

THE ROLE OF IT IN CAPTURING AND MANAGING KNOWLEDGE FOR ORGANISATIONAL LEARNING ON CONSTRUCTION PROJECTS

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ABSTRACT: Many construction companies, and their clients, are recognising that the way they manage knowledge and learn, across the supply chain, can greatly improve their performance and the efficiency of the construction process.

This paper describes work forming part of the research project: 'The Role of IT in Capturing and Managing Knowledge for Organisational Learning on Construction Projects' – known now under the acronym KLICON (Knowledge and Learning In CONstruction). It sets the scene for the detailed research project reviewing the current state of the use of Information Technology (IT) in knowledge management and organisational learning in the construction industry.

Knowledge is a broad area and this paper gives a brief overview of some of the key aspects of knowledge management (KM), including types of knowledge, KM strategy, and the use of IT in KM. The knowledge environment is complex and particularly difficult in construction. Construction is project based with a large number of often relatively small projects with constantly changing members of the supply chain. IT offers real opportunities for capturing knowledge and feeding it back into the project organisation. This is important if performance is really to improve. The aim of the research is to investigate how Information Technology can facilitate organisational learning and KM in the construction industry.

KEYWORDS: Knowledge Management (KM), Construction, Information Technology (IT), Organisational Learning.

INTRODUCTION

Although Knowledge Management (KM) may seem a very contemporary topic, it can be traced back to earliest civilisations. The current interest in the subject from a management perspective largely derives from the growth of data processing capabilities, the increasing recognition of the need to continuously improve (Total Quality Management), and the recognition of learning as a core strategic competency¹.

The late 1990s saw KM become increasingly important in the construction industry. The topic has occupied much space in the technical press. The KLICON project investigates where Information Technology (IT) can assist KM within the construction industry. IT is seen as having good potential, both because of the continually growing power of Computer and Information Technology, and because of the promise IT offers in addressing the problems caused by the temporary nature of construction projects and supply chain configurations.

Organisational learning is the ability of the organisation to collect and use information so that members exploit it to learn and to improve performance. Learning is something that pervades



every individual's life in one form or another. Organisations may be capable of learning and such organisational learning may in turn impact upon various aspects of an organisation's performance.

Knowledge Learning In CONstruction (KLICON)

The KLICON project aims to improve the understanding the role of KM and how it adds value in the built environment. This is being achieved by studying the participating industrial organisations to analyse how experience and best practice are currently being captured. KLICON is investigating how detailed IDEF0 models of construction activities and information models in EXPRESS can enhance understanding of generic construction knowledge and specific project knowledge. KLICON will also evaluate, on live projects, selected KM tools.

KLICON hopes to provide an understanding amongst construction practitioners of how knowledge is gained and learning can be formalised across the organisational interfaces within a project. The role and appropriateness of IT tools for knowledge capture and management will also be clarified.

There is very little agreement, in an organisational context, on what learning is; on how or why it occurs; how it can be cultivated or how it can be used for an organisation. Organisational learning has been described as the experience-based improvement in organisational task performance² and as the organisation's autonomous capacity to create, share and use strategic information about itself and its environment for decision making³. An organisation can be said to learn when it improves its actions through better knowledge and understanding⁴.

In KLICON, knowledge is being taken as the cognitive ability to generate insight based on information and data. Much of the current work in KM focuses on the collection, classification, storage, accessing and communication of information. Important though this is, many organisations are increasingly recognising that the way information is used in order to facilitate continuous improvement is often of more immediate relevance. This, broadly, is the area of organisational learning.

KNOWLEDGE MANAGEMENT

KM is an emerging practice. As yet there is no standard definition and no framework in which to align it with other disciplines. There are thus many different interpretations as to how to use its potential effectively.

KM involves all types and forms of data and information including external data and that internal to the organisation. These data and information may be operational, historical, in summary form, or news. They must be aligned with the organisation's business purposes and strategy. A central issue is how to interconnect relevant data and information in a way that relates to the enterprise's business processes and quality.

The value of knowledge⁵ depends on the context of the decisions or actions to which it leads. As we discuss knowledge, we have to approach it both as a 'thing' that we can manage and the process, through which the knowledge is captured, processed and disseminated. Knowledge can also be considered as the end of a chain that begins with data and passes through to become information, leading ultimately to insight (cognition). Knowledge can

appear in the form of formal documentation or experience. Textbooks, articles in journals, web-based material, and technical reports are all obvious and valued kinds of documentation.

In practice, the terminology used in KM literature is used with considerable variability. It is useful to define what we mean by data, information and knowledge and to indicate where their boundaries lie. This is important because many sources in the past have used these terms interchangeably. In KLICON we have adopted the following basic definitions.

