



Perceptions of the impacts of organizational culture and information technology on knowledge sharing in construction

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Abstract

Purpose – The purpose of this paper is to expand understanding of the factors that affect knowledge sharing in construction organizations. The outcome of this study will enable further understanding of knowledge sharing in construction and will therefore contribute towards successful implementation of knowledge sharing as part of organizational knowledge management (KM) initiatives in construction organizations.

Design/methodology/approach – A survey was conducted of the 2005 *Engineering News Record* Top 400 US contractors to assess their perceptions of how factors such as organizational culture (OC), trust and information technology (IT) impact knowledge sharing in their construction organizations.

Findings – The survey respondents strongly agreed on the perception that a proper organizational culture will enhance mutual trust in the organization. The respondents also perceived that IT will assist but not motivate people in sharing their knowledge and that not all types of knowledge can be shared using IT.

Research limitations/implications – The results are limited to the respondents' perceptions of how knowledge is shared in large construction organizations. By encouraging the participation of a larger number of construction companies, a higher confidence level can be achieved for the responses.

Practical implications – Knowledge sharing is one of the key processes in KM and, as such, understanding the perceptions of how knowledge is shared in large construction organizations is very important in their implementation of KM.

Originality/value – Very few studies have been conducted in the USA on the perceptions of management level employees about knowledge sharing in large construction organizations. The study is an important first step in collecting such data.

Keywords Construction industry, United States of America, Knowledge management, Knowledge sharing, Organizational culture, Trust

Paper type Research paper



Introduction

Various writers have indicated that knowledge is an organization's best sustainable source of competitive advantage. Knowledge management (KM) is considered a key part in creating a competitive advantage today. Knowledge sharing is one of the most important stages of the KM process. The purpose of this study is to determine the role of culture, trust and information technology (IT) in encouraging employees to share

their knowledge in organizations that have effective KM implementations. Hence, the goal of this study is to test the following three hypotheses:

- H_{o1}*. There is no significant linear relationship between organizational culture (OC) and mutual trust (MT) between employees.
- H_{o2}*. There is a no significant linear relationship between the heavy use of computer-supported collaborative work (CSCW) and MT between employees.
- H_{o3}*. There is no significant positive relationship between successful implementation of KM on one side and proper organizational culture (POC), MT between employees and CSCW on the other side.

This study examines the role that OC, MT between employees and IT play in improving knowledge sharing between employees. A survey was conducted of *Engineering News Record (ENR) Top 400 US Contractors (2005)* to find out how OC and CSCW affect MT between employees and whether CSCW is able to substitute for personal relationships. The data collected were analyzed statistically and recommendations were made based on the results of the data analysis.

The intended audience for this study is the top management personnel of large construction companies who consider KM as one of their top priorities. The intent of this study is to enable better understanding and awareness by top management personnel of the relationship between IT and knowledge sharing, e.g. investing in IT may lead to less socialization which in turn can lead to less knowledge sharing.

Background

Knowledge sharing

Knowledge sharing is one of the most important stages of the KM process. It is one of management's greatest challenges, because employees are often unwilling to share information. Knowledge sharing is directly related to the competitive advantage of the firm because knowledge that is not shared slows the improvement of an organization. Knowledge sharing assumes a relationship between at least two parties, the owner and the recipient of the knowledge. The owner of that knowledge shares it through the process of externalization whereas the recipient internalizes it.

Tacit knowledge is difficult to share as it never leaves one's brain. When individuals leave a firm, the tacit knowledge leaves with them (Tsoukas, 1996). Organizations encourage employees to share knowledge by investing in technology to capture and store it so that when a person leaves the company, knowledge will remain behind for future reuse.

Factors that affect knowledge sharing

Where knowledge has a tendency to spread easily, it is not a reflection of suitable technology, but suitable social contexts (Brown and Duguid, 1998). van Beveren (2002) indicated that the need to create the right OC and infrastructure in which knowledge can be created and disseminated is important. Technology can contribute by providing methods for the processing, delivery and sharing of valuable information that is needed for knowledge creation within individuals. Pan and Scarbrough (1998) summarized the socio-technical analysis in terms of three major layers of KM systems: infrastructure (hardware/software), infostructure (rules), infoculture (stock of background knowledge).

According to Davenport and Prusak (1998), as regards implementation, at the initial stage, projects could be carried out. However, in the second stage, KM should be integrated with strategy, process, culture and behavior. The factors that contribute to knowledge sharing are culture, trust and IT.

Organizational culture

OC is a complex concept that has been researched extensively, rejecting various perspectives (Harris and Ogbonna, 2002). In addition, no commonly agreed definition of OC exists in the management literature (Alvesson, 2002). For example, OC is historical and reflects the beliefs of the owners of the firm and it is the glue that binds individuals together (Mwaura *et al.*, 1998). Furthermore, some aspects of OC are highly visible, while others are salient; other aspects are taken for granted by members of the organization and often difficult to change (Alvesson, 2002). Schein (1996) noted that “OC is shared tacit, taken for granted ways of perceiving, thinking and reacting.”

A knowledge-enterprising culture is one of the most important conditions leading to the success of a KM project. OC is difficult to change as it evolves over a period of time (Alvesson, 2002). In addition, within the organization employees build up sub cultures that may work against the existing corporate culture.

de Long and Fahey (2000) classified four ways in which culture influences the behaviors central to knowledge creation, sharing and use in that it shapes assumptions; defines the relationships between individual and organizational knowledge; creates the environment for social interaction that determines how knowledge will be used in particular situations; and shapes the methods by which new knowledge, with its accompanying doubts, is created, legitimized, and distributed within organizations. To achieve successful knowledge sharing, companies need to persuade people to eliminate the old-school thinking that they are being measured by what they know. Such thinking only perpetuates knowledge hoarding which leads to little value-adding transfer. One way in which this can be achieved is through performance appraisal (Robertson and Hammersley, 2000).

