DEVELOPING A METHODOLOGY FOR LIVE CAPTURE AND REUSE OF CONSTRUCTION PROJECT KNOWLEDGE

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Abstract: There are a growing number of research projects on knowledge management addressing various issues in construction, but the live capture and reuse of construction project knowledge has remained a major challenge that has not been adequately addressed. This paper describes work forming part of the research project on capturing and reusing of project knowledge in construction. It starts with an identification of the current state of knowledge management and its application in construction. The ways in which knowledge is captured and reused in real live construction projects is then examined to provide the basis of a conceptual approach for the live capture of reusable project knowledge reflecting both organisational and human dimensions. Managing knowledge will provide considerable benefits in construction projects, but appropriate techniques and technologies are required to promote knowledge capture and reuse. The paper concludes that the capture and reuse of knowledge, will not only prevent the re-invention of the wheel, but could be the basis for innovation, increased agility, better teamwork, supply chain integration, and improved performance in project delivery.

Keywords - Knowledge management, construction organisations, project knowledge, live capture and re-use

1. INTRODUCTION

The role and importance of knowledge as a key source of potential advantage for construction organizations have been addressed by several authors (Rezgui, 2001; Kamara et al., 2002; Robinson et al., 2001; Bresnen et al., 2003 and Lima et al., 2003). Managing knowledge is not new for the construction industry. The project nature of the industry is abound with a frequently reconfigured set of participants, non-repetitive nature of work, pressure to complete, and lack of incentive to appraise performance or improve overall project delivery (Elhag et al., 2000). This means that information is not often captured for re-use in subsequent tasks or future projects (Kamara et al., 2003). Many practitioners and researchers in the industry have acknowledged the limitations of current approaches to managing information and knowledge related to and arising from a construction project (Fruchter et al., 2000; Rezgui, 2001 and Lima et al., 2002). These limitations are due to several technical, human, business related factors, detailed below:

➤ Each team member develops multiple alternatives. Evolution of discipline solutions and interactions among professionals are hard to document and track;
Most of the concepts generated in the early phases of the project as well as the rationale behind these concepts are not captured. These concepts are hard to communicate to the stakeholders of the project and re-used in future projects. Consequently, a large rework time and effort are involved in recreating these concepts and linking them to the later stages of the project, such as design, design development, and construction;

Unsatisfactory changes prompt team members to backtrack to earlier solutions, which at many times have to be recreated;

Different discipline solutions interact with each other. The process of identifying shared interests is ad-hoc and based on participants’ imperfect memories. This error-prone and time consuming process rapidly leads to inconsistencies and conflicts;

Memos are generated by computers but handled as paper documents, distributed to selective team members, and filed. Paper memos cannot be easily updated and are hard to retrieve;

Project documents that are captured in heterogeneous media preclude team members and clients to have a global project memory that they can access, visualize and navigate through;

Project documents are not linked with the information on the construction site. This precludes the design-build team to quickly assess the status of the project, identify current delays, and act in an informed fashion and;

Much of construction knowledge still resides in the heads of individuals, or at best, exists in an informal and unstructured form that makes it difficult to comprehend and exploit.

These factors have not merely inhibited effective knowledge management; but they have inhibited the industry’s ability to learn and re-use project knowledge for improved performance. Improvements in project procurement using KM can reduce the construction period and help clients save cost. Some of these improvements can be accomplished through better capture and reuse of knowledge during the project life cycle.

There are several on-going research projects investigating different aspects of knowledge management, across various sectors including construction, manufacturing and other engineering fields. However, live capture and re-use of project knowledge has not been adequately addressed. The CAPRIKON project is a 2-year EPSRC-funded project aimed at establishing a methodology to improve the live capture of reusable project knowledge in the construction industry. The project which is supported by five industrial partners focuses on the tactical issues associated with knowledge capture and reuse on construction projects. Construction projects are often unique in macro terms (e.g. context, client requirements, etc.) but similar in a micro context; thus the lessons learned during their execution should be reused in other projects. The capture and reuse of knowledge does not only prevent the ‘re-invention of the wheel’, but can also serve as a basis for innovation, increased agility, better teamwork and supply chain integration, and improved performance in project delivery.

