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Modelling Knowledge Management Enablers: The Case of Hong Kong Construction Organisations

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Abstract
Knowledge management is a method of acquiring a strategic asset that drives sustainable business benefits. This paper adopts a modelling approach to explore the relationships among the various knowledge management enablers identified in the seminal literature. Using a combination of a focus group with industry practitioners in Hong Kong, and the interpretive structural modelling technique, the paper identifies the direct and indirect relationships among the enablers. The results show that such enablers as: leadership, knowledge management strategy, and organisational culture, have highest influence on other enablers. The paper findings should help construction organisations focus their effort in targeting enablers with highest influence to ensure successful knowledge management implementation.

Keywords
Knowledge Management, Enablers, Hong Kong Construction Practice, Dependence, Interpretive Structural Modeling

1. Introduction

Knowledge is one of the most important driving forces for business success. Knowledge management (KM) helps organisations to find, select, organise, distribute, and transfer vital project and business information. KM is now recognised as a core business concern because intellectual assets have a vital role in improving business effectiveness and gaining a competitive advantage. KM is particularly important in the construction industry – an industry that is extremely competitive due to tight construction schedule, low profit margins, and the complexity, diversity and non-standard production of construction projects (Zhang et al., 2009). Effective KM facilitates the generation of new technologies and processes, which in turn improve the industry's productivity, profitability and competitiveness (Pathirage et al., 2006).

KM enablers (KMEs) are the organisational mechanisms for developing knowledge and also stimulating knowledge creation within organisations as well as sharing and protecting the knowledge. They are the necessary building blocks to improve the effectiveness of activities for KM (Stonehouse and Pemberton, 1999). They are called enablers because they have an essential role in facilitating KM implementation. KMEs should be made clear in organisations, not only because they create knowledge, but also encourage individuals to share their knowledge and experiences with others (Yeh, et al., 2006). This paper identifies and discusses the seven most important KMEs that determine the feasibility of KM implementation within construction organisations operating in Hong Kong. It presents the relationships among the identified KMEs in order to help better understand the mutual influence of KMEs. It also identifies those KMEs which support other KMEs. Study findings classify KMEs as either driving or driven enablers based on their driving and dependence power.

2. Research Methodology

An in-depth literature review was carried out to identify a set of KMEs which were then empirically assessed through focus group discussions in order to gather input from industry practitioners. A total of 16 senior managers voluntarily participated in the nominal technique of a focus group series of sessions. They had extensive and eminent experience, to reach consensus on a set of seven KMEs, and to identify the direct and indirect relationships among the enablers. Section 3 provides a brief description of each KME, whereas Section 4 details the Interpretive Structural Modelling (ISM) technique used to develop a model depicting the relationships among the seven KMEs.

3. Enablers for KM Implementation

i) Leadership: Plays a key role in the creation and management of organisational knowledge. It is well documented that organisation failure to leverage knowledge is mainly due to the lack of leadership commitment to sharing organisational knowledge (APQC, 1999).

ii) Organisational Culture: An important element for facilitating sharing, learning and creating organisational knowledge. Organisational culture should value knowledge, encourage its creation, sharing and application, and promote an open climate for the free flow of ideas. A culture that consists of norms and practices which promote the transfer of information between employees and across department lines tend to lead to effective KM (Yeh et al., 2006).

iii) KM Strategies: Represent the process of generating, codifying and transferring explicit and tacit knowledge within an organisation, and getting the right information to the right person in the right place at the right time. Knowledge strategising determines the needs, means and activities to accomplish objectives. There is an increasing recognition that the competitive advantage of firms relies on the strategy that they use to create, share and utilise knowledge (Chen and Mohamed, 2008).

iv) Technology: A powerful enabler of KM success. It is generally accepted that databases, intranets, knowledge platforms and networks are the main building blocks of KM. IT facilitates quick searches, access to information, and cooperation and communication between organisational members (Yeh et al., 2006).

