

A CONCEPTUAL MODEL FOR EXPLORING KNOWLEDGE CHANNELIZATION FROM SOURCES OF INNOVATION IN CONSTRUCTION ORGANIZATIONS: EXTENDING THE ROLE OF KNOWLEDGE MANAGEMENT

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The model presented in this paper is a conceptual one, based upon analysis of the literature and a series of preliminary interviews in the construction industry. It is a part of a research project that is examining knowledge management and innovation in the Australian construction industry. Extensive research has focused on the various types of knowledge contained within specific organizational settings exists in the domain of knowledge management. However, rather less research is available that considers the flow of knowledge from sources of innovations and its channelization in and out, and between organizations. The premise of the model lies in a hypothesis that an organization changes itself into a more mature, learning organization over time. Specifically, knowledge flows into it through “pull” rather than “push” forces. This paper concludes that a successful knowledge management initiative installs a learning and knowledge sharing culture, which is easily adaptable to the new learning, and poses little resistance to the new knowledge that flows in the organization. The model is an attempt to bridge the gap between research and its practical application in construction through knowledge management, which is important to improve the low productivity levels of the construction industry.

Keywords: innovation, knowledge management, organizational culture, organizational learning, sources of innovation.

INTRODUCTION

Academic research in construction has produced a number of innovative processes, products and technologies. The adoption and diffusion of these innovations can often lead to strong resistance in construction organizations. Resistance to change, stiff culture, lack of motivation, weak leadership in strategy and vision, absence of learning mechanisms, and not foreseeing the immediate benefits of adopting innovations can lead to this discrepancy and gap (Gann, 2001, Santos *et al.*, 2002; Oglesby, 1989; Bresnen and Marshall, 2001). Recently, success of knowledge management initiatives in other industries - mainly pharmaceuticals, electronics, and manufacturing - is taking the attention of the construction organizations. The increased chance of success of adopting knowledge management principles and its diffusion into construction

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organizations is acting as an impetus for academic researchers to develop best practice knowledge management for construction organizations.

A successful knowledge management initiative will install a learning and knowledge-sharing culture and environment, provide vision and effective leadership to overcome learning barriers (Walker, 2003; Cook, 1999). This will help an organization to transform into a learning organization that is open to learn new techniques and continuously changes itself based on the learned knowledge. According to Cohen and Levinthal (1989, 1990), this change is evident in an increase in the absorptive capacity of the organization. This is a function of how organizations retain and distribute knowledge internally, and is the practical exercise of knowledge management. Furthermore, prior knowledge of particular knowledge domains tends to make it easier to understand new knowledge (Burton-Jones, 1999). It confers ability upon the organization to recognize the value of new information, assimilate it and apply it to the commercial ends (Cohen and Levinthal, 1990). This paper argues that successful knowledge management initiatives in the construction industry will make an organization open and fertile for new innovative ideas.

KNOWLEDGE MANAGEMENT AND THE CONSTRUCTION INDUSTRY

Knowledge is being recognized as a vital resource and source of competitive advantage in today's dynamic and changing business environment (Burton-Jones, 1999). The role of effective management of knowledge is producing innovation, reducing project time, improving quality, and customer satisfaction (Kamara *et al.*, 2002; Love *et al.*, 2003). Through the process of knowledge management, the exploitation of an organization's intangible assets creates value and knowledge both internally and externally (Liebowitz and Megbolugbe, 2003; Davenport and Prusak, 2000; Snowden, 1999). In the project environment, knowledge management will assist project managers to improve the communications within the teams. It will also provide informed knowledge to the project manager and project teams. Knowledge management can ensure better sharing of best practice documents, lessons learned, project management and system engineering methodologies, and review and document the rationale for strategic decision-making (Liebowitz and Megbolugbe, 2003). The failure to capture and transfer project knowledge leads to the increased risk of 'reinventing the wheel', wasted activity, and impaired project performance (Siemieniuch and Sinclair, 1999). These potentials and benefits of knowledge management are convincing enough for the construction organizations to venture into adopting its principles.

Current State of Knowledge Management Research

The quest for obtaining knowledge and effectively utilizing it is not a new endeavour. Tiwana (2002) asserts that knowledge management grew from the 1950's in the form of various management philosophies that have developed and modified over time. For this reason Collins (2002) noted that he was struck by "an eerie sense of déjà vu" when analysing 'knowledge work'. Current knowledge management philosophies find their roots in many initiatives started in late 1980's and early 1990's under the name of knowledge engineering, artificial intelligence, and expert systems. These initiatives did not achieve strong adoption by the business communities. This failure and non-use is attributed to the complexity and poor usability of such technologies, rendering them ineffective (O'Brien, 1997).

