This is the authors’ final peer reviewed (post print) version of the item published as:


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Implementation of enterprise resource planning (ERP) software in a major construction contracting organization in Hong Kong

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Acknowledgements


Abstract

Purpose – The purpose of this paper is to summarize the scope, methodology and main findings of a doctoral thesis about the implementation of enterprise resource planning (ERP) software in a major construction contracting organization in Hong Kong. This research is taken from a leadership and power and project management (PM) perspective.

Design/methodology/approach – The project adopted a case study approach in which the candidate was an employee/observer, who was embedded as a member of the business transformation team taking an action learning approach to study the ERP adoption. The research used the soft system methodology to identify gaps in the observed maturity level which exists in the organization. Data was gathered using public and private documentation, semi-structured interviews, observation and was validated through review of evidence with participants.

Findings – The results identified the importance of leadership and cultural issues in implementation of the business strategy. This research includes a contribution in two spheres: PM and construction procurement. The first implication for PM theory was to illustrate how knowledge has been efficiently managed within a construction organization by using information communication technology (ICT). It can be represented by the ladder of ICT>ERP>KM>PM. The second implication was to pave the way for the use of partnering strategies in PM practice. It can be represented by the ladder of National Culture>Organizational Culture>Leadership>Partnering Strategy>PM.

Practical implications – This model could be adapted to other large and complex organisational contexts. The research project also has implications as opening up a PM perspective on business transformation.

Originality/value – The contribution of this research is proving the success of adopting KM in a construction company by using an ERP system. The importance of culture in the traditionally collectivistic construction industry, and the issues senior management should take into account when formulating business strategies.
Introduction

A popular Chinese saying, "Fixed graphic 1" (zhī shì jiù shì lì liang) means "knowledge is power". This slogan was originally attributed to Francis Bacon, scientia potestia est. The phrase implies that knowledge will increase abilities and competitive advantage, and it can be gained through good management of knowledge. It is particularly valid in today's business world because knowledge management (KM) is an essential component in successful organizations. The more knowledge that an organization can utilise, the more competitive it can become.

The construction industry has successfully adopted project management (PM) over years, but it has long been criticized as having a poor record in the use information communication technology (ICT) and slow to adopt KM. Researchers suggest that using effective and efficient ICT systems can improve KM, and enterprise resource planning (ERP) software can be one of the tools that can help to do so. It has been suggested that ERP is a powerful to assist the integration of business processes and this is particularly important in the case of the construction industry.

The principle objective of this research is to explore the drivers and inhibitors that determine successful adoption of an ERP system in a complex business enterprise. Second, it aims to identify the successful factors of a partnering strategy and its integration into the ERP system. The third objective was to investigate the appropriate leadership style that influences the ERP system and partnering strategies and to identify the impact of culture on the leadership style. The research was conducted within a large Hong Kong-based construction organization.

Background and context of the thesis

The construction industry is segmented, fragmented and project based. Winch (2002) suggested that construction projects can create high value for clients by using inputs of financial and human resources, and at the same time can generate learning for the owners of these resources. Kamara et al. (2002) noted that KM is recognized within the project based architecture, engineering and construction industry as being vital to gaining competitive advantage by innovation and thus improving performance.

KM has been defined as “the identification, optimization and active management of intellectual assets to create value, increase productivity, and gain and sustain competitive advantage (Liao and Yau, 2001). The authors also concluded that KM can contribute to the construction industry in the following areas:

- Knowledge-based strategy (new forms of competitive advantages and value creation).
- Knowledge-based PM (virtual projects, transfer knowledge across project interfaces).
- Knowledge-based organization (virtual organizations, knowledge workers).
- Continuous improvement and customer satisfaction (product, process and service improvement).
- Innovation and customer creation (new products, process innovation and new services).
- Intellectual capital (market asset, customer asset, structural asset).

