

KNOWLEDGE MANAGEMENT STRATEGY FOR CONSTRUCTION: KEY I. T. AND CONTEXTUAL ISSUES

Patricia M. Carrillo, Chimay J. Anumba, John M. Kamara

Department of Civil and Building Engineering, Loughborough University.

ABSTRACT: Most business organisations often cite the staff as their greatest asset but have not appropriate mechanisms for managing the knowledge or intellectual capital that is embodied in these staff. The importance of Knowledge Management is now being realised and businesses are starting to formulate strategies and to invest in systems that will enable them to manage their corporate knowledge. This is a relatively new concept for construction organisations, which have a fundamental need to manage knowledge as they move from one project to another, working with different partners and supply chains. This paper examines the information technology (IT) and contextual issues involved in formulating an appropriate knowledge management strategy for construction firms. Basic definitions of knowledge and knowledge management are provided. Insights from ongoing research are used to discuss the context for knowledge management in construction, and the role of information technology (IT) as an enabler for knowledge management. The concluding section of the paper formulates guidelines that will enable construction organisations to more appropriately develop IT and knowledge management strategies that will enable them to improve their business performance.

KEYWORDS: construction organisations, information technology, knowledge management

1. INTRODUCTION

The need for change and continuous improvement in the construction industry has resulted in various initiatives, which are aimed at improving the construction process. These initiatives are primarily targeted at reducing fragmentation, and have included: (a) the development of alternative procurement strategies to clarify and improve the communication structure between different participants in the construction process (BPF, 1983; Ashworth, 1991); (b) the use of computer technology to integrate the construction process through the electronic sharing of data/information in both directions at the design-construction interface (Howard et al. 1989; Miyatake and Kangari, 1993; Evbuomwan and Anumba, 1996); (c) the adoption of a wide range of concepts, tools and techniques (e.g. total quality management, partnering, etc.) to enhance collaboration, and improve efficiency and quality (Baxter and Macfarlane, 1992; Hellard, 1993; Bennett and Jayes, 1998); and (d) the development of improved components, materials and construction methods, including standardisation and pre-assembly (Egan, 1998).

However, it is now being recognised that the management of project knowledge (especially within the construction industry where projects are implemented by temporary 'virtual' organisations) is open to considerable improvement, both within construction organisations, and between firms in the supply chain (Siemieniuch and Sinclair, 1993, 1999; Egbu et al. 1999). The emphasis on Knowledge Management (KM) reflects the growing realisation that it is a core business concern, particularly in the context of the emerging knowledge economy, where the know-how of a company is becoming more important than the traditional sources of economic power (capital, land, etc.) (Drucker, 1993; Scarbrough & Swan, 1999). Within the construction industry, it is increasingly being acknowledged that KM can bring about the much needed innovation and improved business performance the industry requires (Webb,



1998; Egbu et al. 1999). Failure to capture and transfer knowledge generated within one project, which is usually buried in unread reports and arcane filing systems, or lost because people move on, leads to wasted activity and impaired project performance.

This paper explores the information technology (IT) and contextual issues involved in formulating an appropriate knowledge management strategy for construction organisations. It begins with basic definitions of knowledge and knowledge management, and then emphasises the importance of knowledge management in a construction setting. The paper also examines the role of information technology (IT) as an enabler for knowledge management. The concluding section of the paper formulates guidelines that will enable construction organisations to more appropriately develop IT and knowledge management strategies that will enable them to improve their business performance.

2. KNOWLEDGE MANAGEMENT

Knowledge management can be defined as the identification, optimisation and active management of intellectual assets to create value, increase productivity, and gain and sustain competitive advantage (Webb, 1998). It involves the capture, consolidation, dissemination and reuse of knowledge within an organisation (Kazi et al. 1999). The formulation of a knowledge management strategy involves an examination of a number of interrelated concepts and factors (Kamara et al. 2000). However, before these are described it is needful that the meaning of knowledge is discussed.