v) People: They are the key source of creativity. Yet many organisations tend to invest in technology rather than their employees in the mistaken belief that this will improve their firm. However, this will not provide the desirable results if employees are not able to use the technology. Therefore, it has been noted that many successful companies are now more prepared to invest in their employees to add to their vision, capabilities and experiences (Bozbura, 2007, Chen and Mohamed, 2010).

vi) Processes and activities: The four KM processes: creation, storage/retrieval, transfer and application, lead to changes in behaviour as well as practices and policies, and the development of new ideas, processes, practices and policies (Bender and Fish, 2000). The success of KM processes and activities mostly depends on the efficiency and effectiveness of the knowledge used and the level of action taken based on the knowledge (Chong et al., 2000).

vii) Innovation: The use of knowledge is critical for innovating and achieving competitive success (Andreeva & Kianto, 2011). Goh (2005) stated that knowledge has critical importance, and management needs to use knowledge as one of the core components of an organisation because it is vital for carrying out innovation. Zhou and Uhlaner (2009) indicated that innovation represents the utilisation of knowledge in order to create something which has new economic value.

4. Interpretative Structural Modelling (ISM)

ISM is a well-established methodology for identifying relationships among specific items. It is a qualitative tool used by a number of researchers in various contexts, (Sahney et al., 2008; Thakkar et al.,

2007). ISM is an interactive and interpretive method in that group judgment decides whether and how items are related. It is structural in that based on the relationship, an overall structure is extracted from a complex set of items. It is also modelling in that the specific relationships and overall structure are portrayed in a diagraph model (Singh et al., 2007). ISM helps to impose order and direction on the complexities of relationships among the various system elements (Sage, 1977).

In this paper, ISM was used to provide a collective understanding of the relationships among KMEs. The opinions from a group of industry practitioners are used in developing the relationship matrix, which is later used in the development of the ISM model. The opinions of industry experts are expected to reflect their insights and experiences in KM adoption within their respective organisations at the management level. Pairwise comparison was done among the enablers to determine whether or not a relationship exists (e.g. are Enabler 1 and Enabler 2 related?), and if the answer is positive, experts were then asked to denote the direction of such relationship (e.g. Enabler 1 helps to achieve Enable 2 or, Enabler 2 helps to achieve Enable 2, OR both Enablers help to achieve each other). If the answer to the key question is negative, it was noted that both enablers are unrelated.

The determination of the relationships among the seven KM enablers is based on the majority of the responses and general consensus of the industry experts, expressed by compiling KM evidence, viewpoints and experience sharing on various specific and real life examples of KM practices at the execution or operational level. A structural self-interaction matrix (SSIM) of the KMEs, indicating their pairwise relationships, was later converted into a binary matrix developed converting the relationships. Readers can refer to Warfield (2005) for detailed description of the development of forming the SSIM and reachability matrices. The final reachability matrix is illustrated in Table 1.

Table 1: Final Reachability Matrix

Enabler(s)	PA	C	IN	L	P	S	T	Driving power
Processes and activities (PA)	1	1	1	0	1	0	1	5
Organisational Culture (C)	1	1	1	0	1	0	1	5
Innovation (IN)	0	0	1	0	0	0	1	2
Leadership (L)	1	1	1	1	1	1	1	7
People (P)	0	0	1	0	1	0	1	3
KM Strategies (S)	1	1	1	0	1	1	1	6
Technology (T)	0	0	0	0	0	0	1	1
Dependence	4	4	6	1	5	2	7	29

Table 1 shows the final reachability matrix obtained for this study, along with the calculated driving power and dependence of each enabler. For any enabler, driving power simply refers to the total number of enablers (including itself), which it may help achieve. On the other hand, dependence is the total number of enablers (including itself), which it may help in achieving it. An ISM model is thus generated by putting the enablers according to their level in a directed graph as shown in Figure 1 which pictorially illustrates the contextual relationships between each enabler and its hierarchies as derived by the analysis. KMEs with highest driving powers are put at the highest hierarchy in the ISM model. From Figure 1, it is observed that both Technology and Innovation are highly dependent enablers, and have low driving power toward other enablers in the system, instead they are driven by other enablers. On the other hand, enablers such as Leadership and KM Strategies are at the higher levels of the hierarchy which means they are highly driving enablers, they do not depend on other enablers. Enablers which are at the intermediate hierarchy levels (e.g. People, Processes and Activities, and Organisational Culture) are both driving and

driven enablers in nature.

