

AN EXAMINATION OF KNOWLEDGE MANAGEMENT IMPLEMENTATION WITHIN CIVIL ENGINEERING CONSULTING ORGANIZATIONS

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UK construction industry trends are towards collaboration, knowledge exchange and new networks, to increase competitiveness and profitability. Knowledge management is starting to be recognized as a necessary activity to increase the competitiveness of companies within construction. The application of knowledge management within construction organizations offers the opportunity to tap into the knowledge gained from projects in a coherent fashion. It offers the opportunity of sharing, storing and developing knowledge that is often lost as projects conclude. Civil engineering consultants are facing the challenge of how to access this knowledge from projects in a structured fashion. This paper will examine how knowledge management is being developed and implemented within civil engineering consultancies. Its focus will be on how companies are developing, understanding and implementing their knowledge strategies. The central themes that emerge from this paper are that information technology and organization cultures are the key influences on knowledge development.

Keywords: knowledge management, learning communities, information technology, sharing infrastructure, civil engineering.

INTRODUCTION

The value of intellectual capital to the organization is gaining more recognition. The view that the firm has to maximize the use of its intellectual capital is now an accepted part of the broader business strategy requirements. This theme combined with organizational learning has brought knowledge management to the forefront of current management thinking.

Knowledge Management refers to the organizational processes that seek the combination of data and information processing capacity, with the creative potential of people. It is concerned with the management of knowledge processes, interactions between individuals and teams, and the means through which they acquire and exploit knowledge. This process of managing knowledge does not operate in isolation but is an integral part of achieving the objectives of the organization. Knowledge management is about getting the right knowledge to the right people at the right time.

The need for knowledge and learning is the same in construction, as within any other industry. Market and competitive forces are putting greater pressures on firms within the industry. In the post Egan (1998) era industry performance has received greater attention and there is a growing recognition of the role of learning and knowledge in achieving improvement. This paper is concerned with implementation of knowledge management within the civil engineering consulting environment. The paper focuses

on how the firms are developing, understanding and implementing their knowledge strategies and the drivers behind knowledge management initiatives.

What is knowledge management trying to achieve?

Knowledge management is about sharing and acquiring knowledge in ways that can be translated into improved organizational performance. The intellectual capital of the organization is presented in a tangible form that facilitates the adding of value to the organization and ultimately its customers. This process of added value is achieved through the continuous recycling and creative use of shared knowledge and experience. This is followed by the structuring of the shared competencies with the help of technology, process maps and descriptions, manuals, networks and so on, to ensure that the competence remains in organization even when staff leave. The knowledge, once packaged, becomes part of the capital of the organization. This creates an environment for the rapid sharing of knowledge and sustained and collective knowledge growth. Lead times between learning and knowledge sharing are shortened and human capital becomes more productive through intelligent work processes. Knowledge management is about acquiring, structuring, and transmitting intellectual material for the benefit of the organization.

Knowledge and community

Most discussions about knowledge and knowledge management start with definitions of data, information and knowledge.(see Davenport and Prusak , 1998a) This is important but how does knowledge emerge within the individual? A computer or library may store a great deal of information but we cannot say they have knowledge. It is the human ability to use the information that creates the knowledge. The art of knowledgeable practice is to turn information into solutions. Professionals face a stream of problems and to resolve these problems professionals piece together information, reflect on their experience, generate insights and use these insights to solve problems. Engineers, architects and other professionals do not 'cut and paste' best practice from the past. They draw on the past to find solutions for the future. Knowledge evolves from shared practice and experience.

Sharing is an important concept in knowledge development. McDermott(1999) suggests that we do not learn on our own but through shared experience. Knowledge belongs in communities of learning. Engineers and other professions have a body of knowledge that flows from one generation through to the next. This transfer through the generations is only possible through a learning community and the willingness to share. Learning communities may take many forms such as libraries, workplace routines, seminars, conferences, learned organizations, etc. McDermott(1999) contends that we acquire knowledge by participating in a learning community while we acquire information when we operate in isolation. This approach suggests that collective knowledge acquisition is needed and sharing may require us to undertake an organization culture shift.