A reward system is an important component of an OC because regardless of their nature, rewards strengthen and transmit the culture by providing tangible indication of what the organization values. Civi (2000) suggested that training is the best way to start to induce a culture within organizations seeking to engender a more open collaborative environment. A common purpose and a sense of shared meanings help in building trust to share knowledge (Bechky, 2003).

Mutual trust

Trust is defined as “as an expectancy held by an individual or group that the word, promise, verbal, or written statement of another individual or group can be relied on” (Rotter, 1980). In addition, trust is the expectation that the other party will perform a particular action important to the person trusting them, irrespective of the ability of the person trusting them to monitor or control the actions of the other party (Mayer and Davis, 1995).

Trust is an important element and a key ingredient for the success of KM because, if the recipient of knowledge is not persuaded that the source is capable and trustworthy, it is not likely knowledge from that individual will be accepted. Trust is essential to an organization because it improves positive behavior, encourages network relations, reduces conflicts and transaction costs and improves the creation of a good working environment.

In a study done by Connelly and Kelloway (2002), respondents noted that they would only be willing to share knowledge in situations where they trusted the recipient of this knowledge. However, it has also been noted that sharing information between different members of the company increases the level of trust (Bowles, 1999). In other words, as people start to share their knowledge because of the company's policies, they will feel interpersonal trust with each other. Therefore, interpersonal trust may develop as a result of knowledge sharing.

Nonaka and Takeuchi (1995) also made suggestions for creating trust for KM. The recommendations are the following:

- create a sense of mutual dependence;
- make trustworthy behavior part of the performance review;
- increase individual reliability by creating a map of expectations;
- share personal information (applicable for smaller groups); and
- use symbolic gestures to indicate interdependency (von Krogh *et al.*, 2000).

The final component for trust and KM is the issue of distrust. Distrust is characterized by fear, doubt, cynicism, wariness, watchfulness and caution (Lewicki *et al.*, 1998). If distrust is present within an organization, KM cannot, and will not, succeed (Davenport and Prusak, 2000). The reason for this failure is that when fear is present, people will not contribute in sharing critical information and will be suspicious regarding the organization's true intentions.

Technological innovation

Technology platforms may assist, but no technology will stimulate the flow of knowledge without attention to the cultural and organizational contexts in which people are encouraged to develop and share their knowledge (Clarke and Rollo, 2001). According to Pan and Scarbrough (1998), the socio-technical analysis can be summarized in terms of three major layers of KM systems: infrastructure (hardware/software), infostructure (rules), infoculture (stock of background knowledge).

Information technology (IT)

IT has a great potential to facilitate organizational learning and KM within a construction firm, both because IT is continually growing and because it promises to address the problems experienced in completing construction projects. Examples of IT tools that can assist KM and learning within an organization are decision support tools, data mining, case-based reasoning, computer supported work reasoning as well as networking and communication technologies.

Real knowledge is usually tacit but there is also a great amount of data, information and knowledge that can be represented in electronic form. People tend to use IT such as web technology and document management systems to make the above reachable and to call this a KM system.

IT and the construction industry

IT is becoming more important to KM in construction organizations. However, the construction industry has been slow to recognize the benefits of IT as a major communications tool (Egbu *et al.*, 2001b). Transferring knowledge and information

across projects is a critical issue for construction companies. Professional and practical knowledge is lost from one project to the next weakening an organization's ability to develop knowledge and generate new ideas. Gann (2000) argues that IT can assist the transfer of knowledge and information between project teams, enabling the expansion of new knowledge for innovation.

The concept of KM technologies is both broad and difficult to define (Egbu, 2000). Even some information infrastructure technologies that appear not to fall naturally within this theory can be helpful in assisting KM. Examples are video-conferencing and telephone. Although it is doubtful whether these technologies capture or distribute structured knowledge, many would argue that they are useful at enabling people to transfer tacit knowledge. Other KM technologies include intranets, portals, semantic engines and ontology-based tools.

In a survey by Egbu *et al.* (2001a) the respondents, 19 small, medium and large British public and private sector construction organizations, were asked to rank the usage and the effectiveness of certain tools and technologies in managing knowledge. From the responses, it was clear that the most commonly used technologies in British construction companies are: telephone, internet/intranet/e-mail and documents and reports. These are followed by face-to-face meetings and interaction with the supply chain. This suggests that conventional techniques for acquiring, developing, sharing and storing knowledge are still used frequently among construction companies. The telephone remains an important tool for KM because it could be used to capture explicit and tacit knowledge (Egbu, 2000). Groupware is also an important collaborative software tool for the sharing and transferring of knowledge in organizations (Robinson *et al.*, 2001).

