and their knowledge management awareness and their activities, more obvious results are presented in the form of charts in Figure 1 through Figure 6.

### *Section 1: Respondents Details (type of firm, job title)*

Section 1 of the questionnaire dealt with getting the details of the construction firms. Majority of the companies that responded were CM companies and those who completed the surveys were upper level managers from these companies as shown in Figure 1 and 2 respectively.



*Figure 1: Type of company surveyed*

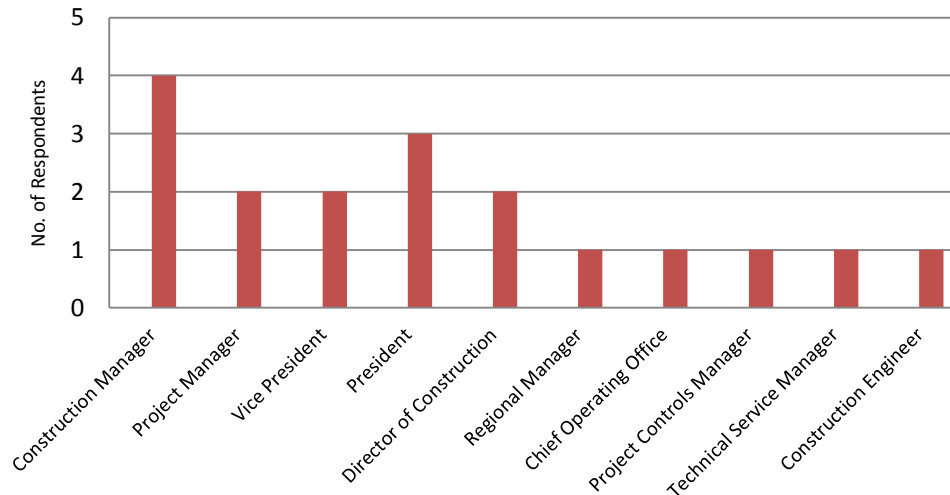


Figure 2: Respondent's role

*Section 2: KM Awareness and Application (understanding of KM, application, quantification, knowledge transfer)*

Section 2 of the questionnaire dealt with finding the KM awareness of the construction firms and how many of these firms applied KM in some form. When asked what KM entailed, 50% of the respondents said that they knew and the rest replied they did not know what KM actually covered. Almost the same percentage of respondents who replied they knew about KM said that they applied it in their firms in some ways.

*Section 3: KM Strategies and Tools (knowledge priority area, tools)*

Section 3 had several questions to investigate the different strategies and tools used by the firms. As shown in Figure 3, KM was mostly resorted to aid company's technical know-how. Figure 4 illustrates the different mechanisms for sharing knowledge within these companies. These firms were also surveyed on the activities that had the greatest positive impact on KM in their companies and the results are presented in Figure 5.