Knowledge management strategy

Knowledge management, like all other organization activities, can fail if it is not developed correctly. The problem facing most initiators of knowledge management is that it is an evolving field with no set standards for what is required. A useful starting point would be to articulate the specific business management objectives that a knowledge management initiative would serve. This ties in the activity to a business objective that should make acceptance easier. The next stage of the process is to

identify the objectives of knowledge management in relation to the business objectives. This creates focus and should help prevent unnecessary information from cluttering up the knowledge system.

One of the major misconceptions of knowledge management is that it is about information technology. The technology is a support tool. There are two philosophies associated with knowledge management, a personalized knowledge strategy and codified knowledge strategy. The personalized strategy is very much tied into the person that developed the knowledge and sharing is achieved through person to person contact. There is an opportunity to transfer tacit knowledge. This may take the form of structured mentoring for the learner. Information technology under this system provides a means of communication but does not act as a knowledge repository.

The codified knowledge approach is associated with explicit knowledge, which can be more precisely expressed and formulated, even when removed from its context. These are the training manuals, process and systems that are generated in organization context. The key to this approach is to create a knowledge asset that can be used a number of times. This is almost a person to document approach. The knowledge is extracted from the person who developed it, made independent from that person and used many times (Davenport, 1998a) Electronic document systems help facilitate the codifying, storage, dissemination and reuse of knowledge. Information technology can be a great help when this type of system is used. Teece (2000) however warns of the dangers of information technology systems masquerading as knowledge management initiatives.

The question that arises; what is the most appropriate system for the management of knowledge? In common with almost every management application, the appropriate decision is contingent on the nature of the business, the organization structure, the products or service and the customers that receive the product. In all organizations there are both tacit and explicit knowledge creation opportunities. The tacit knowledge is developed through the individual or project teams, while the explicit knowledge is created through processes, procedures and other routines that can be codified. The knowledge management strategy is dependent on how the organization perceives itself. Does it wish to adopt a knowledge management approach that seeks the re-use of knowledge to implement solutions? Does it wish to use knowledge objects that are easily accessible, reliable and easy to use? The explicit knowledge approach stresses the economics of re-use and “ready to wear” solutions. Alternatively the company can go down the route of a highly personalized approach to knowledge strategy where the investment is in tacit knowledge transfer. Under this approach the knowledge is transferred to the individual and customer solutions are specifically tailored for the individual project.

Research conducted by Nohria, Hansen and Tierney(1999) on management consultants suggest that a firm should choose to adopt one of the strategies with the other acting as a support mechanism or the focus of the approach will be lost. They suggest a 80% -20% approach which indicates that one strategy or the other will be dominant. A mixed approach is not advocated as the focus of the knowledge strategy will be reduced.

Creating the knowledge management architecture

Once the business case and the knowledge management strategy philosophy is agreed then the next stage is to look at setting up the process. The process for creating and

distributing knowledge is achieved through the following stages: (adapted from Zack, 1999)

Acquisition - creating relevant information and knowledge

Refinement - refining the information to add value

Storage and Retrieval.- creating a system to store the knowledge

Distribution - making sure the system is accessible

Transfer - making sure that the knowledge is transferred.

Measurement/Feedback - evaluating how successful the initiative is.

Many of the knowledge management projects that companies have instituted are still in their infancy and the benchmarks still have to be set. As these projects reach maturity measurements will emerge. The only indication of the benefits of knowledge strategies and culture are, that companies that have a known knowledge sharing culture such as 3M, Intel, Hewlett Packard, Chaparral Steel and Kao. They are held out to be the benchmarks for other companies (Leonard, 1996). They represent organizations that have a knowledge driven culture and are seen to be leaders in their respective fields. While knowledge management is still in its infancy in managerial terms these organizations have demonstrated that benefits can accrue from adopting a knowledge based organization culture.