**ERP in KM, partnering and leadership**

Accurate and up-to-date, relevant information is vital to ensure that organizations are properly managed and achieve their business objectives. The traditional information management in the construction industry has long been criticized. More obvious weaknesses include the “paper-based data” and the “non-real time approach”.

It is a common phenomenon that information is often duplicated, inconsistent and not current. Few people will deny that information is an intangible asset of a company and those that manage and use it well will flourish. Handling information by traditional ways is costly and is wasteful of natural and human resources. In the construction industry, quality of information is extremely important for decision-making. Project managers find it difficult to fulfil these requirements using low quality or out-of-date information. Effectively exercising project control requires accurate, current and relevant information. Part of the problem faced by users of PM data was “information overload” and various strategies were developed in an attempt to overcome the problem. An effective information management system leading to a KM system is one efficient tool to provide the right information to different managerial level personnel.

**The benefits of ICT use in construction industry**

Many scholars have studied the benefits of information and communication technology (ICT) in construction and have identified the competitive benefits from its use (Abudayyeh et al., 2001; Bjork, 1999; Skibniewski and Abdul, 2000; Tam, 1999; Betts et al., 1991; Betts and Clark, 1999; Bjornsson and Lundegard, 1993). Porter (1985) and Tan (1996) argued that ICT innovation is perceived as providing a key competitive advantage. According to Peansupap (2004), the benefits of using ICT innovation may influence construction at both strategic and operational levels. At a business strategy level, ICT could be used to establish a corporate differentiation strategy as well as a cost reduction strategy. At an operational level, ICT can be used to help improve information exchange, communication and document sharing during the construction project life cycle. In addition, it can also enhance the process of construction procurement. These benefits should provide one of the primary drivers for ICT use in the construction industry.

ICT can help to enhance communication and manage information processes (Bjork, 1999) and also benefit the management of construction projects (Abudayyeh et al., 2001; Hossein et al., 2002; Nah, 2002). For example, a study by Tam (1999) on the development of total information transfer systems for PM, demonstrates that the use of such systems can save considerable time and cost of document transfer. Second, ICT applications can help improve project planning and scheduling, cost control effectiveness and KM (Abudayyeh et al., 2001; Huang et al., 2002; Voordijk et al., 2003). ICT can also improve data base distribution through use of a web-based electronic
document management system. For example, all documents can be stored in a central database and be simultaneously accessed from many locations (Bjork, 2002). ICT also supports information integration among construction processes that helps to reduce errors from data re-entry and also supports real time construction project monitoring (Anumba et al., 2005; Bjork, 1999).

Use of ERP

Many organizations use ERP as their ICT backbone. Al-Mashari et al. (2003) described ERP as customised standard integrated software applications that facilitate IT coordination to control aspects of management and other operational facets such as human resource management and logistics. ERP also can integrate numerous PM control processes such as cost and time management. Therefore, they are supposed to be integrated solutions for project delivery. They also link to groupware that allows communication and coordination, joint problem solving and recording transaction histories. In this way, they can be seen as facilitating KM in that they are capable of facilitating groups of people to solve specific problems (such as how to best manage project costs) and through the audit trail of data to trace the evolution of decision making and its consequences.

An ERP system is not a KM system but a tool that in theory should reduce management effort in gathering, storing and using data so that more time and creative energy can be devoted to analysing and contextualising information and refining it into knowledge (because it embodies context and thus embeds some of the tacit knowledge relating to hypothesised causal links and important work practice-specific cultural factors that may shape decisions). So an ERP system is not indicative of a KM application, rather it allows the unburdening of administrative effort to allow management energy to be directed towards knowledge-based activities. Including creating meaning out of information, transferring the significance of that meaning to others and using the refined knowledge to practically solve problems.

Relationship of ERP and partnering

If an ERP system is adopted as a KM tool, it is viable to consider synchronizing it with other business functions, e.g. integration with the supply chain system. Partnering is increasingly important within a supply chain; it is worthwhile implementing this procurement approach into the ERP system. An ERP system is useful to generate both upstream and downstream supply chain expectations with client’s subcontractors and suppliers (Akkermans et al., 2003).