2.1 Meaning and types of knowledge

An understanding of what constitutes 'knowledge' is central to its effective management. For example, if knowledge is considered to be interchangeable with information, then the focus tends to be on the management of information systems as a proxy for knowledge management (Blumentritt and Johnston, 1999). However, the various definitions of knowledge suggest that it is much more than information. According to Nonaka and Takeuchi (1995), knowledge can be defined as a dynamic human process of justifying personal belief toward the "truth" (i.e. a justified true belief). Knowledge has also been defined as 'know-why, know-how, and know-who', or an intangible economic resource from which future revenues will be derived (Rennie, 1999). Attempts to distinguish between data, information and knowledge have also geared towards the understanding of the latter (Webb, 1998). However, it is necessary to view knowledge on the basis of its final use and/or on the basis of the context of its use ('wrapper' knowledge). This underscores that fact that knowledge can be viewed as a component of a task performing system. That is, a state of that system which warrants task completion, and the future repetition of this task. The lack of this component implies a failure when completing a task. If this lack is sustained over time, it means that this system ceases to exist. Knowledge is built from data, which is first processed into information (i.e. relevant associations and patterns). Information becomes knowledge when it enters the system and when it is validated (collectively or individually) as a valid, relevant and useful piece of knowledge to implement in the system (Blumentritt and Johnston, 1999).

Closely associated with the meaning of knowledge, is the identification of the kind of knowledge that is to be managed. Various classifications of knowledge include: formal (explicit) and tacit (expertise) knowledge; foreground and background knowledge; classifications with respect to the role of knowledge for business relevance (e.g. knowledge of business environments), or with respect to the functional roles within an organisation (e.g. knowledge for control activities) (Siemieniuch and Sinclair, 1999). An understanding of the nature of these types of knowledge contributes to their effective management. For example,

tacit knowledge, which 'oils' the wheels of formal procedures, is difficult to transfer because it is held in peoples' heads. Similarly, foreground knowledge (defined as knowledge which has direct applicability to organisation and its operations) relies on background knowledge (generalised knowledge) for it to be effective.

2.2 The management of knowledge

The management of knowledge involves various tasks and activities that are performed to ensure that knowledge is generated and/or captured, stored, disseminated or shared, and retired. However, this may not necessarily be a linear process, as the context of use and supporting infrastructure and tools also have to be considered (Laudon and Laudon, 1998; Webb, 1998). These interrelated factors can be grouped into four main categories:

- The knowledge base (used in a wider sense) that is to be managed. This includes data, information, and knowledge. The purpose of this knowledge with respect to what it is required for; what it contributes to; who needs it, etc., also need to be identified.
- The context of use. This includes issues like the factors that initiate the need for knowledge, and how it is applied within the organisational structure and culture.
- The actual processes, procedures and tools required to capture, share and reuse knowledge.
- An indication or measurement of how managed knowledge is contributing to improved business performance, since knowledge management is not an end in itself, but a means to increased competitive advantage.

Figure 1 is a conceptual (theoretical) framework that illustrates the interrelationships between the various factors involved in the management of knowledge.

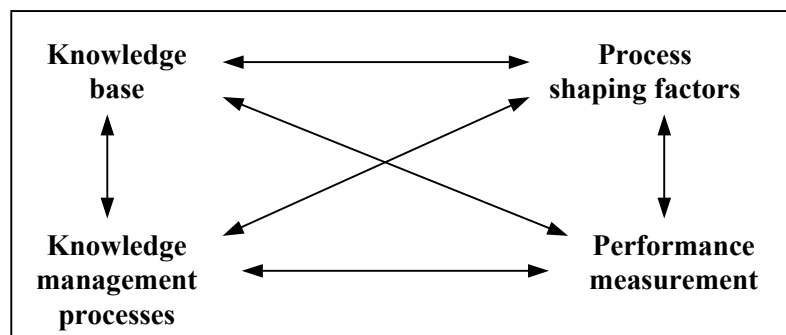


Figure 1. Conceptual framework for knowledge management.