RESEARCH METHOD

This paper is about knowledge management and its implementation. The subject is in its infancy, which makes large data samples difficult to access. Strategic implementation cannot be separated from its context. " The case study is the method of choice when the phenomenon under study is not readily distinguishable from its context"(Yin, 1993). This statement encompasses the problems within many aspects of management research. It is often difficult to distinguish the various phenomenon under consideration from its setting. The case study provides an opportunity to use a variety of methods such as observation, current and historical documents, interviewing, etc. and it allows cases to be developed through both longitudinal and current studies. Case studies allow for detailed investigation on limited problems and contextual causality to emerge. Case studies while an attractive format for management research offers only limited elements of generalization and opportunities for theory building. There is also the danger of getting immersed in the details of a particular case and not seeing the wider context outside the organization. There is also the danger of the case builder getting too close to the context and thus loses objectivity.

The case approach seemed appropriate for construction knowledge management research. In Preece and Moodley (2000), the writers found that there was limited activity in knowledge management. This has subsequently increased but the subject is still in its infancy in construction. Developing an understanding of knowledge management through a case approach suited the objectives of the research project. The research objectives were to understand the knowledge strategy, implementation and influences on knowledge management within consulting engineering organizations. In developing the cases, the writers wanted to identify how the overall business strategy influenced knowledge management. This questioned the scale of commitment of the firm to knowledge management. It was also important to focus on the issue of IT

masquerading as knowledge management (Teece, 2000). This would demonstrate if there was a true understanding of knowledge management within the firms. The final area that was important for case development was to understand to what extent did learning and learning communities exist. Learning is critical for knowledge development and it was therefore essential to try to capture how this was being achieved. These issues allowed the writers to develop their understanding of the wider implementation issues.

The development of the case studies utilized a variety of research methods, including documentation, observation and interviews. Documentary evidence was corroborated through interviews with senior managers concerned with either strategy or knowledge management initiatives. While only three cases were developed, it did offer the opportunity to isolate influences on knowledge management implementation. All three cases were in organizations with similar profiles and core businesses, making comparisons and strategic motivations easier to isolate. Generalization of the findings of the cases does however remain a problem, as the sample does not reflect the general population of the industry.

CASE STUDY

Case company A

This organization has 75 offices world-wide and over 5000 employees with an annual turnover of \$335m. It operates in all commercial and industrial sectors with a view to providing innovative engineering solutions as its core business.

The organization has good awareness of knowledge management and sees it as a business concept that can change the way it does business. In a similar manner to all good technical organizations it has a good technical library that is well funded and supported. The organization has its own database, navigator and viewer that allows access to project information from different projects. The system allows peer to peer networking for project information. The company does not consider this a knowledge management initiative but a support tool for organization improvement and technical improvement. The company has a good information technology infrastructure with groupware, internet, video conferencing, its own intranet and other forms of multi-media infrastructure. The information technology that is in place is suitable to implement technology led knowledge management.

The sharing infrastructure the company operates at number of different levels with knowledge sharing and learning initiatives. For its business strategy it undertakes a number of short workshops with its associates and partners. These are typically single day brainstorming sessions bring together a cross section of key people to initiate business development, business process re-examination, and strategic redefinition. During the course of building the case, it became apparent that business level knowledge sharing was restricted to only those individuals involved in the workshops. Moreover market knowledge did not filter through the organization and resides in the individual.

As the organization is steeped in engineering it pays particular attention to technical development of its engineers. Technical forums are used to disseminate knowledge. These are supposed to act as mechanisms that develop dialogue, improve skills and develop team knowledge. A great deal of the personal development of the engineers within the company is based on the training and development. While there was no clear demarcation of a learning community, the nature of the forums and the

Information technology infrastructure suggests that the firm has a strong recognition of the need to have a learning community. Technical learning and knowledge development is clearly a priority.

Knowledge management is not part of the underlying strategy of the firm. While it has an impressive record of engineering achievement, it sees knowledge management as a secondary ideal mainly to create a sense of shared value within the organization. The formalization of knowledge management is still in its infancy and not part of the strategy of the firm. It does however have a good foundation for a learning community of structural technical knowledge. This is related directly to the core strengths of the organization and knowledge development in these areas would be expected. Information technology does not have an overriding role in the manner in which the organization is progressing. Formal knowledge management within the firm is largely influenced by external perceptions to be in seen to have a formal knowledge management system.