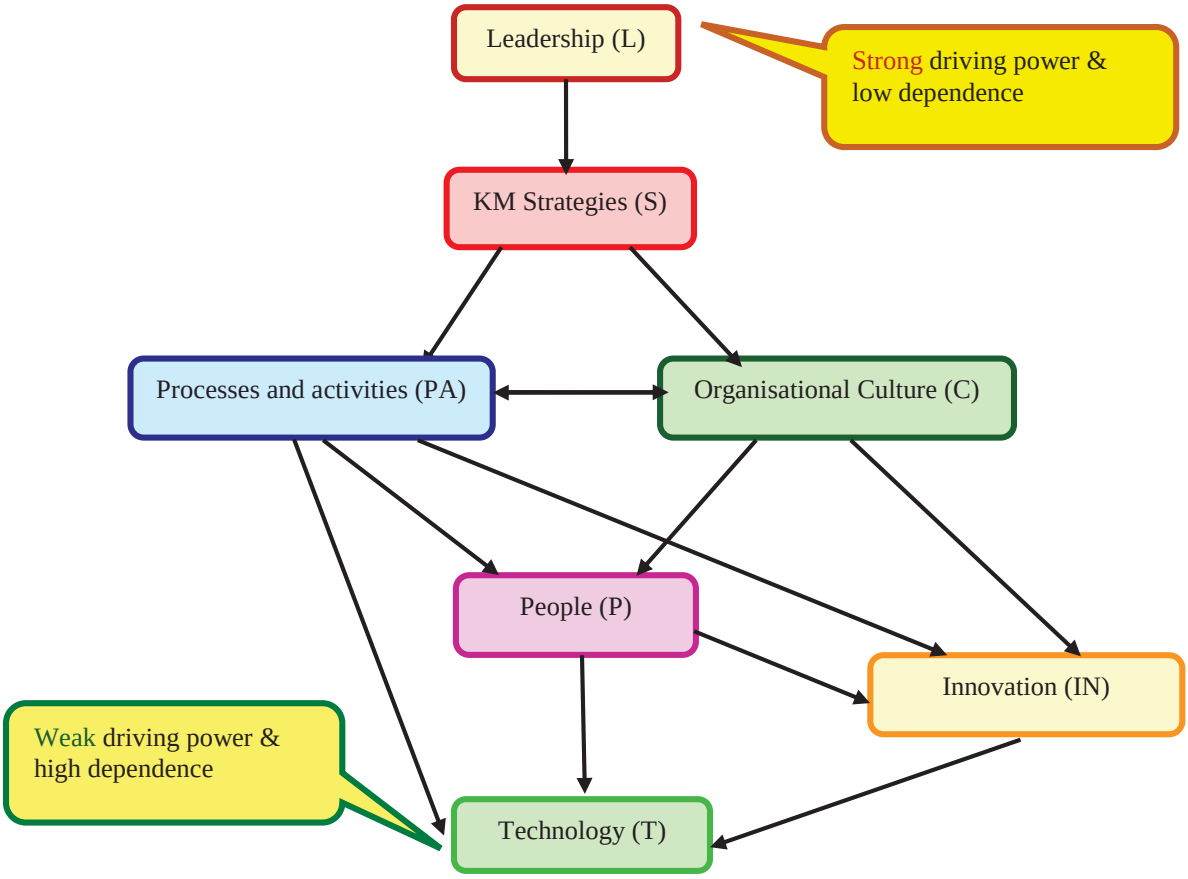

Figure 1: ISM model for KM enablers

5. Discussion

The research results show that Leadership, and KM strategy of the construction organizations are the main driving factors based on which one can build a successful KM effort. With the leadership, KM initiatives will gain support and active participation of the senior executives of the organization. Leadership would also ensure that KM initiatives will have strategic focus, facilitated by KM Strategy. The study had initially argued, based on past research, how the nature of cause and effect in IT is separated in time and it is more exaggerated in the context of KM. These research findings shown in Figure 1 identify various levels in KM to reach intermediate targets such as Business Processes, Culture, and People. Therefore, it is obvious that the separation between cause and effect in KM systems is more pronounced. For instance, this study shows that Business Innovation can be accomplished after Business Processes, Culture, and People are in place. Establishing and using Business Processes, Culture, and People is gradual and time-consuming. Furthermore, the resultant Business Innovation and Technology will gradually transition into knowledge transfer among people and actual impact on business performance is still a far target.

The greater importance of this approach from an organizational standpoint is the emergence of this logical flow of causal influences that is not only logically consistent but is also a view that is owned and shared by the creators of this view. The contextual relevance of this approach has significant implications for practice. Research results show that, competent leadership of KM initiative combined with the support from the KM Strategy would lead to KM processes and activities and organisational culture for KM initiatives. KM processes and activities would assist in developing Technology, People and Innovation for sharing, and archiving knowledge. Organisational culture would assist in developing people and

innovation for sharing, and archiving knowledge.

In addition, KM processes and activities and organisational culture would support in positively influencing People's collaboration and trust for knowledge sharing and generate new knowledge. Figure 1 also shows that Leadership would also lead KM Strategy in KM initiative to formalize KM-related functions and consequently, develop KM processes and activities. Since, resource integration, efficient and effective use of resource utilization, implementation of plans to bring stability – important tenets of management – help manage complexity associated with these processes, standardization of these processes is aimed at improving efficiency and effectiveness.