The 'knowledge base' refers to the kind of information, data or project knowledge that is to be managed. 'Knowledge management processes' refer to the tasks and activities that are implemented to manage knowledge, within the context of the project and/or organisation ('process shaping factors'). 'Performance measurement' deals with the assessment of the real-time usefulness of knowledge management efforts, since KM is not an end in itself, but a means to add value and increase competitive advantage.

This paper focuses on the contextual issues (process shaping factors in Fig. 1) and the tools (particularly IT tools) for a knowledge management strategy in construction. A discussion of the organisational context for KM in construction now follows.

3. ORGANISATIONAL IMPLICATIONS

In recent times, the UK construction industry has been forced to critically examine its performance. The Latham and Egan Reports (Latham, 1994; Egan, 1998) have both highlighted the plight of the UK construction industry. Client's dissatisfaction, low profitability, and over-capacity are a few of the many ills described. The industry is beset with solving short-term problems. Historically, financial indicators were seen by many as the key performance indicator. However, the signs are that there may be a cultural shift. Senior construction executives are becoming more aware of management principles and the philosophy of a holistic approach to performance through the use of Key Performance Indicators (KPIs) is gaining acceptance.

Knowledge Management fits comfortably amongst KPIs being advocated. It forms an integral part of Kaplan and Norton's Balanced Scorecard (Kaplan and Norton, 1996) 'Internal Business' perspective, as well as the 'Learning and Growth' perspectives. It fits into EFQM's Excellence Model criteria for 'People' as well as 'Partnerships and Resources'. KM also fits in well with the UK Construction Best Practice Programme's KPIs for project performance.

3.1 Need for organisational strategy

Organisational strategies provide a framework for decision making (Boseman and Phatak, 1989). Without such a strategy KM may be approached in a haphazard manner without any boundaries defined. Construction companies have been practising some form of knowledge management for some time. It is only in doing so that they, and the professional teams that operate within them, have developed national and international expertise in certain areas of work. The term 'Knowledge Management' is relatively new to construction organisations and there continues to be a debate on whether it is a passing management fad or whether it forms a permanent company asset. Informed companies realise it is an important non-monetary asset to the organisation and can assist in maintaining competitive advantage. There are a few companies interested in the concept; some have appointed knowledge management officers but others see KM as limited to the use of Intranets.

However, it is evident that Knowledge Management complements many of the initiatives being promoted to improve the construction industry. An organisational strategy on KM will allow a framework in which companies may operate, establish timeframes, and allocate an appropriate agenda.

3.2 Development of a strategy

Implementing Knowledge Management in a structured manner is a major undertaking for an industry that is not geared to responding quickly to new ideas. A strategy will determine what major plans are to be undertaken and allocate resources to them (Cannon, 1968). Aaker (1984) also suggested assigning people or groups of people the responsibility for analysing new issues, such as KM and developing responsive strategies. A strategy for implementing Knowledge Management within an organisation should set out clear goals and how these are to be achieved within a specified timeframe. For a construction organisation there are a number of considerations. For example, which part of the construction process may obtain maximum benefit, which section of the company will be able to benefit most from a KM strategy, how large a problem should be identified, what medium will be used (IT or individuals), how is the system to be evaluated etc. Other considerations include:

- Prepare a business case of introducing KM in the organisation;
- Map the organisation's business processes to identify one small area that could bring tremendous benefit to the users of such a system;

- Consider appointing a champion;
- Talk to front-line staff and find out what information they need for their work;
- Allocate adequate resources (financial and non-financial) for a prototype;
- Start with a small problem which relies on in-house knowledge before moving onto large projects involving the supply chain;
- Map out clearly the methodology for the knowledge lifecycle from capturing data to knowledge retirement;
- Identify a strategy for dealing with obstacles such as limited time and data validation;
- Evaluate progress and obtain feedback from front-line staff on a regular basis; and
- Review the strategy and achievements periodically for possible revision.