Data

Data is un-interpreted material on which a decision is to be based. A fact is a thing known to be true or to exist.

Information

Information is data interpreted in a given context. Different information may be gleaned from a single data source if the context is different.

Knowledge

Knowledge is a body of information, coupled with the understanding and reasoning about why it is correct. Knowledge is the cognitive ability to generate insight based on information and data. Knowledge is typically gained through experience or study in some combination. For example, if we ask an expert for their opinion and we receive it, the opinion becomes information for us but remains knowledge for the expert. The difference is that the expert has used reasoning and other information and understands why it is true. We do not. The route of data-information-knowledge is bi-directional. Knowledge can be externalised into information, which can be broken down into data, and vice versa.

Types of Knowledge

The distinction between data, information and knowledge is not always obvious. This is partly due to the human habit of taking information, accepting it, and treating it as knowledge. While information is interpreted data, knowledge is more than information. Knowledge implies the ability to generate patterns and to extrapolate based on some form of cognitive framework. Figure 1 shows the two main types of knowledge: explicit knowledge and tacit knowledge⁶.

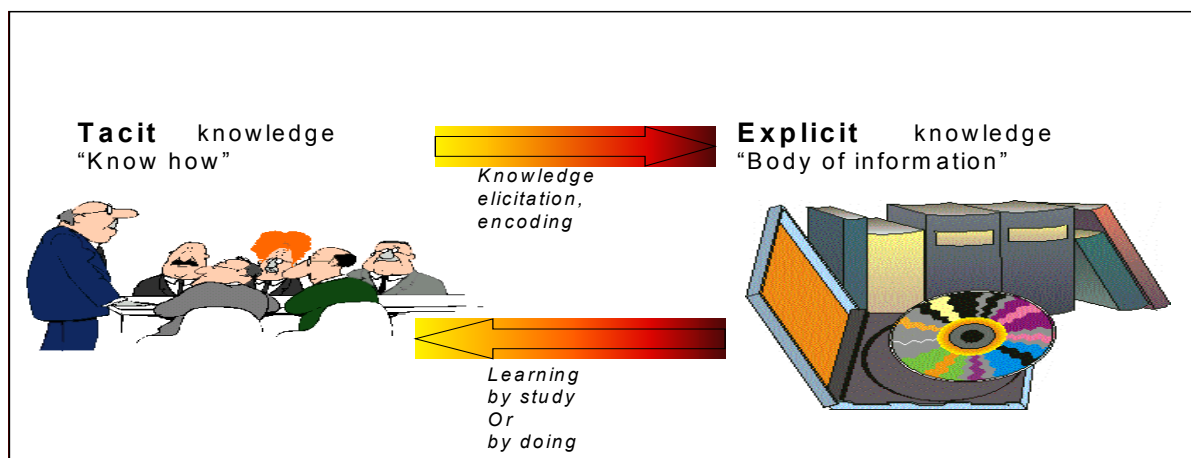


Figure 1: The two main types of knowledge

Explicit Knowledge

Explicit Knowledge is the most common type of knowledge. It is 'readily available' and can be codified and structured in a way that makes it easily transmissible. It is the kind of knowledge that is recorded and allows people to find it and use it. It can be found in a range of diverse sources, such as human resources data, meeting minutes and the Internet.

Tacit Knowledge

Tacit knowledge is hard to articulate with formal language. It is personal knowledge embedded in individual experience and involves intangible factors such as personal belief, perspectives, and values.

A distinction also has to be made between individual knowledge and organisational knowledge. The latter is quantitatively and qualitatively different from the former. Individual knowledge is ever changing. Organisational knowledge is also changing, but at a greater rate than that for each individual employee. Organisational knowledge is in a constant state of flux as individuals leave or join the organisation, and as knowledge bases change and grow.

Most organisations are at a level of learning that enables them to cope with managing information, but not necessarily to manage knowledge. Management of knowledge is a new and emerging area.

Knowledge Management Strategy

KM is a combination of mechanical and human disciplines. Applications that turn data into information and in turn into knowledge are an important component of KM strategies.

Organisations have started to come to terms with the importance of harnessing knowledge as a critical organisational asset. However, as an asset, knowledge has some highly individual characteristics. It can move across the globe in seconds. It is often largely invisible, being carried around inside people's heads. And in business terms, it is valuable only if it is used. People will only share it if they want to.

For an organisation to implement a KM strategy, it has to engender a knowledge culture. Sharing information and being part of a team are both important in creating a culture in which the organisation is able to learn. An important enabling component of this culture is the infrastructure to handle the knowledge. This will need to be embedded in the enterprise knowledge strategy⁷.