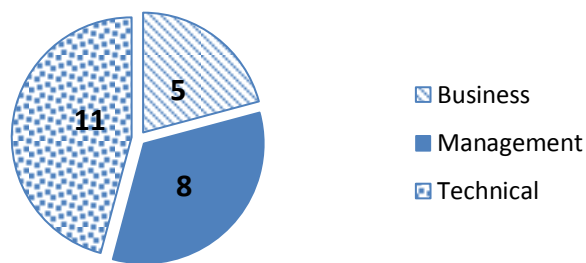
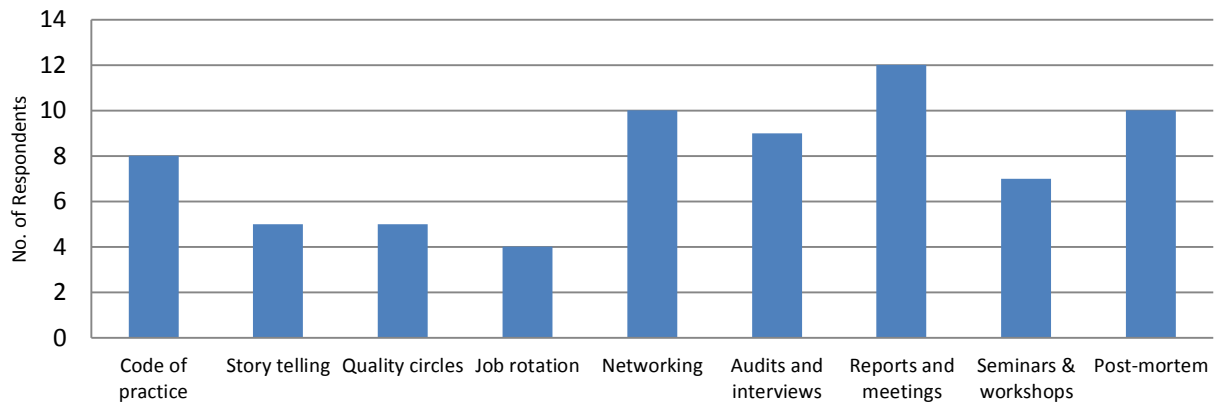
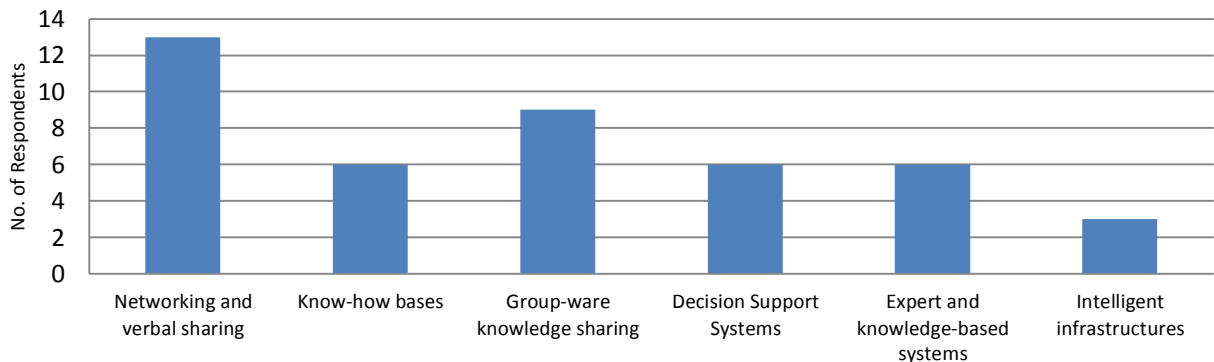


Figure 3: Perspectives focused by company



*Figure 4: Methods used to exchange knowledge within company*



*Figure 5: Activities that have positive impact on company*

#### *Section 4: Company Policies and Procedures (knowledge storage, security)*

The last part of the survey asked for information on the company's policy regarding storage and security of the knowledge encoded documents. For three quarter of the companies surveyed there was no formal mechanism to guard or secure their knowledge from leaking or being shared to other organizations. The rest of the respondents replied that confidentiality agreement was signed with every employee at the time of hiring in order for the company's knowledge secrets to be guarded and secured.

#### *Statistical Analysis*

While the results presented above demonstrated easily observable information about the companies and their KM status, statistical analyses were performed on the data as appropriate in order to gain a deeper appreciation of the responses garnered through the questionnaire. The analyses incorporated consisted of numerous Pearson chi-square tests, t-tests, and ANOVA's. The types of analyses were carefully chosen in order to glean as much information from the available data as possible. The Pearson chi square test was used to examine the relationship between various categorical data, while the t-test and ANOVA were used to explore the interplay of the scale data with the categorical data. In order to conduct the aforementioned tests, the data was input into the Statistical Package for the Social Sciences (SPSS). Due to the small sample size ( $N = 21$ ), some responses were recoded from the original format to allow for meaningful analyses to be conducted. The minimum threshold of significance was set at the accepted standard of  $p < 0.05$ . In other words, a p-value less than 0.05 was required in order for the null hypothesis to be rejected in favor of the alternative.