In the past, “Procurement” tended to be a backroom function that merely took sales orders from departments and placed them with suppliers. However, this practice is rapidly changing and modern organizations are putting more emphasis on the advanced techniques of supply chain management. According to Baker (1990), the world of contracting is challenged by many problems such as poor communications, adversarial contractual language, cost overruns, continuity from project to project, extended schedules, poor-quality work and change-order negotiations. In many cases, the work is not performed in the most cost-effective manner. To strengthen the competitive position, construction companies must strive to improve their internal procedures,
working relationships, and cost performance. Contractors must change to respond to the needs of the marketplace by providing the environments for, and capitalizing on, the synergies that result from contractors, subcontractors and suppliers working together as partners. ERP can provide a useful platform for that “partnership”.

**Relationship of ERP, partnering and leadership**

Strong leadership is an essential element for success. The ultimate goal is to obtain competitive advantage over other players in the market. Cheng and Li (2001) stated the importance of identifying the critical factors affecting partnering success. Zhang et al. (2005) completed qualitative research by case study of four Chinese organizations using the ERP system and concluded that “lack of top management support” was one of the factors affecting the success of an ERP system. It is very obvious that the strategies of “ERP” and “Partnering” require “Leadership”. It is therefore viable to study the impact of leadership in the implementation of “ERP” and “Partnering” for construction PM.

Many scholars have researched the inter-relationship between leadership and power (French and Raven, 1959; Yukl and Flabe, 1991; Yukl, 1994). However, different industries may view leadership and power differently. In fact, leadership has an inextricable link with power and the power relations are likely to be significant in the highly interdependent construction industry. All organizations today are facing increasing pressures of globalization and should therefore strive to build an organization that accommodates inter-cultural management. Therefore, prior to putting forward and promoting any strategy, it is worthwhile studying the impact of leadership together with power and culture.

**Research questions, scope and objectives**

The thesis (Chan, 2009) proposed that PM practice will be advanced by using an effective ICT system for KM with competent major supply chain partners. An integrated use of ERP within the supply chain was argued to effectively support the knowledge work of the project manager and team members in their construction management activities. This proposition is tested by action research that followed exploratory surveys and a descriptive study. This case study organization has since 2002 used an ERP as its information management backbone and also has adopted a partnering approach with its key supply chain partners.

To test the proposition, the following research questions were developed:

*RQ1.* What are the principal drivers and inhibitors influencing the successful implementation of ERP in the case study organization?

*RQ2.* To what extent do the three identified areas of ICT leadership and culture, shape the way that the ERP was adopted in the case study organization?

*RQ3.* What suggested improvements are viable for this organization in improving the way that the ERP was adopted within the Hong Kong construction?

**Research scope and objectives**
This research explored the present practice of ERP adoption within the Hong Kong case study organization that already uses ERP as part of its information and KM tools. The research also identified key factors and processes that influence integration of its existing ERP system with several of its key supply chain partners. It involved participation in a change management process being undertaken using an action learning approach. Reflection on action that triggered action research cycles was based on data from surveys and interviews. This involved the researcher observing actions undertaken to improve the level of performance measured by a capability maturity model (CMM) that was developed for the study by the thesis author.

The primary objective of three research pilot surveys that were undertaken within the case study construction organization was to explore and reflect upon issues affecting the implementation of the ERP system. It focused on employees within the organization who were working with the ERP. These problems represent clusters of interrelated variables identified by a rigorous review of the literature. The surveys not only helped to identify problems that the employees perceived, but also allowed researchers to understand the nature and extent of the supportive environment within the organization that could facilitate partnering. Once identified, the problems were then used as the basis for conducting further interviews with targeted teams. In the next phase of the research study, the interviews provided a rich understanding of the nature of the workplace environment that drives and/or inhibits ERP performance within the case study organization. The focus of attention throughout the study was to map the interrelationship for performance improvement of ERP system, including partnering and leadership in the work processes. The map then led to a series of actions that were taken to improve the performance.