All organisations have to excel not just in managing but also creating, applying and exploiting knowledge to the full. To realise its value, they must combine distinctive, renewable sources of know-how with complementary skills and assets. Since knowledge can be an extremely valuable organisational asset, there should be a strategic framework within which it is generated/captured, represented/codified, transferred, and assimilated.

THE SCOPE OF KNOWLEDGE MANAGEMENT STRATEGY

Knowledge capture/generation is very difficult to measure and nurture, though organisations that fail to generate knowledge are prone to fail as a business⁶. As organisations interact with their environment they absorb information and turn it into knowledge, and take action based on it in combination with their experiences, values, and internal rules.

The generation of knowledge alone does not help businesses perform better. The knowledge generated needs to be shared. For the sharing process to be relevant, there has to be some form of representation. The aim of representation is to put knowledge into a form that makes it accessible to those who need it. As representation converts the knowledge into a code (not necessarily computer code) so the knowledge can be organised and made explicit, transferable and easy to understand.

The challenge in representation is that knowledge is not, and should not be, constrained by cultural or physical boundaries. Even with data or information, where there is a well-established representation scheme there is always data or information that does not fit neatly into any single slot.

Transferring, re-using or sharing knowledge is the primary aim of KM. As knowledge transfer is essentially an interface concern certain tools and techniques are frequently used to aid this process. Providing access to knowledge alone is not sufficient to ensure that knowledge will be used. Knowledge transfer involves two actions, transmission (sending or presenting knowledge to a recipient) and absorption by that recipient. If the knowledge is not absorbed, it has not been transferred. Even transmission and absorption have no useful value if the 'new' knowledge does not lead to new development or a new idea.

Knowledge transfer cannot take place at the speed of data or information interchange. There needs to be an on-going interface, or stimulation, since knowledge transfer is by nature bi-directional or multidirectional if more than two individuals are involved. Tools that enable on-going dialogue include organisational groupings such as meetings, or specific IT tools such as email or access to records of context sensitive interactions. Barriers to knowledge transfer exist, but this has its basis in culture as well as physical positioning. This type of barrier exists due to the individuals protecting their own position within the organisation. In our research, we have found that this can be especially true of the older workforce – an unfortunate fact, considering that they are the very people who often have the most to offer in terms of organisation-specific knowledge.

Before an organisation can establish a KM strategy it must determine what knowledge to share, why share it, how to share it, and with whom to share it. The fundamentals should flow from an organisation's knowledge strategy. An information strategy is business/quality driven and addresses tacit knowledge as well as explicit knowledge.

Sharing knowledge could be a simple matter of providing customers/colleagues with indexes and procedures that enable them to use the organisation's services/processes more effectively. Additionally, it could be functional (sales/marketing) or it could relate to a specific area of expertise. Comprehensive and organisation-wide knowledge sharing tends to emerge when an organisation recognises its knowledge assets to be business critical, and where knowledge is high and where it operates globally.

KM may primarily be focused either internally or externally to the business. Internal initiatives, such as directory of expertise and intranets, are intended to speed up, reduce the cost of, and add value and quality to business processes. External initiatives, such as helpdesks and websites, are clearly of benefit too; however, they do raise issues of confidentiality, copyright and the protection of private information and intellectual capital. Except in certain circumstances the benefits generally outweigh the risks.

To share knowledge requires partnerships. These can speed up the creation of useful content, enhance quality and build trust. As with most organisation initiatives, knowledge sharing requires senior-level management commitment. An incentive structure is also important. Knowledge sharing can be made a formal part of the organisations personnel evaluation systems. Alternatively, 'knowledge fairs' can be used (in which knowledge workers present their services to communities of practice) and awards given for knowledge sharing.

An organisation implementing KM requires the creation of 'new' roles for its employees working within the knowledge strategy (the knowledge workers who do the work of generating, representing, transferring and using knowledge). Employees in specific roles with dedicated responsibilities to perform these processes. Such persons cannot be solely responsible for KM. The organisation has to place responsibility on its entire staff to incorporate KM into their everyday tasks. The goal, for the organisation, is to encourage each employee to become a knowledge manager.

Knowledge experts are critical to an organisation and are involved in the work of KM. Many of these functions are technical, though pure technology is not enough. Knowledge integrators are increasingly being employed to extract, frame, input, refine, and structure an organisation's knowledge. Ideally, these knowledge experts will have technical expertise and have intuitive skills.