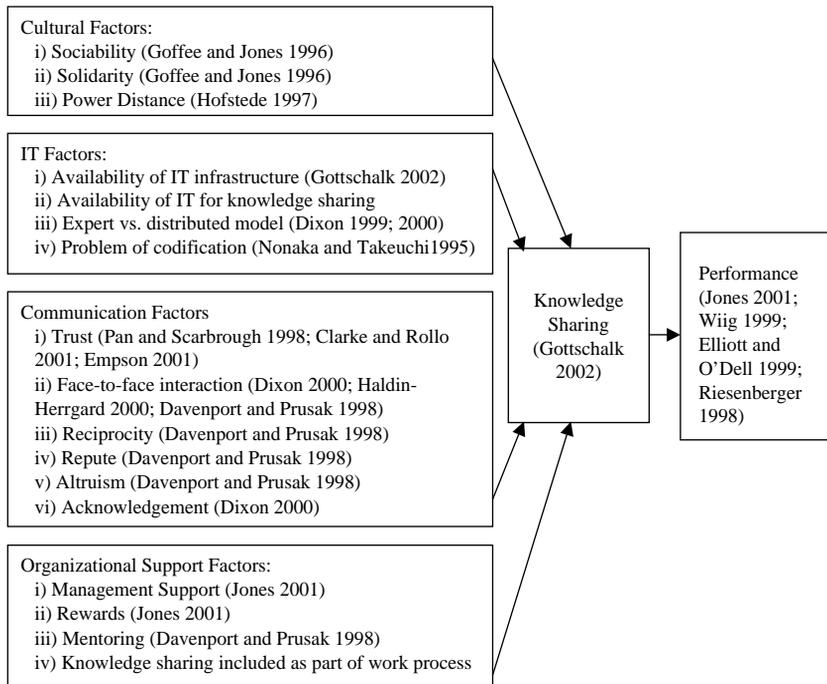
Supar *et al.* (2005) used the research framework in Figure 1 to test four main categories for their significance as a contributing factor towards knowledge sharing among 2,320 staff members at three academic institutions and then investigated the outcome of knowledge sharing in terms of its effect on performance. The findings highlighted the importance of management support, solidarity, knowledge sharing to be included as part of the work process, presence of IT infrastructure and mentoring in affecting knowledge sharing. The study indicated that organizational support and culture have a bigger effect than IT on knowledge sharing which in turn contributes to performance.

Summary

As discussed above, encouraging knowledge sharing is one of management's greatest challenges, because employees are often unwilling to share information and this adversely impacts a firm's competitive advantage. Knowledge that is not shared slows the improvement of an organization. The factors found in the literature that affect knowledge sharing are trust, OC and IT (CSCW) and these are the factors addressed in this study.

Research methodology and data collection

In order to collect the data needed for this study, a survey questionnaire and the research model shown in Figure 2 were developed. The data gathered through the survey were used to help determine the effect of OC and CSCW on MT between employees and the relationship between successfully implementing knowledge sharing



Source: Supar *et al.* (2005)

Figure 1.
Research framework

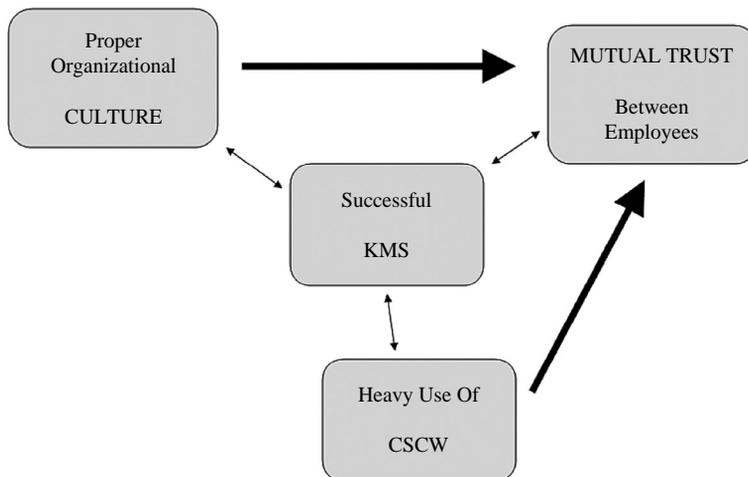


Figure 2.
Proposed research
framework

on one side and culture, trust and CSCW on the other. Survey respondents were top management personnel at 33 large construction companies across the USA. These companies were chosen from the list of the 2005 *ENR* Top 400 US construction companies. The survey was sent by regular mail as well as by e-mail, in 2006, to 195

companies 33 of which filled out the survey. The response rate was 16.9 percent. Only 29 out of the 33 surveys were used in this study because the remaining four questionnaires were incomplete. A search of the literature suggests that the sample size used in this study is adequate (Ostle and Malone, 1988).

Data analysis and results

Demographic information

As shown in Figure 3, 38 percent of the respondents were company presidents, CEOs or chairmen, 17 percent vice presidents and senior vice presidents, 17 percent HR managers and directors and the other 28 percent were senior project managers, project managers, business development managers and employee relations coordinators. In total, 66 percent of the respondents were from companies doing business in Florida and 34 percent were from other states like California, New York, Texas, Georgia, Nevada, Rhode Islands and Missouri. The respondents' average number of years with their firms was 14. The rest of the survey questions asked and the responses to those questions are shown in Figures 4-7 and will be referred to in the rest of this study. As can be observed from the individual results for each question, the distribution of the responses appears to depart substantially from a normal distribution. Hence, the standard error of the mean will be used for hypothesis testing in accordance with the central limit theorem (Ostle and Malone, 1988).

KM as a top priority

The respondents were asked whether KM was one of their top priorities because the aim of this study is to look at the large construction companies that consider a good KM as one of their top priorities. As shown in Figure 4, Question 1, the respondents indicated by an average of 5.93 out of 7 that good KM was one of their top priorities.

Role of culture, trust and technological innovation in knowledge sharing

The survey respondents were asked about the importance of a POC in Figure 4, Question 1; MT between employees in Figure 5, Question 6 and technological innovation (TECH) in Figure 5, Question 9 in improving the sharing of knowledge in an organization. The majority of the respondents agreed that POC motivates employees in sharing their knowledge in an organization. The Question 6 responses show that the majority of the respondents strongly agree that MT is needed in order for knowledge to