One good way of developing a strategy is to learn from others who are at a more advanced stage of implementing knowledge management systems.

3.3 Impact on structure and working practices

The construction industry does not have a strong record of valuing its employees and their individual and collective contributions. This, therefore, makes it more difficult to share knowledge. Tacit knowledge tends to be regarded as personal property rather than organisational property. Hierarchical organisational structures and multi-disciplinary teams also make it more difficult to share knowledge. The introduction of new management structures to deal effectively with knowledge management may be viewed with suspicion. Likewise, radical changes in work practices are not desirable. Any task that is seen as requiring more effort will not be widely accepted. Knowledge Management will have to become an integral part of the way individuals work if it is to succeed.

3.4 Cultural and other barriers

The typical construction organisation does not encourage the culture of sharing knowledge. Wates Group, a medium sized UK building company, stated it took four and a half years before staff accepted the concept of sharing knowledge (CPN, 2000). Primarily, the culture of the organisations need to be addressed if KM is to be of benefit. Each organisation has its individual culture and only they can say what initiatives need to be set up to encourage a culture change. There are many other barriers to the successful implementation of KM within a construction enterprise. These include:

3.4.1 Lack of Time

Sharing knowledge demands additional effort. This effort may be minimised by work practices and the introduction of better knowledge sharing tools. Construction projects are always working to tight deadlines. Anything that detracts from the main business is seen as of diminished importance.

3.4.2 Trying to solve large problems

The various stages involves in KM are complex. It is easy to envisage the utopian world of delivering knowledge to different members of the project team as and when required for different stages of the construction process. However, in reality, for a company embarking on Knowledge Management, it is best to undertake very small projects that are self-contained with little input from external parties.

3.4.3 Converting Knowledge

One major obstacle is how organisations capture knowledge on projects that cuts across organisational boundaries. The industry is full of individuals, skilled trade workers and professionals who have years of experience of doing specific tasks. Converting their tacit

knowledge to explicit knowledge for the benefit of others is a problem, which is difficult to conduct within a reasonable period and at an acceptable cost.

3.4.4 Large number of SMEs

The UK construction industry consists of a large proportion of small to medium-sized enterprise (SMEs). These organisations have more pressing concerns than KM and in many cases do not see the need nor do they have the commitment and resources to undertake KM.

3.4.5 Multi-Disciplinary Teams

Some project team members may belong to different divisions or even different companies. Managing knowledge with such a team within a limited time period is difficult. Each team member will be working towards the agenda set by their employer. The benefits of KM may be seen as limited to the life of the individual project unless in long-term partnering type relationships.

3.4.6 Unique Projects

Despite efforts to encourage the UK construction industry to view itself as a manufacturing enterprise, it still regards each project as a one-off. This reinforces the view that KM on individual projects will be wasted as the next project may be quite different.

3.4.7 Lack of Learning

Because of the view of the industry producing unique projects, there has also been a failure to learn from past mistakes. In many circles, the UK construction industry is regarded as a national (rather than international) industry and there is an unwillingness to learn from internal and external sources.

3.4.8 Lengthy Time Period

KM is a long-term goal without any short cuts. If it is to bring long-term benefit to the organisation, it will take a considerable period to have systems up and running with sufficient time to be validated and for benefits to percolate to the organisation's performance.

3.4.9 Loss of faith

With KM systems available, employees may be tempted into thinking the data required is always easily accessible. In fact, it will take considerable time to get a spread of working KM systems. This may lead to employees losing faith in the system because it does not deliver immediate benefits in their own individual areas.