The next logical step would to utilize technology to streamline and digitalize of these KM processes and activities to determine the success of KM initiatives. Results show and it makes logical sense that KM processes and activities promote People's collaboration and the streamlining / simplified workflow environment enhances Innovation that is available for knowledge transfer. Organizational culture that encourages open and transparent communication among the people of the organization would lead to increased collaboration and knowledge sharing at hierarchical levels of the organization, which leads to knowledge sharing. Increased communication with the aid of KM processes and activities, and technology make it easy and enhance collaboration.

6. Conclusion

The ISM model for KM enablers (Figure 1) can also be interpreted in terms of domains, mediators and trailers in a KM effort. The elements at the top can be considered as the set of domains. These ''domains'', from a management standpoint, can be considered to be aspects that have to be in place. It is generally difficult to put them in place in a medium or short time frame. They can be thought of as aspects that are necessary (though not sufficient) for KM to succeed. In our model, Leadership and Strategies are considered a set of domains.

The elements at the bottom are classified as the ''trailers''. Technology, people and innovation are the trailers in the KM effort in the context of the construction organisations. These are the elements that for the desired outcomes of the KM intervention. In other words, these can for the basis of outcome metrics for KM evaluation. "Mediators'' are elements that appear between the ''domains'' and the ''trailers''. From a practitioner perspective they are those elements that can be controlled, manipulated or developed to form the link between the ''domains'' and the ''trailers''. KM processes and activities and organizational culture of the KM effort are all aspects that helps translate the ''domains'' into the ''trailers''. From the standpoint of enablers, this approach allows us to understand how each of these elements can behave as an enabler or inhibitor to the KM effort. For instance, the weakness of an element makes it an inhibitor while the strength of that very same element makes it an enabler. As a case in point, strong and effective Leadership leads to KM Strategy and KM processes and activities of the KM effort. However, weaknesses in Leadership will dilute the support for KM strategy and KM processes and activities. This approach goes to show the dual nature of elements in terms of whether they are enablers or inhibitors in the KM effort. It also goes to show that it may not be useful to normatively classify elements as facilitators or inhibitors.