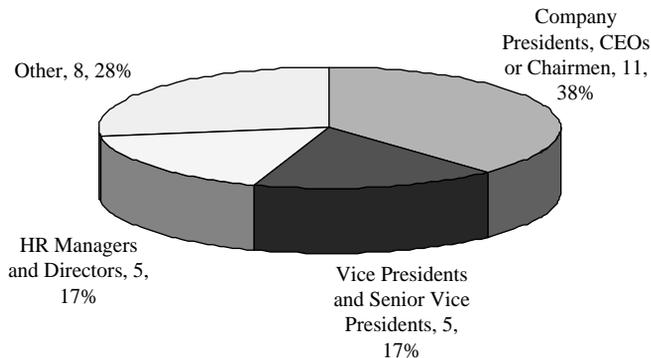
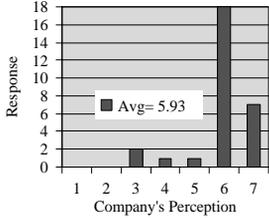
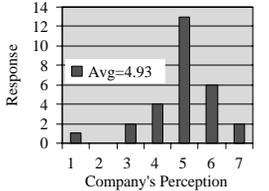
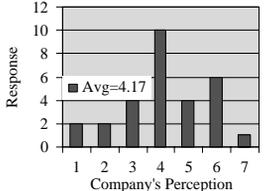
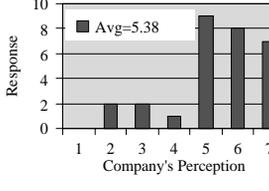
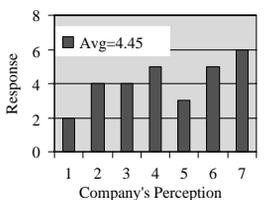


Figure 3.
Respondents' demographics

QUESTIONS	RESULTS
<p>1. Proper organizational culture motivates employees to share knowledge and ideas for the improvement of the company.</p> <p>N = 29 Mean = 5.93 Median = 6 Mode = 6 S.D. = 1.00 S.E. = 0.185</p>	
<p>2. Employees believe that sharing their knowledge will help them in their career.</p> <p>N = 29 Mean = 4.93 Median = 5 Mode = 5 S.D. = 1.18 S.E. = 0.219</p>	
<p>3. There are negative consequences for employees who do not share their knowledge in your firm.</p> <p>N = 29 Mean = 4.17 Median = 4 Mode = 4 S.D. = 1.49 S.E. = 0.276</p>	
<p>4. Your organization holds meetings that support employees in getting to know one another better.</p> <p>N = 29 Mean = 5.38 Median = 6 Mode = 5 S.D. = 1.40 S.E. = 0.261</p>	
<p>5. Your company has established an incentive program for the sharing of knowledge (e.g.Suggestion Box, etc)</p> <p>N = 29 Mean = 4.45 Median = 4 Mode = 7 S.D. = 1.91 S.E. = 0.355</p>	

¹Likert Scale
 1 Strongly Disagree 2 3 4 5 6 7 Strongly Agree
 S.D.= STANDARD DEVIATION
 S.E.= STANDARD ERROR