3.4.10 IT support

Many of the existing systems rely on IT for delivery. Construction offices may be portacabins in isolated environments with inadequate infrastructure. The IT support, a key element in KM systems, must be present to deliver the knowledge required.

Based on current working practices and the barriers to KM, a discussion of the IT support required within the construction sector now follows.

4. I.T. SUPPORT FOR KNOWLEDGE MANAGEMENT

Information Technology (IT) has long been recognised as critical for successful knowledge management. This is probably a legacy of the growth in knowledge based systems (KBS) in the eighties and early nineties, and has led to much of the early work on knowledge management focusing on the delivery of technological solutions. While it is now recognised that good knowledge management does not result from the implementation of information

systems alone (Grudin 1995; Davenport 1997; Stewart 1997), the role of IT as a key enabler remains undiminished (Anumba et al, 2000; Egbu, 2000). Laudon and Laudon (1998) classify information systems for knowledge management into four main categories (Figure 2):

- those for creating knowledge (knowledge work systems): these support the activities of highly skilled knowledge workers and professionals as they create new knowledge and try to integrate it into firms;
- those for distributing knowledge (office automation systems): these help disseminate and co-ordinate the flow of information in an organisation;
- those for sharing knowledge (group collaboration systems): these support the creation and sharing of knowledge among people working in groups;
- those for capturing and codifying knowledge (artificial intelligence system): these provide organisations and managers with codified knowledge that can be reused by others in the organisation.

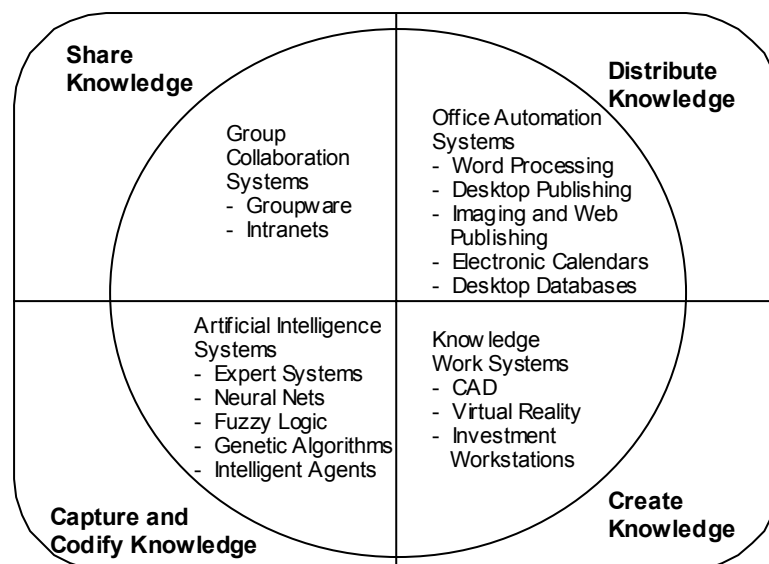


Figure 2. Information systems for knowledge management (Laudon & Laudon, 1998)

These information systems are considered especially useful for knowledge management because they focus primarily on supporting information and knowledge work and on defining and capturing an organisation's knowledge base (Laudon and Laudon, 1998). While the classification in Figure 2 is debatable, it represents a useful framework for discussing IT support for knowledge management.

4.1 Current usage of IT

There is a preponderance of IT systems available to support knowledge management. Most of these systems provide support for only one or more of the four areas illustrated in Figure 2 and so cannot realistically be labelled 'knowledge management systems' as most vendors do. These are discussed below:

4.1.1 Systems for knowledge creation

Within the construction industry, there are now a variety of systems that facilitate the knowledge creation process. These are usually discipline-specific and include CAD systems, analysis systems, estimating systems, etc. Increasingly, these systems are being integrated both within and across disciplines, thereby facilitating the flow of information.