Many organisations are also employing a 'Chief Knowledge Officer'⁸, a role that involves the management of knowledge and the facilitation of organisational learning. This role is multi-faceted and must include effective communication skills and be an authoritative champion of knowledge and its associated management processes.

KNOWLEDGE MANAGEMENT & INFORMATION TECHNOLOGY (IT)

Much real knowledge is tacit but there is also a significant body of data, information and some knowledge that can be represented in electronic form. Organisation procedures, Quality Assurance procedures, product catalogues, work procedures, historic databases for example can all contribute to know-how and experience.

There is a temptation to use IT (e.g. Document Management Systems, Web Technology) to make the above accessible and to call this a KM system. Significant efficiency gains can be achieved but the danger is that inappropriate historic practices are perpetuated and effort is not concentrated the organisations' most value-adding areas.

Knowledge Management Tools

KM tools can be categorised into the four general areas. Tools in general are designed to make specific tasks easier to perform and to produce a better end product. KM tools should be considered as embracing both these ideals. KM tools are not a re-branding of either data or information management tools.

Knowledge Generation

The generation of knowledge may benefit from tools that aid and/or automate the task of obtaining, combining, and constructing knowledge. A popular way of obtaining knowledge in the year 2000 is the Internet. Refining the collection process can enhance knowledge generation features most directly, as opposed to simple data, information generation, and data mining. Intelligent agents can be set against user profiles to improve information generation for particular knowledge profiles. The user, or knowledge, profile should detail individual

user information requirements and levels of expertise within given specific areas. Filtering information documents in this manner moves the acquisition towards knowledge, as it will be based upon a predefined set level of individual knowledge and thus information is assimilated both automatically and usually subconsciously to broaden the individual knowledge base.

Knowledge Representation

If IT tools are to play a part in KM the knowledge needs to be represented electronically and much true knowledge is difficult to map to computer intelligence. However difficult representation/codification may be, it does need to be carried out. As knowledge is to a certain extent information that is context sensitive, then by removing the context and treating it in similar fashion to metadata (data about data), it may be possible to formulate solutions for managing two separate knowledge elements.

There are many types of modelling used to represent different types of knowledge⁹, including Information Modelling, Construction Information Models, Process Models, Product Models, Objects and Integration Networks.

Knowledge Retrieval

Once generated and stored in suitable forms, knowledge needs to be retrieved. There are increasingly robust search and retrieval facilities, within web search engines and even in word processing tools. Tools exist to summarise documents, search all office documents, emails, web sites, etc. for Boolean strings of text, file types, creation state and other metadata. The tools include intelligent agents that can learn and act autonomously on recommendations for other users.

Knowledge Sharing

Good intranet systems can facilitate sharing of documents. If the document has metadata, some semantic "understanding" can begin to suggest which documents are relevant to the user (alert the user to a new document relevant on the related topic).

Knowledge Management and IT

We have already identified data as a starting point of the KM Strategy. To this we can add applications such as email, GroupWare, and document control products. Each of these applications can move and share information in and out of an organisation. Many organisations will then introduce decision support system that will facilitate the trends and operational patterns that are critical for the success of the organisation. (Typically, this sort of application is reserved for a dedicated knowledge expert.)

Web based technology allows direct access to information (knowledge) by individuals throughout the organisation structure. The web provides the means to deploy an organisation intelligence system quickly and easily. This knowledge sharing is/can be used internally and externally within an organisation.

Many of the mainstream applications (such as Microsoft Outlook, Lotus Notes etc.) have been recognised as very useful tools. Much can be done with existing common & low-cost systems e.g. Windows + Office + Outlook, AltaVista Discovery for full text search of all documents and e-mails, Browser for QS procedures, checklists, training.

The KLICON project has produced a first draft (Table 1) of non-mainstream examples of commercially available software, which could contribute to the KM of an organisation. The organisations' KM strategy brings forward knowledge of information from the mass data.