### *Discussion of Results*

The first noteworthy finding to come out of the data analyses was the result of a Pearson chi-square which showed that companies which reported knowing about KM were significantly more likely to report its application than companies unaware of it,  $X^2(1, N = 19) = 8.872, p = .003$ . However, strong interpretation of this result would be premature in the absence of further research. This is especially true in light of the fact that the companies which reported knowing about KM were not found to be significantly different from the companies which reported not knowing about KM in the application and use of the KM strategies present in the survey. A result such as the one obtained in this case suggests companies may be applying some forms of KM without knowing they are participating in KM. With KM being highly beneficial to the organizations utilizing it, the avenue of KM education is certainly an area ripe for future research.

In addition to the first broad finding, two other strong themes emerged from the data and deserve exploration. The first such theme is the benefits to KM which are abundant in companies that treat their employees as rare assets and strive to fit each person into the optimal job. Companies which view each employee as a rare asset were significantly more likely to report the application of KM than companies which do not view each employee as a rare asset,  $X^2(1, N = 18) = 8.416, p = .004$ . In addition, the companies which view each employee as a rare asset were also significantly more likely to have employees that know how their job contributes to corporate goals,  $X^2(1, N = 19) = 6.046, p = .014$ ; significantly more likely to use the management process to strengthen employees as team members,  $X^2(1, N = 19) = 3.893, p = .048$ ; and significantly more likely to have employees that understand the innovation process and are encouraged to participate in it,  $X^2(1, N = 18) = 5.625, p = .018$ . Furthermore, it was discovered that companies which view each employee as a rare asset have passed through significantly more KM stages ( $M = 3.60, \sigma = 2.547$ ), than companies which do not view employees as rare assets ( $M = 1.67, \sigma = .577$ ),  $t(10.907) = 2.218, p = .049$ ; employ significantly more knowledge exchange methods ( $M = 5.50, \sigma = 1.414$ ), than companies which do not view employees as rare assets ( $M = 2.50, \sigma = 1.414$ ),  $t(14) = 4.243, p = .001$ ; and engage in significantly more activities that may positively impact KM ( $M = 3.75, \sigma = 1.488$ ), than companies which do not view employees as rare assets ( $M = 1.67, \sigma = .816$ ),  $t(12) = 3.079, p = .010$ .

The second large theme which emerged was the KM benefits which are present in companies that use the management process to make employees into stronger team members. As was previously touched upon, companies that use the management process to strengthen employees as team members are significantly more likely to view employees as a rare asset  $X^2(1, N = 19) = 3.893, p = .048$ . The benefits of treating employees as a rare asset have already been explored in depth, but there are many KM benefits which are prevalent in companies that use the management process to make employees into stronger team members as well. Of note, companies which use the management process to make employees into stronger team members are significantly more likely to ensure there is synergy between learning programs and corporate goals  $X^2(1, N = 19) = 4.636, p = .031$ ; significantly more likely to have the infrastructure in place to help employees do a good job  $X^2(1, N = 20) = 4.781, p = .029$ ; significantly more likely to reward employees for helping the company achieve its corporate goals  $X^2(1, N = 20) = 5.952, p = .015$ ; and significantly more likely to have employees that understand the innovation process and are encouraged to participate in it  $X^2(1, N = 19) = 6.902, p = .009$ . Also, companies which use the management process to make employees into stronger team members employ significantly more knowledge exchange methods ( $M = 4.75, \sigma = 1.815$ ), than companies that do not use the management process to make employees into stronger team members ( $M = 2.20, \sigma = 1.095$ ),  $t(15) = 2.896, p = .011$ ; utilize significantly more physical mechanisms to store knowledge ( $M = 3.45, \sigma = 1.368$ ), than companies that do not use the management process to make employees into stronger team members ( $M = 2.00, \sigma = .894$ ),  $t(15) = 2.328, p = .034$ ; and incorporate significantly more interactions that generate knowledge as a by-product ( $M = 7.25, \sigma = 2.832$ ), than companies that do not use the management process to make employees into stronger team members ( $M = 3.50, \sigma = 2.074$ ),  $t(16) = 2.864, p = .011$ .