Figure 4.
Survey results

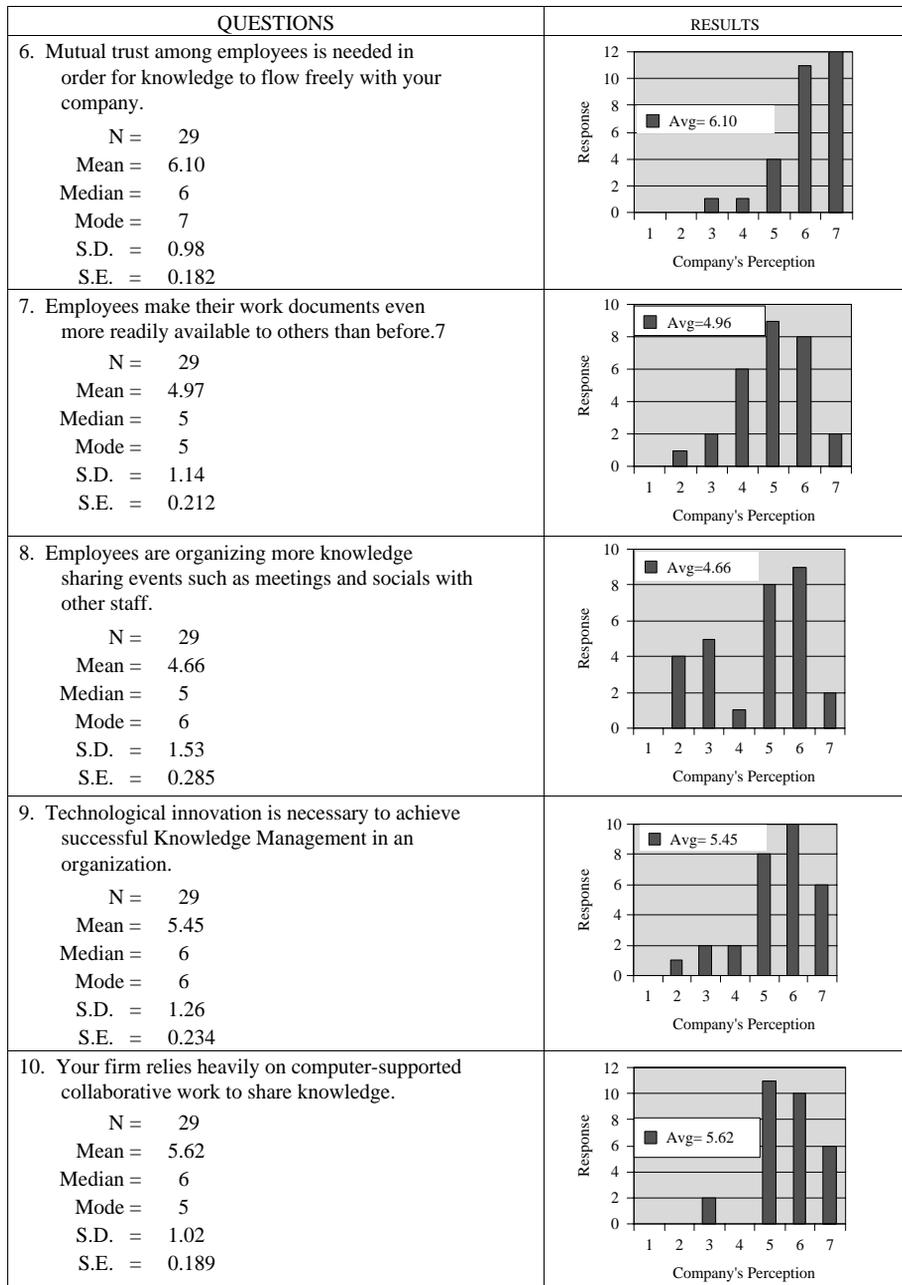


Figure 5.
Survey results

QUESTIONS	RESULTS																
<p>11. Your organization is facing difficulties in using new information and communication technologies.</p> <p>N = 29 Mean = 3.72 Median = 4 Mode = 5 S.D. = 1.71 S.E. = 0.318</p>	<table border="1"> <caption>Data for Question 11</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>4</td></tr> <tr><td>2</td><td>5</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>5</td></tr> <tr><td>5</td><td>9</td></tr> <tr><td>6</td><td>1</td></tr> <tr><td>7</td><td>2</td></tr> </tbody> </table>	Company's Perception	Response	1	4	2	5	3	3	4	5	5	9	6	1	7	2
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<p>12. All types of knowledge can be represented in an electronic format.</p> <p>N = 29 Mean = 3.93 Median = 4 Mode = 2 S.D. = 1.84 S.E. = 0.342</p>	<table border="1"> <caption>Data for Question 12</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>3</td></tr> <tr><td>2</td><td>6</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>5</td></tr> <tr><td>5</td><td>5</td></tr> <tr><td>6</td><td>4</td></tr> <tr><td>7</td><td>3</td></tr> </tbody> </table>	Company's Perception	Response	1	3	2	6	3	3	4	5	5	5	6	4	7	3
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<p>13. Your organization has been very successful in implementing knowledge and information management.</p> <p>N = 29 Mean = 5.10 Median = 5 Mode = 5 S.D. = 1.22 S.E. = 0.227</p>	<table border="1"> <caption>Data for Question 13</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>6</td></tr> <tr><td>3</td><td>1</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>14</td></tr> <tr><td>6</td><td>5</td></tr> <tr><td>7</td><td>4</td></tr> </tbody> </table>	Company's Perception	Response	1	1	2	6	3	1	4	4	5	14	6	5	7	4
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<p>14. Computer-Supported Collaborative Work can lead to less interaction between employees.</p> <p>N = 29 Mean = 4.52 Median = 5 Mode = 5 S.D. = 1.56 S.E. = 0.291</p>	<table border="1"> <caption>Data for Question 14</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>7</td></tr> <tr><td>4</td><td>1</td></tr> <tr><td>5</td><td>10</td></tr> <tr><td>6</td><td>5</td></tr> <tr><td>7</td><td>3</td></tr> </tbody> </table>	Company's Perception	Response	1	1	2	2	3	7	4	1	5	10	6	5	7	3
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<p>15. A good cultural strategy will enhance trust in an organization.</p> <p>N = 29 Mean = 6.34 Median = 6 Mode = 6 S.D. = 0.54 S.E. = 0.100</p>	<table border="1"> <caption>Data for Question 15</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td></tr> <tr><td>2</td><td>0</td></tr> <tr><td>3</td><td>0</td></tr> <tr><td>4</td><td>0</td></tr> <tr><td>5</td><td>1</td></tr> <tr><td>6</td><td>17</td></tr> <tr><td>7</td><td>11</td></tr> </tbody> </table>	Company's Perception	Response	1	0	2	0	3	0	4	0	5	1	6	17	7	11
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Figure 6.
Survey results

QUESTIONS	RESULTS																
<p>16. Information technology will assist employees in sharing their knowledge. N = 29 Mean = 5.90 Median = 6 Mode = 6 S.D. = 1.08 S.E. = 0.200</p>	<table border="1"> <caption>Data for Question 16</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td></tr> <tr><td>2</td><td>1</td></tr> <tr><td>3</td><td>0</td></tr> <tr><td>4</td><td>2</td></tr> <tr><td>5</td><td>3</td></tr> <tr><td>6</td><td>15</td></tr> <tr><td>7</td><td>8</td></tr> </tbody> </table>	Company's Perception	Response	1	0	2	1	3	0	4	2	5	3	6	15	7	8
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<p>17. Information technology will motivate employees to share more of their knowledge N = 29 Mean = 4.69 Median = 5 Mode = 5 S.D. = 1.24 S.E. = 0.231</p>	<table border="1"> <caption>Data for Question 17</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>6</td></tr> <tr><td>5</td><td>11</td></tr> <tr><td>6</td><td>5</td></tr> <tr><td>7</td><td>2</td></tr> </tbody> </table>	Company's Perception	Response	1	0	2	2	3	3	4	6	5	11	6	5	7	2
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<p>18. Good Knowledge Management is one of your organization's top priorities. N = 29 Mean = 5.28 Median = 5 Mode = 6 S.D. = 1.06 S.E. = 0.197</p>	<table border="1"> <caption>Data for Question 18</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td></tr> <tr><td>2</td><td>0</td></tr> <tr><td>3</td><td>2</td></tr> <tr><td>4</td><td>5</td></tr> <tr><td>5</td><td>8</td></tr> <tr><td>6</td><td>11</td></tr> <tr><td>7</td><td>3</td></tr> </tbody> </table>	Company's Perception	Response	1	0	2	0	3	2	4	5	5	8	6	11	7	3
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<p>19. My organization has met difficulties in implementing Knowledge Management because: a- The focus was on IT and Communication rather than on people. N = 28 Mean = 3.50 Median = 4 Mode = 4 S.D. = 1.28 S.E. = 0.241</p>	<table border="1"> <caption>Data for Question 19a</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>2</td></tr> <tr><td>2</td><td>5</td></tr> <tr><td>3</td><td>4</td></tr> <tr><td>4</td><td>8</td></tr> <tr><td>5</td><td>6</td></tr> <tr><td>6</td><td>1</td></tr> <tr><td>7</td><td>0</td></tr> </tbody> </table>	Company's Perception	Response	1	2	2	5	3	4	4	8	5	6	6	1	7	0
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<p>b- Resistance by certain employees. N = 28 Mean = 4.25 Median = 4.5 Mode = 5 S.D. = 1.43 S.E. = 0.270</p>	<table border="1"> <caption>Data for Question 19b</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td></tr> <tr><td>2</td><td>5</td></tr> <tr><td>3</td><td>4</td></tr> <tr><td>4</td><td>5</td></tr> <tr><td>5</td><td>8</td></tr> <tr><td>6</td><td>5</td></tr> <tr><td>7</td><td>1</td></tr> </tbody> </table>	Company's Perception	Response	1	0	2	5	3	4	4	5	5	8	6	5	7	1
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<p>c- It is not my organization's top priority. N = 29 Mean = 3.62 Median = 3 Mode = 2 S.D. = 1.65 S.E. = 0.306</p>	<table border="1"> <caption>Data for Question 19c</caption> <thead> <tr> <th>Company's Perception</th> <th>Response</th> </tr> </thead> <tbody> <tr><td>1</td><td>2</td></tr> <tr><td>2</td><td>7</td></tr> <tr><td>3</td><td>7</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>3</td></tr> <tr><td>6</td><td>5</td></tr> <tr><td>7</td><td>1</td></tr> </tbody> </table>	Company's Perception	Response	1	2	2	7	3	7	4	4	5	3	6	5	7	1
Company's Perception	Response																
1	2																
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7	1																