The second objective was to identify factors that influenced the partnering strategy and its integration to the existing ERP system. These factors also represented clusters of interrelated variables identified by the literature review. Once identified, these factors were then used as the basis for conducting interviews with staff to obtain their perception of the partnering strategy. This was done to gain a richer appreciation and understanding of the nature of the workplace environment that drove and/or inhibited partnering strategy within the organization.

The third objective was to obtain in-depth views about what leadership style influencing ERP system and partnering strategy, and lastly to explore the cultural impact on leadership style from an implementation viewpoint. The research also aimed to identify how the ERP system could be better used within the construction organization.

To summarize the research objectives, these were:

- to explore factors that influence ERP system at the actual implementation stage within a large Hong Kong construction organization;
- to identify the successful factors of the partnering strategy and its integration into the existing ERP system;
- to investigate the proper leadership style influence the ERP system and partnering strategy within the construction organization; and
• to identify the cultural impact of leadership style and its ability to implement the ERP system and partnering strategy within a complex construction organization.

A summary of the thesis findings

The research helped develop a model of successful PM within the construction industry. The integration of an ERP system and partnering strategy relied on linking the leadership approach with PM practice. In conclusion, this thesis discussed the implications of the research from both an academic and practical point of view. Primarily, this thesis provided evidence, based upon a case study, of how to improve KM in order to lift project delivery performance. Second, there is a need for partnering to address the needs of the various multi-cultural stakeholders. Accordingly, given the trend of globalization, this thesis investigated how national culture interacts with organizational culture with subsequent impact on PM within a given context.

The study concluded that using an ICT system to facilitate KM was a viable approach. It also demonstrated the benefit of integrating partnering approach into the procurement system and explained how that was facilitated by the ERP system. Using an effective and efficient ICT system was also shown to improve communication within the organization by streamlining the working process internally and linking stakeholders externally. ERP systems are expensive and complex and present significant challenges to implement, some of these complexities were revealed through this study. The study also found that organizations which adopt ERP systems as a KM initiative would generally have built absorptive capacity through the experience of adopting the ERP and adapting to required business process changes.

The implication of this thesis to PM, in terms of ICT, is shown in Figure 1 by the ladder of ICT>ERP>KM>PM where ICT tools are better integrated into an ERP which enables KM that enhances PM.

A similar finding relating to the implication of the influence of culture on ERP integration is also illustrated in Figure 2.

The doctor PM degree at RMIT

The Doctor of Project Management (DPM) is a professional doctorate degree in PM. The DPM is a combination of 33 per cent coursework and 67 per cent research. The program is specifically designed for candidates to better understand their existing skills and knowledge on how to manage projects. This program enables project managers to reflect upon their diverse experience in order to gain insights into core strategic areas of in KM, PM Leadership and ethical Project Procurement. The research component involves industry-based case study research work, often using an action learning approach. Since candidates undertake the program while employed on their PM activities, the program allows candidates to gather data and reflect on practice as part of action learning cycles performed on their PM work.

The philosophy of the program is to focus is on candidates gaining an in-depth understanding of emerging strategic issues and to lead and advance the PM profession.
Consequently, this leads to case study research work being the principal means to prepare candidates for their final dissertation.

The DPM is undertaken by a candidate in his or her own work place usually using an online mode but with an initial one week residential workshop in Melbourne during the first year of the program. The need of balancing work, social and family results in the three-year program normally results in a mixed part and full time enrolment and so it usually takes four to five years to complete. During this period, the candidate typically undertakes deep reflection, generates research ideas, reviews the literature, collects and analyses data and writes the thesis. This was also the experience of the thesis author.