4.1.2 Systems for knowledge processing

These are systems that Laudon and Laudon (1998) term 'office automation systems'. They enable the processing manipulation (storage, etc) of knowledge in an organisation and include, amongst others, word processors, spreadsheets, desktop publishing systems and databases. These systems are now routinely used within construction organisations to ensure the smooth running of businesses.

4.1.3 Systems for knowledge sharing

Knowledge sharing systems are utilised to support groups working together such that members of the group can share data, information and knowledge within a given context. Examples of these systems are intranets and other groupware systems such as video-conferencing, document management systems, bulletin boards, shared databases, electronic mail systems, etc. The use of these systems is growing in the construction industry but, so far, the emphasis has been more on supporting intra-organisation groups rather than virtual project teams that have members drawn from several organisations. This is expected to change.

4.1.4 Systems for knowledge capture and codification

Systems that are able to encapsulate knowledge and expertise in coded or symbolic form are vital for knowledge management in an organisation. They enable the setting up and maintenance of knowledge bases that preserve knowledge/expertise that might otherwise be lost when a key member of staff is no longer available. These systems are generally based on the concept of 'artificial intelligence', (AI) and are effective decision support systems. The uptake of AI systems in construction has been disappointing and is partly attributed to the hype associated with 'expert systems' in the eighties. However, there is renewed interest and AI systems are increasingly embedded as components of larger IT systems.

4.2 Requirements of a KM system

For any IT system to be classified as a Knowledge Management system, it must fulfil a number of requirements:

1. It must support the full KM lifecycle – from knowledge creation through distribution and management to retirement – and not just a subset thereof.
2. There should be appropriate mechanisms for validation and authentication of the knowledge encapsulated in the system (Kamara et al, 2000).
3. The system should be able to seamlessly integrate with existing legacy IT systems within a real or virtual organisation.
4. Flexibility and ease of use are essential components of the system, as they are crucial for ensuring its acceptability and utilisation.
5. The knowledge contained within the system must be well maintained and up-to-date. This is essential for building up user confidence in the system and ensuring that decisions are based on the latest information available.
6. The system must be designed in accordance with an organisation's goals, culture and business processes. End-user involvement in the design and implementation of the system is crucial in this regard.

The above list of requirements is not exhaustive but is indicative of the key issues in the development of IT systems to support knowledge management in an organisation.

5. SUMMARY AND CONCLUSIONS

This paper has discussed the key IT and contextual issues that have a bearing on the formulation of a knowledge management strategy for construction organisations. It first introduced the concept of knowledge management and then discussed the organisational implications, including the considerations in formulating a KM strategy, the impact on structure and working practices, and the cultural and other barriers. The role of IT as an enabler for KM is also covered and the requirements for an IT system to support knowledge management outlined.

It is evident from the discussion so far that construction is an industry that needs to better manage its knowledge resources in order to improve business processes and satisfy its clients. However, several IT and contextual issues highlighted in this paper need to be addressed in order to ensure the development of an effective KM strategy. In particular, construction organisations need to:

- recognise the importance of harnessing and managing their knowledge resources;
- formulate a KM strategy that is proactive and has built-in mechanisms for ensuring that it results in improved business performance;
- understand the impact of KM on the organisational structure and working practices of a real or virtual organisation;
- develop appropriate strategies for overcoming the cultural and other barriers that inhibit knowledge management. For example, it may be necessary to implement incentive/reward systems that encourage people to share knowledge;
- view IT as an enabler, which should be part of an integral multi-faceted KM strategy;
- develop and implement an IT infrastructure for KM which is tailored to suit the needs of the organisation;
- implement an appropriate training programme that educates the organisations employees on the benefits of KM, and in the use of any supporting IT systems.

In conclusion, it is important to state that knowledge management is not an end in itself and is of limited value if it is not geared towards improved business performance. Construction organisations need to better manage their knowledge assets if they are to remain competitive in the new Millennium. This paper has set out the key IT and contextual issues that need to be addressed in this regard.

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