The remainder of this paper consists of four main parts. The first part outlines the research objectives and methodology. The second part explores the characteristics of project knowledge, and the management issues associated with it, focusing on key aspects relevant to knowledge capture and reuse in projects. This provides the basis for the development of a conceptual approach on how live project knowledge can be captured and re-used in the same project or future projects in the third part. The final part draws some conclusion on the work so far, and outlines the future work to be undertaken.

2. RESEARCH OBJECTIVES AND METHODOLOGY
The specific objectives of the CAPRIKON project are:

- To investigate current practice and identify requirements for knowledge reuse by end users of project knowledge;
- To explore concepts and techniques for live capture of reusable project knowledge;
- To develop a methodology for the live capture of reusable knowledge on construction projects; and
- To test and evaluate the methodology on a web-hosted project environment.

In order to achieve the objectives of this project the following research methods will be adopted:

- Use of published sources, through an extensive literature review to establish current ‘state-of-the-art’ practice on the knowledge capture and reuse, both in the construction and other industries.
- Case studies of current practice for knowledge capture and reuse within collaborating organisations. Case studies will involve semi-structured interviews with representatives of collaborating organisations to identify the requirements for knowledge reuse (i.e. the nature of reusable project knowledge and how it is represented) and the strategies adopted to capture that knowledge.
- The case studies (and literature reviews) will be used to develop a conceptual framework identifying the kind of knowledge to be (and can) be captured, and the manner it should be presented to facilitate reuse, etc. Both soft and hard issues will be addressed.
- In developing the methodology, existing Web-hosted project collaboration tools (otherwise known as project extranets), and collaborative learning will be explored.
- The initial methodology will be tested using industrial workshops and refined to ensure that it is comprehensive and cost-effective.

3. PROJECT KNOWLEDGE

Knowledge is a vital resource in project-based industries and has been described as the product of learning, which is personal to individuals or organisations (Orange et al., 1999). Kamara et al (2002) noted that knowledge is an intangible economic resource from which future revenues will be derived. From a social science perspective, Barthelmé et al (1998) argues that knowledge is everywhere. They visualized this fact, by taking a classical systemic model with three different systems: the operating system, the decision system, and the information system. They argued that knowledge is not a property of one subsystem, but hence the fact of the whole system.

Knowledge management has received attention ever since, yet conceptually what constitutes knowledge is not particularly well understood. In providing a topology of the knowledge concept, this research supports Davenport and Prusak's (1998) contention that within the KM literature there is a confusing profusion of overlapping terminology and meanings. As a consequence, in the literature many labels can be found referring to knowledge as general knowledge (Court, 1997), commercial knowledge (Demarest, 1997), cultural knowledge (Magaldi, 2000), organisational knowledge (Orange et al., 1999), individual knowledge (Patel et al., 2000), procedural or process knowledge (Tiwana and Ramesh, 2000) and more recently project knowledge (Rezgui, 2001) etc.

However, irrespective of how the literature has conceptualised these terms, they are simply another metaphor for knowledge. But what really stands out is that knowledge can either be tacit or explicit (Nonaka and Takeuchi, 1995). Explicit knowledge is the most common type of knowledge. It is readily available and can be codified in a way that makes it
easily transmissible. Explicit Knowledge is the kind of knowledge that is recorded and allows people to find it and use it. This knowledge can be found in human resource data, minutes of meetings and the Internet etc. Tacit knowledge on the other hand is hard to articulate with formal language. Patel et al (2000) described it as a personal knowledge embedded in individual experience and involves intangible factors such as personal belief, perspectives and values.

However in this paper, project knowledge is knowledge of participants within a communities of interest that come together to share knowledge that affects project performance (Ramaprasad and Prakash, 2003). This knowledge as identified by Tiwana and Ramesh (2001) can be categorized into three types. General knowledge is knowledge that people gain through everyday experience and apply it without regard to any specific or direct relation with any task domain. The second is domain specific knowledge, which is gained through study and experience (Court, 1997). Each member of a multi-disciplinary construction team has domain knowledge that helps the organization to carry out specific tasks. The third kind of project knowledge is the procedural or process knowledge; this is gained from experience of undertaking a task within the domain. In another context, Tiwana and Ramesh (2001) argued that this is a combination of both the general and domain knowledge.