Figure 7.
Survey results

flow freely within the company. The Question 9 responses indicate that the majority of the respondents agree that technological innovation is necessary to achieve a successful implementation of KM in an organization. Thus, from a comparison of the mean scores of the responses to questions 1, 6, and 9 (Table I), it can be concluded that the respondents perceived MT between employees with a mean value of 6.10 as the most important factor that affects knowledge sharing, followed by a POC (5.93) and by technological innovation (5.45), respectively.

Organizations’ cultural characteristics

A number of survey questions addressed the organization’s culture. Respondents were asked in Figure 4, Question 2 whether they perceived that their employees believed that sharing knowledge would help them in their career (promotion); in Figure 4, Question 3, whether there were negative consequences for those who did not share knowledge (sanctions); in Figure 4, Question 4, whether their organization held meetings for employees to know one another better (meetings); and in Figure 4, Question 5, whether their company had established an incentive program for those who share knowledge (incentives).

The respondents’ perception that their companies were not giving a lot of attention to the cultural characteristics of their organizations is shown in Table II. Their responses indicated that they were not putting a lot of effort in encouraging their people to share knowledge. The mean scores shown in Table II indicate that the companies were holding meetings (Figure 4, Question 4) for their employees to get to know each other better but they were not promoting (Figure 4, Question 2) and giving incentives (Figure 4, Question 5) to those who shared knowledge nor were they sanctioning (Figure 4, Question 3) those who did not.

Statistical parameters	RC	MT	TECH
N	29	29	29
Mean	5.93	6.10	5.45
Median	6	6	6
Mode	6	7	6
SD	1.00	0.98	1.26
Standard error	0.185	0.182	0.234

Table I.
Perceptions of RC, MT
and TI in the sharing
of knowledge^a

Notes: ^aRC – role of culture; MT – mutual trust; TI – technological innovation

Statistical parameters	Promotion	Sanctions	Meetings	Incentives
N	29	29	29	29
Mean	4.93	4.17	5.38	4.45
Median	5	4	6	4
Mode	5	4	5	7
SD	1.18	1.49	1.40	1.91
Standard error	0.219	0.276	0.261	0.355

Table II.
Perceptions of attention
to cultural characteristics

Computer-supported collaborative work (CSCW)

Participant organizations were asked whether they relied heavily on CSCW to share knowledge. The responses to Question 10 in Figure 5 shows the perception that the respondents relied heavily on CSCW to share knowledge with an average score of 5.62 out of 7. This shows that the participating firms were investing in technological innovation to improve the sharing of knowledge between their employees.

Trust between employees

The respondents were asked whether their employees were making their documents more readily available than before (Figure 5, Question 7) and whether they were organizing more knowledge sharing events such as meetings and socials with other staff members (Figure 5, Question 8).

It can be concluded from the responses to questions 7 and 8, that the employees were not taking enough initiatives to share knowledge between themselves, which means that there was not a high level of trust between them.

IT and knowledge sharing

Participating companies were asked to give their opinion on several statements regarding IT and knowledge sharing. The goal of those questions was to study the relationship and the effect of IT on the sharing and distribution of knowledge. The respondents were asked whether their firms were facing difficulties in using new information and communication technologies (Figure 6, Question 11), whether all types of knowledge could be represented electronically (Figure 6, Question 12), and whether IT would assist or motivate the sharing of knowledge (Figure 7, questions 16 and 17).

The mean scores shown in Table III for questions 11 and 12 and questions 16 and 17 indicate that the participant companies were not facing difficulties using IT. This is attributable to the fact that good KM is one of their organization's top priorities and due to the large size of these companies. Moreover, the majority of the firms believed that not all types of knowledge can be represented electronically, e.g. tacit knowledge can only be shared through personal contact and experience. Finally, there was a strong agreement between respondents that IT would assist in sharing knowledge and a weaker belief that it would motivate employees to share their knowledge.