ICT (Information Communication Technologies), the Internet and intranets are examples of new technological tools that allow organizations to capture, codify, transfer and share knowledge. Unfortunately, these initiatives again met with failure (Aouad *et al.*, 1999; Davenport and Porsak, 2000; Fernie *et al.*, 2002). The identified causes of this failure include (Davenport and Porsak, 2000; Fernie *et al.*, 2002, Walker, 2003, Liebowitz and Megbolugbe, 2003, Kamara *et al.*, 2002, Malhotra, 2000):

- High technological dependence of these initiatives,
- Inability to properly understand the complexity of knowledge and its esoteric nature,
- Neglect of human related factors associated with any change,
- Lack of recognition of appropriate leadership, vision, strategy and culture,
- Ignoring individual value system and notions of trust, and
- Insufficient rewards systems and motivation.

Storey and Barnett (2000) conducted a study “Knowledge management initiatives: Learning from Failures” confirming the above factors. Such failures have generated learning, and the current state of knowledge management now recognizes it as 90% human activity and 10% technology (Egbu *et al.*, 2001). Tiwana (2002) emphasizes that knowledge management is not about building a smart intranets, digital networks, one-time investment and an enterprise-wide ‘Infobahn’. Similarly, Fernie *et al.* (2003) argues against the assumption that knowledge freely exists and can be easily captured and shared through machines. Now, knowledge management professes to be based upon the building of communities of practice (Wenger, 1998) and the development of social networks through which tacit knowledge transfers and sharing is possible (Bresnen *et al.*, 2003; Augier and VendelØ, 1999 and Swan *et al.*, 1999; Hearn *et al.*, 2002). These communities of practice may be real and exist in the physical form of conference/seminars/workshops, or in the virtual form of online forums or web-discussion boards. In either form, experts can interchange ideas and leave their expertise and knowledge in the forum for others to utilize and share further (Liebowitz and Megbolugbe, 2003).

Knowledge Management Implications for Construction Organizations

Knowledge management is usually associated with producing innovation by converting tacit knowledge into explicit (Nonaka and Taguchi, 1995; von Krogh 2000). This is true for the organization whose sole objective and survival depends on bringing a new innovative product into the market. Organizations in the pharmaceutical, electronics and manufacturing industries are primarily exploiting knowledge management to carry out such innovations. These organizations run in-house research and development programmes. Knowledge gathered or captured comes together to produce a various innovations.

In the construction supply chain, not all organizations are determined to carry out such innovations. These businesses argue that it does not match with their objectives and strategy. The organizations near the heart of construction process are mainly contractors, subcontractors and specialist contractors who are more concerned to carry out the construction with the knowledge, skills and technologies they have in hand. Research and development in these organizations is almost non-existent. Therefore, the organizations may not be in a position to produce innovation by exploiting

knowledge management but there is still an opportunity to be able to use it to enhance their learning levels and absorptive capacity. Exploiting knowledge management can also improve their decision-making and productivity by learning lessons from the mistakes and avoiding re-inventing the wheel.

For the construction organizations, knowledge management initiatives will assist the formation of a learning and knowledge sharing culture, and help to overcome the problems associated with the learning derived from project histories. Liebowitz and Megbolugbe (2003) observe that with the creation and capture of knowledge, learning takes place and the knowledge is applied and embedded within individual and organizational processes. Organizations may learn effectively from the experiences and utilize them efficiently.

Organizational Learning and Learning Organization

Organizational learning is the set of processes used to obtain and apply new knowledge, behaviour, tools and values (Bennis and Manus, 1985). Through this process, members of the organization detect errors or anomalies and correct them by restructuring the current organizational model (Argyris and Schön, 1978). This results in improved actions through better knowledge and understanding. It is the process of information leading to changes in a range of potential behaviours (Huber, 1991).

Learning is so insinuated in the fabric of life that you cannot not learn (Senge 1990). Pedlar *et al.* (1991) agrees, observing that an organization can facilitate the learning of all its members and so continuously transform itself. Such an organization has the skills to create, acquire and transfer knowledge, and then modifies its behaviour to reflect new knowledge and insights (Gravin, 1993). Resolving the discrepancy between terms of 'organizational learning' and 'learning organization' Love *et al.*, (2000) states that organizational learning is used mainly as a descriptive term to explain and quantify learning activities and events. The 'learning organization' tends to refer to organizations designed to enable learning and having an organizational structure with the capability to facilitate learning. Mirvis (1996) noted that the learning organization focuses on managing chaos and indeterminacy, flattening hierarchies, and decentralization. It also encourages the empowerment of people, teamwork and cross-functional teams, network relationships, adoption of new technologies and new forms of leadership and mentoring.