The thesis author's learning journey

The author has been working in the construction industry since 1982 and was in a project manager capacity, in a construction organization, at the time of conducting the research. That construction company undertakes a range of construction work including; piling, foundations, substructures, tunnelling, bridges, building, marine works and water storage schemes in Hong Kong and the Asia Pacific region. The company maintains approximately 11 per cent of the market share out of a total HK$24 billion, and employs approximately 2,000 full-time staff, including 450 professional engineers and builders. Staff are well qualified with more than 50 per cent having a diploma or higher academic qualification.

The company appreciates the importance of KM, its ethos suggests that it is unusual to compete with other firms purely based on price. The firm believes that it is more effective to sharpen its own knowledge advantage to derive its market position based upon a competitive advantage based on service quality and effectiveness. The case study organisation introduced the ERP system in 2002. This was the first construction firm known to be using an ERP system as its main information management backbone in Hong Kong or the region at that time.

The objective of the ERP system was to bind the various parts of the company's information and knowledge resources together. The ERP system required the different parts of the company to connect via a common ICT infrastructure and thereby enhance the information flow. The system's design facilitates existing organizational process and allows possible improvements to be made to increase the diffusion of information throughout other partner organizations. The ERP system also streamlines and standardizes procedures, reduces duplicate administration costs and facilitates a better "Knowledge Platform".

The studied company provided an ideal opportunity to conduct research which was inspired by core strategic course areas that were part of a DPM program. The objective of the DPM learning process was to build understanding of crucial knowledge of PM and its application. The thesis author improved his understanding of important emerging PM learning summarized by the three core study areas discussed earlier.

It made sense to examine an organization that had considerable experience with IT and ICT in order to understand the manner in which the organization improved its ERP
system implementation. The case study organization fits those criteria. Therefore, the thesis author's learning journey can be summarized as starting with basic PM knowledge and theory, followed by more intense exposure to the application of advanced PM theory followed by reflective practice based upon workplace-based action research.

Discussion and conclusions

This thesis discussed the root cause of the problems and management issues involved in the implementation of an ERP system, including the integration of a partnering strategy. Using soft system methodology (SSM) techniques, the author showed the significance of the ERP system, partnering strategy and leadership style; this provided a fascinating insight only possible using an in-depth action learning approach. However, the results from this research cannot be widely generalized. Data gathered in the surveys recorded the perceptions of participants within only one organisation and so the context will vary in other firms.

KM research is relatively new in the construction industry and not well recognized in Hong Kong. This research considered the distinct culture of Hong Kong Chinese as it integrates partnering with the body of knowledge in KM with PM. Research results provide a strong case for employing KM in order to improve the organization's strategic knowledge advantage within the construction industry. This research has also demonstrated in a practical way how SSM can be used for capturing, sharing and creating knowledge.

The thesis research results revealed several interesting issues that are worthy of further investigation by others. First, cultural bias has a major influence on the leadership style adopted by project managers, so further research on the impact of cultural differences on leadership/power influencing KM would be valuable. Second, ICT innovation can support communication, management information and document exchanges within and among project members, thus it would be valuable to further study how a stand-alone system (e.g. ERP) could be integrated with other ICT/IT systems/tools. Third, this study suggests that ERP systems can become one of the most widely accepted models of obtaining competitive advantage for construction organizations that move towards a more closely-knit supply chain. It is therefore worthwhile to investigate the possibility of applying ERP as a KM tool in other firms in the construction industry.

A DPM thesis is expected to generate work of a publishable standard and the work of this thesis has resulted in the publication of a number journal papers (e.g. Chan et al., 2008, 2009). Further, two papers were published for professional institutes and three papers were presented in professional conferences together with one paper accepted for presentation. Those papers were published or presented in Australia, the United Kingdom, Malaysia, South Korea and Hong Kong.
Fixed graphic 1

**Figure 1** Ladder of value to PM through information and knowledge integration

**Figure 2** Ladder of value to PM through considering the impact and influence of culture on ERP integration of information and knowledge

**References**


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