In addition to the two main themes which became apparent, there was one smaller finding that deserves a closer look as well. The finding involves the types of companies likely to make use of significantly more knowledge exchange methods than their counterparts. The importance of this distinction comes from the fact that companies which reported the application of KM employed significantly more knowledge exchange methods ( $M = 5.71, \sigma = 1.380$ ), than did companies that did not report the application of KM ( $M = 3.00, \sigma = 1.323$ ),  $t(14) = 3.996, p = .001$ . This relationship is especially important as it ties companies that may not have known what KM was, as they were asked in the original survey, to the application of KM. As was already expressed, both companies which use the

management process to make employees into stronger team members and companies which view each employee as a rare asset utilize significantly more knowledge exchange methods than their counterparts. However, the use of more knowledge exchange methods is not exclusive to the companies that answered in these ways. Companies which give their employees the opportunity to create a career plan with the company make use of significantly more knowledge exchange methods ( $M = 4.80, \sigma = 1.814$ ), than do companies that do not give their employees the opportunity to create a career plan ( $M = 2.50, \sigma = 1.643$ ),  $t(14) = 2.538, p = .024$ . Likewise, companies with synergy between learning programs and corporate goals employ significantly more knowledge exchange methods ( $M = 4.91, \sigma = 1.446$ ), than companies lacking synergy between learning programs and corporate goals ( $M = 2.40, \sigma = 2.074$ ),  $t(14) = 2.820, p = .014$ . Also, companies which have employees that understand the innovation process and are encouraged to participate in it utilize significantly more knowledge exchange methods ( $M = 5.13, \sigma = 1.727$ ), than companies with employees who do not understand the innovation process and are not encouraged to participate in it ( $M = 2.75, \sigma = 1.669$ ),  $t(14) = 2.797, p = .014$ . Similarly, companies which have employees that understand the innovation process and are encouraged to participate in it take part in significantly more activities that may positively impact KM ( $M = 3.57, \sigma = 1.512$ ), than companies with employees who do not understand the innovation process and are not encouraged to participate in it ( $M = 1.86, \sigma = .900$ ),  $t(12) = 2.578, p = .024$ .

Apart from the previously explored findings which are easily categorized and fit nicely together, there were some other significant relationships highlighted by the data that cannot go unmentioned. First, companies which maintain a standard 'follow-up' procedure with customers report having electronic records that are significantly more secure from unwanted intrusion ( $M = 3.00, \sigma = .953$ ), than companies that do not maintain standard 'follow-up' procedures ( $M = 1.50, \sigma = .577$ ),  $t(14) = 2.931, p = .011$ . Also, companies which keep track of each employee's work were found to have a significantly higher level of average employee proficiency ( $M = 2.58, \sigma = .515$ ), than companies that do not keep track of employee work ( $M = 1.33, \sigma = .577$ ),  $t(13) = 3.688, p = .003$ .

## Conclusions

The research conducted was able to come up with an exploratory understanding of the perception of the construction firms in the South Eastern US on the awareness and usage of KM within their firms. This being a specialized topic that upper level managers within a company would be familiar with, the target of this questionnaire survey were the company executives and the people in the higher level authorities as evident from the results of the survey. It was quite interesting to find that even some of these company executives did not have clear understanding of what the term KM entailed for the type of works they pursued. Only about half of the respondents had applied KM concepts in their firms. For the other half, even if they had participated in KM activity they were unaware of it. It was discovered that companies which view each employee as a rare asset have passed through significantly more KM stages (advanced stage) and employ significantly more knowledge exchange methods. Also, companies which focused on a combination of business, management, and hands-on perspectives have passed through significantly more KM stages than companies that focused only on the business perspective. Companies which keep track of each employee's work were found to have a significantly higher level of average employee proficiency than companies that do not keep track of employee work. It is hoped that the results of the in-depth statistical analysis performed will give a good direction for further research in developing a KM model to be used by these companies.

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