For learning to occur, there is need for processes and structure to be in place to help people create new knowledge, allowing them to continuously improve themselves and the organization (Love *et al.*, 2000). A parent organization will not learn from their projects if they do not have in place the mechanisms to capture the knowledge (Newcombe, 1999). Love *et al.* (2000) noted that currently there is no defined road map for construction organizations to follow if the learning organization is its destination. They have quoted Gravin (1993) as identifying the following five activities that a learning organization in construction should be skilled at:

- Systematic Problem Solving
- Experimentation with new approaches
- Learning from their own experiences and past history
- Learning from the experiences and best practice of others
- Transferring knowledge quickly and efficiently through out the organization

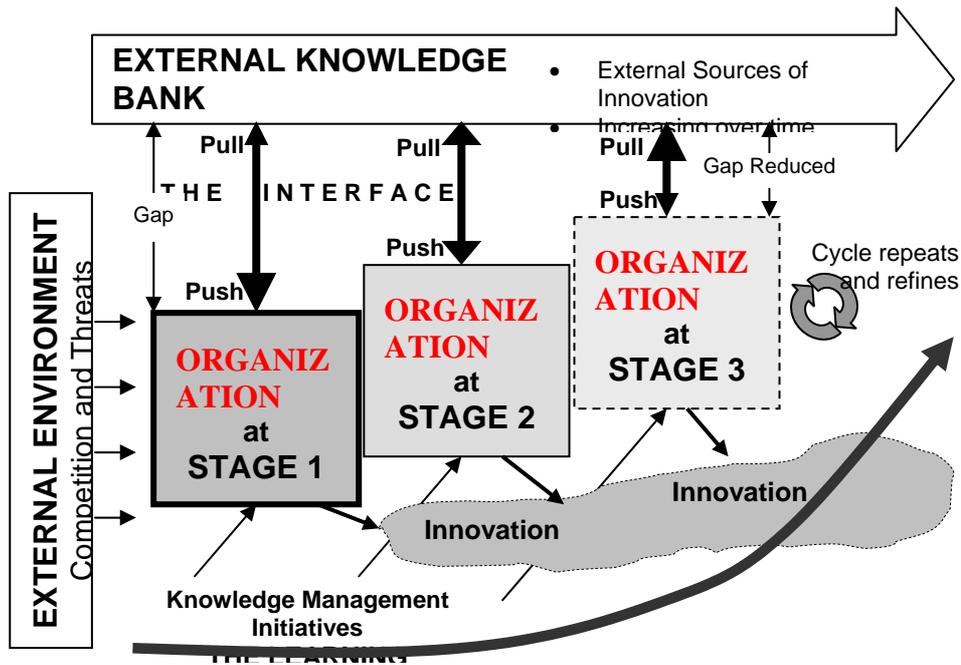


Figure 1: A model illustrating organizational learning and interaction with external sources of innovation

AN INTEGRATED MODEL OF INNOVATIVE KNOWLEDGE ADOPTION, DIFFUSION AND ORGANIZATIONAL LEARNING

The model presented in Figure 1 is a conceptual one, based upon analysis of the literature and a series of preliminary interviews in the construction industry. It explains the transformation of the organization over time by illustrating organizational learning. It shows three transformation stages that are indicative of the transformation process that is actually a continuous process. The model distinctly shows a typical organization and sources of knowledge external to it referred to as an external knowledge bank. This knowledge bank or repository may consist of academic institutions and research centres dedicated to the production of new scientific knowledge. This knowledge includes new innovative processes, products and technologies as well as training and preparing people to utilize these processes through formal education. In addition, this knowledge bank also consists of externally existing knowledge and flows because of social interaction by the organization with other organizations in a supply chain. The external knowledge bank is always increasing with time.

In this model, the interface is conceptualized to exist between the organization and external knowledge. This interface operates under two main influences visualized as “pulling” and “pushing” forces. Push exerts from the external knowledge sources towards organization to adopt new knowledge, whereas pull refers to the drawing-in force of the organization to obtain the knowledge from the sources external to it. The distance between the external knowledge source and the organizations is an indication of gap that exists between external knowledge and its adoption by the organization - a gap between academic research and actual practice.