Statistical parameters	Facing difficulties using IT	All types of knowledge can be represented electronically	IT will assist employees in sharing knowledge	IT will motivate employees to share knowledge
N	29	29	29	29
Mean	3.72	3.93	5.90	4.69
Median	4	4	6	5
Mode	5	2	6	5
SD	1.71	1.91	1.11	1.28
Standard error	0.318	0.355	0.200	0.231

Table III.
IT and knowledge sharing
(questions 11-12, 16-17)

Effect of CSCW and organizational culture (OC) on trust

Participants were asked whether they believed that CSCW would lead to less interaction between employees in the firm and whether they thought that a good cultural strategy would enhance trust in an organization. The results in Table IV show that the respondents did not agree that CSCW would lead to less interaction between people in the company (Question 14). The average rating of their responses was 4.52 out of 7. Moreover, the respondents strongly agreed that a good cultural strategy would enhance trust in an organization (Question 15) with an average rating of 6.34 out of 7.

Successful KM implementation

The respondents were asked in Figure 6 (Question 13) about their perception as to how successful their organization was in implementing knowledge and information management. The average response rate of 5.10 out of 7 indicated that these companies had not been very successful in their KM implementation.

Causes of difficulties encountered by organizations

The respondents were given statements (Figure 7, Question 19) to select from in order to determine the extent to which they agreed that one of the statements expressed the reason that is leading to difficulties in implementing KM in their organizations. The results shown in Table V do not indicate that there is a consensus among the respondents; and that the reason for their difficulties was the focus on IT and communication rather than on people or because it was not their top priority. The average rate of these two responses was 3.5 and 3.62 out of 7, respectively. The respondents were more in agreement (4.25 out of 7) in their perception that the difficulties they faced in the implementation of KM was due to resistance by certain employees to the sharing of their knowledge.

Statistical parameters	CSCW leads to less interaction	A good cultural strategy will enhance trust
N	29	29
Mean	4.52	6.34
Median	5	6
Mode	5	6
SD	1.62	0.55
Standard error	0.291	0.100

Table IV.
Effect of CSCW and OC on trust (questions 14 and 15)

Statistical parameters	Focus on IT rather than people	Resistance by certain employees	Not a top priority
N	28	28	29
Mean	3.50	4.25	3.62
Median	4	4.5	3
Mode	4	5	2
SD	1.28	1.43	1.65

Table V.
Reasons for difficulties in implementing KM (Question 19)

Regression analysis

Effect of a proper organizational cultural strategy on mutual trust between employees
 Promotions, sanctions, meetings and incentives are the main factors that constitute a POC. Sharing of documents as well as organizing knowledge meetings indicates the extent to which employees trust each other. In order to be able to find the relationship between a POC and MT between employees the average perception values of the factors that constitute each one of them (average of promotion, sanctions, meetings and incentives versus the average of shared documents and knowledge meetings) were calculated and compared as shown in Table VI and Figure 8.

Since the calculated value of students' $t = 3.10$ was greater than 1.703, the tabulated student t -value at the 0.05 level (two-tailed) with a degree of freedom of 27, the null hypothesis (H_01) can be rejected at the 90 percent confidence level and the alternative H_a1 can be accepted (Ostle and Malone, 1988). Thus, there is a significant linear relationship between OC and MT among the employees in the respondents' companies.

Effect of heavy reliance on CSCW in sharing knowledge on mutual trust between employees

The respondents were asked whether their companies relied heavily on CSCW in sharing knowledge as well as whether their employees were sharing more documents and whether they were organizing more knowledge meetings between themselves. These two categories were compared as shown in Figure 9 and Table VII to determine the effect of CSCW on MT between employees.

Since the calculated value of students' $t = 0.80$ was less than the tabulated students' $t = 1.703$, the null hypothesis (H_02) at 90 percent confidence cannot be rejected and

Table VI.
Analysis of H_01

H_01 : there is no significant linear relationship between OC and MT between employees	S	Path analysis	$t = 3.10$	$p < 0.05$
	S	Regression	$\beta = 0.8973$	

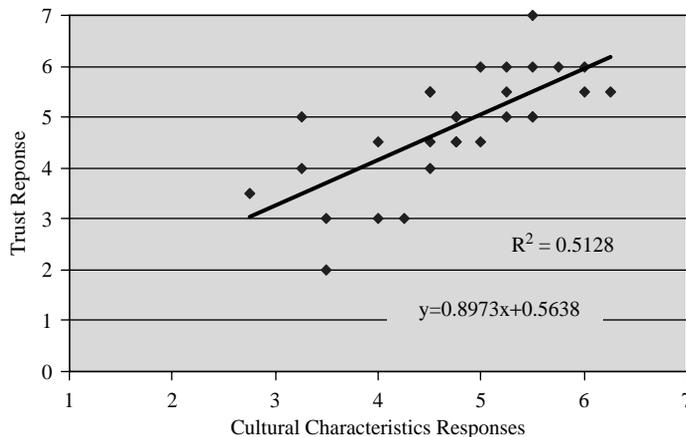


Figure 8.
Effect of a POC on MT

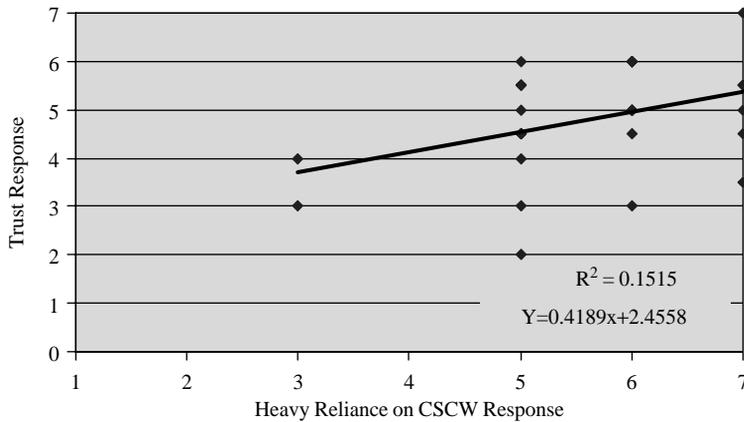


Figure 9.
The effect of CSCW on MT between employees

H_{o2} : there is no significant linear relationship between the heavy use of CSCW and MT between employees NS Path analysis $t = 0.80$ $p = 0.22$
S Regression $\beta = 0.4189$

Table VII.
Analysis of H_{o2}

there is no significant linear relationship between the heavy use of CSCW and MT between employees among the responding companies.