Case company B

Company B has thirteen offices, mainly within the UK. It has over 1000 staff, with an annual turnover of \$50 million. The organization is primarily a civil engineering consultancy involved in all commercial and industrial sectors, with both public and private sector clients. It is moving towards the development of a full multi-disciplinary service and has consequently expanded its non-core activities.

Knowledge management has received board level recognition within the firm. A separate knowledge management unit has been set up with director level involvement in the unit. The organization has set up a knowledge management initiative that it is implementing. It has identified that information relating to its achievements, methods and processes, customer, capital, partners and alliances all contribute to the development of knowledge within the firm. This has been set up within the company intranet as a database that can be accessed. At this stage of the development only limited access is provided to the knowledge base.

The information technology infrastructure of the firm is adequate for its operations and it relies on the internet and an intranet for dissemination. As part of its long-term strategy to develop knowledge management it is developing its information technology infrastructure. The knowledge management initiative is largely IT led and is part of the longer-term strategy of the firm to use IT more creatively. Alongside the knowledge management initiative the firm is also looking to use internet technology to advance its operations. It wants to use e-commerce strategies to create closer links with specific clients. It see business to business (B2B) links on the internet as the way forward. An important part of this strategy is the creation of knowledge bases that selective clients can have access to. This is the key impetus for the development of knowledge management within the firm.

The sharing infrastructure is mainly rooted at corporate level. There are strategy and business development workshops involving directors and other key personnel. They are also the group that has access to the current knowledge management initiative. The concept of a learning community has not been developed at other levels within the organization. Learning and knowledge development at a technical level is limited and, involves only information exchange and a technical library. A representation of the shared culture of lack thereof is illustrated by the absence of any staff common room or other shared space.

Knowledge management is part of company strategy and they use information technology and knowledge to attract clients to the organization. The term the organization uses for its approach is the development of a knowledge consultancy. It is evident that efforts are being made to develop knowledge management at a corporate level there is very little shared culture at the technical level. There is an absence of any form of learning community at the technical level. Learning communities are the essence of the development of professionals and intellectual capital. The key influence on the development of knowledge management within this organization to satisfy and attract clients. These developments are information technology led and structures that are being created follow a explicit knowledge base. An absence of a sharing of knowledge culture leads to the conclusion that information systems are being created rather than knowledge systems.

Case company C

Company C is a consulting engineering company with a presence in the UK, Europe, Asia and Africa. It has a staff complement of 600 and an annual turnover in excess \$40 million. They are primarily concerned with providing engineering solutions for a wide variety of clients across all sectors.

Knowledge management is recognized as being important within this organization. Knowledge sharing is part of the overall objectives of the firm to improve performance. They use the “engineering body of knowledge” as their starting point for all knowledge initiatives. This is integrated with the diagnostic and problem solving techniques that an engineer requires. Knowledge development operates at two levels the scientific level and the traditional business level. It is from these bases that knowledge projects have evolved.

The company has its own knowledge management system in place called “Voyager”. The knowledge that is stored in Voyager is divided into the following sections; commercial, technical, management, IT systems, health and safety and environmental. The data is stored on pages in ‘html’ format and can be accessed via a normal web browser. Personal experience and expertise of staff is mapped and categorized by key words or skills. This is listed in a yellow pages format with staff, contacts and relevant experience. The objective of the system is to tap into the knowledge of the most experienced engineers within the firm and make it available to all members of the organization. The translation of existing knowledge and access to senior engineers offers the organization the opportunity to develop its learning culture. The company has a good information technology that supports its knowledge management initiative.

Knowledge sharing is a central tenet of the firm. It operates workshops and seminars in which all the members of the organization are encouraged to attend. Internal presentations provide an opportunity for cross-office and cross-discipline learning. Senior engineers undertake regular presentations to provide access to their skills. Sector groups foster a multi-disciplinary focus and centres of experience encourage the development of a learning ethos. The company is attempting to create effective learning communities to develop knowledge.

The management of knowledge is important to this organization. It sees knowledge as an important part of the development of its intellectual capital base. It is also aware of the knowledge development required for its staff. Although their approach is information technology centred, it is not the key influence. There is also structured human interaction in the knowledge development process. The influences on

knowledge development are both internal and external. The internal influences derive from the values the company sets itself.