Stage 1: Before Transformation

This is the state of an organization before, or at the commencement of undertaking a knowledge management initiative. In this state, the innovation sources push external knowledge into the organization. Inside the organization, there is specific code of practice and organizational procedures to carry out its role depending on its position in the supply chain. People using various processes and technologies carry out the organizational duties. A high degree of segregation exists between people, processes and technologies, and each organizational part has a specific area of influence.

This stage of the model depicts the circumstances where people in the organization do not fully utilize the processes and technology. It represents the case of poor diffusion. Knowledge of processes and technologies are introduced into the organization, but people are resistant to change and do not fully adopt and utilize the available knowledge. The study by Gottlieb Duttweiler Foundation quoted by Brooking (1996) has supported this notion by observing that only 20% of knowledge available to an organization is actually used.

A stage 1 organization is able to enhance its productivity, improve its decision-making and keep its competitive advantage. At the start of the transformation, the internal knowledge bank will be very weak and less detailed and will improve over time. The internal knowledge bank will also act as a source of feedback for external sources of innovation, providing details of the effect of innovation for further refinement and new developments. At this stage the feedback mechanisms are very weak, showing less collaboration and interaction with the external sources of innovation.

Stage 2: Transformation in Process

This stage is where the organization has improved its absorptive capacity and has learned through knowledge management initiatives. In this state, the culture of the organization is becoming less of a barrier. The quest for learning becomes stronger. This results in an increase in pulling forces that the organization exerts on the external sources of innovation that brings new knowledge into the adopting organization.

Academic institutions and research centres do not have to strongly push their new knowledge at this stage. Through learning, the organization improves and streamlines its processes and routines. People change their attitudes, and under strong leadership become motivated to learn, adopt and utilize the knowledge available. The area of influence grows and there is a reduction of segregation. This is the state where people are learning and seeking to adopt the officially deemed useful knowledge.

Stage 3: Ideal Transformed State

This stage represents a state where the organization has reached an enhanced maturity. The culture of the organization becomes highly adaptable and offers virtually no resistance to any flow of knowledge inside the organization. Knowledge readily flows from outside sources into the organization through strong pulling forces that feed the learning needs. The organization will have gained momentum over time in learning and its appetite for knowledge will become insatiable. No more segregation remains between people in organization, processes and technologies. This state represents high levels of integration between these three organizational components. Knowledge management becomes the integral part of the organization routines and continually assists in developing and maintaining internal knowledge repositories. The feedback mechanisms become solid and strong and the gap between external knowledge

sources decreases remarkably. Under this state, the productivity levels of the organization improve profoundly.

Testing the Model in the Construction Industry

The model shows that as the organization starts to learn and transform itself into a learning organization under the influence of knowledge management initiatives, knowledge from external sources of innovation would start flowing in it under forces visualized as 'pull' rather than 'push'. Therefore, studies have commenced to examine the culture, processes, key linkages, and the use of knowledge within construction organizations, and to compare the processes and flows with those shown in the model. To date this work has concentrated on the examination of introduction of information communication technology, the practical application of project histories, and decision-making processes within a construction project office. The initial outcomes confirm that organizational culture is an important factor that helps to keep organizations in stage 1 of the model. Such an organization needs specific knowledge management initiatives to assist the transformation into a learning organization that can achieve the advanced stages illustrated in the model. Further research will help to identify, develop, and test the efficacy of a set of purposeful activities to build a community of practice that overcomes resistance to knowledge management initiatives.

CONCLUSION

The collaboration of construction organizations with external sources of innovation is important in order to benefit themselves from the innovative ideas developed by the research community. Recent success of knowledge management initiatives in other industries is receiving great deal of attention in the construction industry. It is hoped that the construction industry will adopt its principles. A successful knowledge management initiative would install a culture of knowledge sharing and provide the organization with a strong leadership, vision and strategy. At present, knowledge management is primarily emphasizing to capture, codify and transfer the knowledge embedded and contained in the organization routines/process and tacit knowledge residing in the heads of the people. Besides this, we have argued in this paper through our model for the extension of current theory of knowledge management to include the interface with the external sources of innovation into the organization.

Extending the theory of knowledge management as depicted in the model would merge it with another stream of research related with the issues like adoption, diffusion of innovation and technology transfer and its management. Collectively, both the streams would complement each other and the opportunity for the successful implementation would increase. The common denominator of "knowledge" in both of the streams will act as a driving force in such merger and extension of roles.

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