These results have several implications. In order to build a successful KM initiative, organizations need to secure Leadership (top management involvement) first. Next, the selection of a competent and committed leader is important for the initiative because the leader plays a critical role in securing the implementation of KM strategy and organisational culture to accomplish KM goals and objectives. Organizations must recognize that developing an organisational culture that promotes communication and trust among the people would facilitate accomplishing KM goals such as collaboration and knowledge sharing among people. However, developing and nurturing a culture of openness and trust is usually a gradual process. Once a KM is implemented, it is imperative that KM should maintain the KM strategy (strategic focus), and the platform of the content for meaningful collaboration among the people.

7. References

Andreeva, T and Kianto, A. (2011). "Knowledge processes, knowledge intensity and innovation: a moderated mediation analysis", *Journal of Knowledge Management*, Vol. 15, no. 6, pp.1016 – 1034.

APQC (1999). "Knowledge Management: Consortium Benchmark Study", *Houston*, TX, pp. 1-9.

Goh A.L.S. , (2005). "Harnessing knowledge for innovation: an integrated management framework", *Journal of Knowledge Management*, Vol. 9, no. 4, pp.6 – 18.

Bozbura, F.T. (2007). "Knowledge management practices in Turkish SMEs", *J. of Enterprise Information Management* (20/2), pp. 209-221.

Chen, L. and Mohamed, S. (2010) "The strategic importance of tacit knowledge management activities in construction, *Construction Innovation*, Vol. 10, no.2, pp.138-163.

Chen, L. and Mohamed, S. (2008) "Contributions of knowledge management activities to organisational business performance, *Journal of Engineering, Design and Technology*, Vol. 6 , no. 3, pp.269-285.

Chong, C-W, Holden, T., Wilhelmij, P., and Schmidt, R.A. (2000), Where does knowledge management add value?, *J. of Intellectual Capital*, Vol. 1, no 4, pp.366 – 380.

Pathirage C.P., Amaratunga, D.G., Haigh, R.P. (2007). "Tacit knowledge and organizational performance: construction industry perspective", *Journal of Knowledge Management* 11 (1), 115–126.

Pathirage, C.P. et al., (2006). "A theoretical framework on managing tacit knowledge for enhancing performance in the construction industry", *The Construction and Building Research Conference*, the Royal Institution of Chartered Surveyors, University College London, London, 2006, pp. 1–13.

Sage, A.P. (1977). "Interpretive Structural Modelling: Methodology for Large-scale Systems", *McGraw-Hill*, New York, NY, pp. 91-164.

Sahney, S., Banwet, D.K. and Karunes, S. (2008), An integrated framework of indices for quality management in education: a faculty perspective, *The TQM J*., 20(5), pp. 502-19.

Singh, R.K. (2007). "Interpretive structural modelling of factors for improving SMEs competitiveness", *International Journal of Productivity and Quality Management*, Vol. 2 no. 4, pp. 423-40.

Stonehouse, G.H. and Pemberton, J.D. (1999) Learning and knowledge management in the intelligent organisation, Participation and Empowerment: An International Journal, Vol. 7, no. 5, pp.131 – 144.

Thakkar, J. et al., (2007). "Development of a balanced scorecard: an integrated approach of interpretive structural modeling (ISM) and analytic network process (ANP)", *International Journal of Productivity and Performance Management*, Vol. 56 No. 1, pp. 25-59.

Warfield, J. (2005). "Developing interconnection matrices in structural modelling", *IEEE* Transactions on Systems, Man and Cybernetics.

Warfield, J.N., (1974). "Developing interconnection matrices in structural modeling. Systems, Man and Cybernetics", *IEEE* Transactions on, (1), pp.81-87.

Ying J. Y. et al., (2006). "Knowledge management enablers: a case study", *Industrial Management & Data Systems*, Vol. 106 Iss: 6, pp.793 – 810.

Zhang, X. et al., (2009). "Developing a management system for improved value engineering practices in the construction industry", *Journal of Automation in Construction*, vol. 18, 777 – 789.

Zhou, H. et al., (2009). "Knowledge Management as a Strategic Tool to Foster Innovativeness of SMEs".

A Preliminary Study of the Affect of Dimensional Control on the Accuracy of 3D Photogrammetry Modeling

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