DISCUSSION

The cases have indicated that there is interest in developing knowledge management within civil engineering organizations. A better understanding of trends can be found when considering all three organizations.

In all cases there was a clear understanding of the potential of knowledge management to the organization. Only company B saw knowledge management as part of its broader business strategy. This approach was adopted because the organization saw knowledge management as a way of achieving its goal to become a 'knowledge consultancy'. The implementation of the idea was in still its infancy. Company A and C did not tie knowledge management to their main business strategy but saw the concept as important for the development of their intellectual capital. The knowledge management strategy was focussed internally on the development of people within the organization. Their philosophy could almost be summed up as 'knowledgeable people make knowledgeable organizations.'

The role technology plays is an important part of the knowledge management process within the cases. All the case companies are developing proprietary systems to complement their knowledge management initiatives. Company B is using information technology and knowledge management to generate a new business initiative. Technology is leading the direction in which knowledge management is developing. Company A and C have better information technology infrastructure but use it to support the knowledge management initiative. Both organizations still use a personalized approach to transfer knowledge alongside their information technology. Although the personalized approach is used by both A and C, all three organizations are moving down the path of codified knowledge. Having invested in information systems it is inevitable that the organizations will move towards maximizing their use.

Sharing knowledge is difficult to quantify. Company B has a very limited sharing culture which makes its adoption of knowledge management as a strategic objective difficult to appreciate. It only offers limited staff access to its knowledge base. The implementation of knowledge management is going to be difficult to achieve. Company A has a mixed sharing culture. It shares technical information with all its staff and is attempting to create a learning community at this level. Business and market information sharing is restricted to senior management and often reside within individuals. Company A also seems to be less willing to provide all professionals with access to business information knowledge bases. Argyris(1999) argues that knowledge held in the minds of individuals, may well be lost when they leave the organization. Learning can only be achieved when there is sharing.

Company C has attempted to create a community of learning within it. It uses its information technology infrastructure alongside personalized strategies to develop knowledge across the organization. It makes experienced personnel available to all levels of the organization so that sharing of knowledge may be initiated. It is working towards building a learning community within the organization through the development of its people.

Company A and C have highlighted the importance of having a sense of shared values within their organizations. Knowledge management is being used to build on the values of the organizations and develop a common culture. The values these

companies have are driving their knowledge management initiatives. Another key influence on knowledge management is information technology. Expenditure on information technology is leading all these organizations to adopt primarily codified knowledge strategies. The knowledge tools that are being adopted relate closely to information technology of the firm. The final key influence on knowledge management is the popularity of knowledge management as a general business subject. Since the initial survey done in Preece and Moodley (2000) , it is apparent that more companies are taking an interest in knowledge management.

CONCLUSIONS

Knowledge management is being more widely considered as a business practice worthy of consideration. Civil engineering consulting organizations have also embraced concepts within knowledge management. This paper has highlighted certain issues that will influence the future of the development of knowledge management with consulting engineering organizations.

Information technology spending and infrastructure is becoming the key influence in the direction in which knowledge management develops. High expenditure on information technology requires these systems to be used extensively. Companies adopt knowledge strategies that information technology led. Codified strategies are adopted irrespective if they are appropriate or not for the organization.

Knowledge management implementation also requires a change in culture. There has to be a culture of sharing to create learning communities. Engineering organizations have professionals that require learning communities to facilitate their professional and personal development. Having information systems is not good enough, there has to be a culture of learning and knowledge transfer for knowledge management implementation to work. To initiate cultural and organization change, knowledge management should become part of the business objectives of the organization.

Knowledge management offers the opportunity of developing shared values within the organization. As knowledge is disseminated and learning develops, it is possible to develop an organizational ethos that shared by all. Creating common values is part of creating good companies.

In an economy where the only certainty is uncertainty, the one lasting competitive advantage is knowledge. Few senior managers understand the true nature of a knowledge creating company yet these organizations contain highly educated, highly motivated and dynamic individuals with immense potential. The challenge is how to develop an organization that harnesses the knowledge and intellectual capital of the people within them. A well thought out knowledge management strategy may be the starting point to open the intellectual capital treasure chest.

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