4. APPROACHES TO KNOWLEDGE CAPTURE IN PROJECT MANAGEMENT

Knowledge Management (KM) is a discipline that helps spread the different knowledge identified across organizations in ways that directly affect performance. Finneran (2002) argues that KM envisions getting the right information within the right context to the right person at the right time for the right business purpose. There are various other definitions, illustrating the variations in the scope and content. Davenport and Prusak (1998) identified that KM is the process of creating value from an organisation’s intangible assets. Robinson et al (2001) agrees with this definition, but argued that people, processes and product-based factors need to be evaluated in an integrated way, in order to capture and share key business knowledge to improve organizational productivity. However, there seems to be an agreement across various types of organization that KM contains a combination of some or all of the following features (Junnarkar, 1997; Webb, 1998 and Holsapple, 2001):

- Recognising and building on in-house individual expertise;
- Formalising to varying degrees the harnessing of knowledge through the use of appropriated systems;
- Passing on knowledge;
- Connecting people to people and also with information;
- Developing knowledge from an individual asset into a corporate one; and
- Encouraging the growth of an open corporate culture in which knowledge is viewed as being central to organizational development.

Al-Ghassani et al (2002) noted that regardless of the different approaches for KM, all definitions focus on the fact that knowledge is a valuable asset that needs to be managed and that managing this knowledge is important to improve organizational performance. The next section describes briefly a conceptual approach for the live capture and reuse of project knowledge in construction that incorporates key factors discussed in this section.
5. A CONCEPTUAL APPROACH FOR LIVE CAPTURE AND REUSE OF KNOWLEDGE

Given the above perspectives on current industry practice, it is necessary that learning from a project is captured while it is being executed, and presented in a format that will facilitate its reuse during and after the project (Kamara et al., 2003). It is therefore essential that any proposed solution for the live capture and re-use of construction project knowledge should be capable of fulfilling certain requirements as outlined below:

- The system should be flexible enough to take into consideration various project requirements, the change in organisation, co-ordination strategies and goals of different projects.
- It should allow work to proceed with partial knowledge and the explanation facilities clarifying the systems’ state of knowledge.
- It should be capable of creating and maintaining dependency information among data items over the life cycle of the project.
- It should allow project participants to use the system in familiar ways in dealing with project requirements and at the level of detail that the participants would choose.

In overcoming the limitations in current industry practice on the capture and reuse of knowledge, Kamara et al (2003) argued that it is necessary that learning from a project is captured while the project is being executed, and presented in a format that will facilitate its reuse during and after the project. The ‘live’ capture and representation of project knowledge will help:

- Facilitate the reuse of the collective learning on a project by individual firms and teams involved in its delivery;
- Provide knowledge that can be utilized at the operational and maintenance stages of the asset’s lifecycle; and
- Involve members of the supply chain in a collaborative effort to capture learning in tandem with project implementation, irrespective of the contract type used to procure the project from the basis for both ongoing and post-project evaluation.

When viewed from the above perspectives, ‘live’ capture and reuse of construction project knowledge poses a number of questions:

- What knowledge from a project is reusable in other projects?
- How can this knowledge be captured (during and after project implementation) in a cost-effective way, given the temporary nature of construction projects, and given the various facets (e.g. organisational, human and technology issues) that need to be considered?
- How can project knowledge be captured without causing unnecessary knowledge overload for project participants who already have to cope with huge amounts of project information?
- In what ways can captured knowledge be made available for reuse during (and after) project execution?

The development of the conceptual framework based on the issues raised in this paper is being addressed through the implementation of the CAPRIKON Project. Findings from ongoing case study investigation will provide information for the detailed development of the strategy.

6. CONCLUSIONS

Knowledge Management (KM) is already delivering major economic benefits to businesses as diverse as computer manufacturing, retailers, and construction firms, etc. Properly
implemented KM strategy should be implemented across the entire enterprise or project organisation, from initial conceptualisation and design to the maintenance stage. It will become more pervasive in organisations in the coming years, especially as the need for knowledge capture heightens as relevant personnel leave an organisation or move to other projects. It can enhance the project team’s activities by being better able to leverage knowledge internally and externally through improved knowledge capturing and reusing techniques. Ultimately, improvements in the project procurement as a result of KM can reduce the construction period and reduce the cost of projects. However, fundamental changes are required to address the issues affecting efficient knowledge capture and re-use. These issues will be addressed through the on-going CAPRIKON project, exploring how existing IT tools can be used to harness knowledge capture and re-use in a construction project environment.

7. REFERENCES