The relationship between implementing KM and proper organizational culture, mutual trust between employees and CSCW

Finally, to be able to determine whether there is a relationship between a successful implementation of KM on one side and CSCW, OC and MT between employees the relationships are tested in pairs using H_{o3A} , H_{o3B} , and H_{o3C} . A plot for the paired data is shown in Figure 10 and the results of the hypotheses tests are shown in Table VIII.

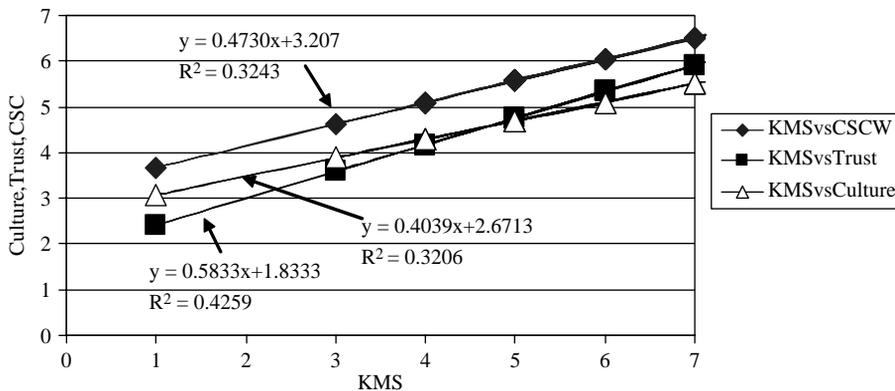


Figure 10.
KMS versus OC, MT and CSCW

After calculating the *t*-values which all came out to be greater than the tabulated students' *t* = 1.703, the null hypotheses (*H_{o3A}*, *H_{o3B}*, and *H_{o3C}*) can be rejected at 90 percent confidence level and the following alternative hypotheses can be accepted:

- H_{a3A}*. There is a significant positive relationship between successful implementation of KM and MT between employees.
- H_{a3B}*. There is a significant positive relationship between successful implementation of KM and POC.
- H_{a3C}*. There is a significant positive relationship between successful implementation of KM and CSCW.

Consequently, based on the survey responses, the following alternative hypothesis can be accepted:

- H_{a3}*. There is a significant positive relationship between successful implementation of KM on one side and proper OC, MT between employees and CSCW on the other side.

Conclusion and recommendation

A lot of research has been conducted on the factors that affect knowledge sharing. Past studies have pointed out that culture and trust are the main factors that affect knowledge sharing. CSCW assists but will not motivate employees to share their knowledge. The results of the survey show that the respondents perceived KM as one of their top priorities. The respondents also believed that POC, MT between employees in the organization and the use of CSCW will lead to more knowledge sharing.

The respondents also strongly agreed that a POC will enhance MT in the organization. They also agreed that IT will assist not motivate people in sharing their knowledge and that not all types of knowledge can be shared using technological innovation. Regardless of their beliefs, the results show that the respondents are investing more in IT rather than in their own people. The respondents did not manifest a lot of concern for cultural characteristics such as promotions and acknowledgements, sanctions for people who do not share their knowledge, incentives to those who share knowledge and meetings for employees to get to know each other better.

The regression analysis conducted showed that among the respondents a POC will positively affect MT between employees. In conclusion, the perception of the respondents is that a POC comprised of motivation, incentives, sanctions and meetings will lead to more trust between employees. Moreover, they also perceived a slight

Table VIII.
Relationship between successful KM implementation and MT, OC and CSCW

<i>H_{o3A}</i> : there is no significant positive relationship between a successful KM implementation and MT between employees	S	Path analysis	<i>t</i> = 2.45	<i>p</i> < 0.05
	S	Regression	<i>β</i> = 0.583	
	<i>H_{o3B}</i> : there is no significant positive relationship between a successful KM implementation and proper OC	S	Path analysis	<i>t</i> = 1.76
S		Regression	<i>β</i> = 0.404	
<i>H_{o3C}</i> : there is no significant positive relationship between a successful KM implementation and CSCW	S	Path analysis	<i>t</i> = 1.78	<i>p</i> < 0.05
	S	Regression	<i>β</i> = 0.473	

positive relationship between the heavy use of CSCW and trust between workers which contradicts the hypothesis.

Finally, the following conclusions can be drawn based on the perceptions of the respondents:

- POC will lead to more knowledge sharing between employees;
- MT among employees is needed in order for knowledge to flow freely with a company;
- technological Innovation is necessary to achieve successful KM implementation;
- POC is significantly related to MT between employees;
- CSCW will assist and could motivate the sharing of knowledge;
- not all types of knowledge can be represented electronically; and
- the successful implementation of KM is related to culture, trust and CSCW.

It can be concluded that the lack of strong trustful relationships among employees working for the responding construction companies is due to their lack of attention to cultural characteristics. Companies should invest in IT but should also be aware that IT is only a tool that helps in the sharing of knowledge. Companies should also not forget that the most important asset that affects the sharing of knowledge is a trustful relationship that is directly affected by a POC. Therefore, construction firms should invest in their employees by promoting them, giving them incentives and by organizing meetings that support them to know one another better. Recommendations for future research include studying the role that social meetings play in enhancing MT between employees; determining which technological KM tools positively affect trust between employees and conducting the same study on small construction companies that do not have enough resources to invest in KM technologies.

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