Type of IT Tool	Examples of Commercial Software					
Knowledge-Based Systems	ART*Enterprise; Eclipse; ICIAS; Elements Expert;	Clips 6.0; Comdale Suite; ALICE; XperRule	Flex; G2; M.4;	KnowMan; Netica; Vidwan	CommonKADS; ILOG Rules 4.0; Fault Expert	Rete++; EXSYS 5.0; LPA;
Cased-Based Reasoning	ART*Enterprise	Case Advisor 3.1	ICIAS			
Object-Oriented Databases	Object Design (Objectstore) Gemstone	Objectivity/DB O2 Technology	Versant Mjølner	Ontos Poet Software	DOORS	
Neural Networks	Process Insights; Neurogon; NN Utility/2; Attrasoft Predictor;	NeuroShell; NeuroSolutions; NeuroLab; Neural Bench;	NeuroWindows; Domain Solutions; Matlab NN toolbox; NeuroLution;	Nestor; Atree 3.0 ALN; ABM; BioNet Simulator;		
Fuzzy Logic	FLINT; EVO; FLDE; LFLC;	DataEngine; Fuzzy Expert; FUZZLE; Neuframe	Fuzzy Control Manager; WINROSA; Matlab fuzzy logic toolbox; Genetica/NeuroForecaster;	NeuroModel; Partek;		
Risk Management	@risk	Crystal Ball	RISKMAN	Risk Pro	Risk Patrol	
Knowledge Management & Search Engines	LiveLink KnowledgeX	Autonomy PC Pack	grapeVine Sovereign Hill	Excalibur Meta Pack	Internet Knowledge Manager Wincite	Muscat Empower
Knowledge Discovery/ Data Mining	Data Mining Workstation (DMW)	CASSIOPEE	CRAYON	FARCAST		
Data Warehouses	Influence Knowledge Warehouse (IKW)	Prism Data Warehouse	Ardent Data Mart			
Genetic Algorithms	Evolver	OOGA	XperRule	GenAsys		
Group Decision Support Systems (GDSS)	GroupSystems SAMM BrainWeb	Negotiator Pro NSS InterAction	VisionQuest Lotus Domino/Notes MEDIATOR	GENIE TCBWorks		
On-Line Analytical Processing (OLAP)	BrioQuery Commander DecisionWeb InfoBeaconWeb	Pilot Internet Publisher DataFountain Oracle Express Server	Business Objects DSS Web	WebOLAP Focus Fusion		

Table 1: Examples of commercially available software which could contribute to KM

KNOWLEDGE MANAGEMENT IN CONSTRUCTION

Knowledge has been recognised as very important in Construction for a very long time. Knowledge of engineering and architecture has long been recognised as a major feature of the industry. Knowledge of construction practices and processes is widely recognised as a core constructor's competence. Commercial know-how permeates the contracting side of the industry.

Construction knowledge is thus both explicit (engineering principles etc.), and tacit (in one's knowledge of organisations, or location). But knowledge is by no means always easily captured or effectively shared amongst industry players. It is generally recognised that there is much "knowledge wastage" and often-considerable difficulty in accessing important information. There are four basic reasons for this.

1. The industry is large and complex, with a high proportion of companies being small. (The construction industry in the UK consists of about 200,000 companies. The top 95 companies of the industry are about 0.05% of the total yet they generate 21% of the industry output. Small firms account for 93% of all firms yet they only generate 28% of the output.)¹⁰.
2. The many different players in the industry typically do not share a common educational base. As a result, cognitive frameworks are not always easily shared.
3. Historically the contractual forms which underpin the way firms and resources are selected, and indeed the whole strategy of contracting (late entrant of the constructor; tendency to select the cheapest bidder rather than necessarily the best, etc.), have encouraged adversarial relationships to grow too easily. These have exacerbated the differences in thinking between firms and have often inhibited the effective exchange of information.
4. The project nature of the industry – with a frequently reconfigured set of supply chain partners, non-repetitive nature of work, pressure to complete, and lack of incentive to appraise performance or pass learning on to others, or to improve overall project delivery – means that information is too often not collected.

What the industry historically has found difficulty with – and has not been good at – has been learning on a consistent basis and improving performance.

Learning has of course definitely occurred. There have been many changes in construction practice in many areas over the last few decades. Safety practices have tightened and performance has improved substantially. Site construction and design practices have changed considerably, directly driven by the desire to reduce costs, and improve productivity and technical performance. Generally, however these four factors have meant that the industry as a whole has not been able to realise the kind of continuous improvement figures seen elsewhere in manufacturing. KM and Organisational Learning are recognised by the larger firms as potentially important but at a formal level little has yet been attempted in this area.

Recent UK Performance Driven Initiatives

The two most important UK government reports in the construction industry have been the Latham¹¹ and Egan¹² Reports. The 1990s saw sustained initiatives to improve the performance of the construction industry. Both the Latham and Egan initiatives preached the

benefits of adopting modern manufacturing management practices – Latham by largely concentrating on reducing the adversarial nature of the industry as it then was, Egan largely by preaching the benefits of greater standardisation. The combined impact of the enormous and sustained energy that these initiatives unleashed have undoubtedly created much change for the better. One dimension of this has been a new awareness of the importance of KM and Organisational Learning.

The increased move towards greater alignment amongst supply chain members and the progressive, if slow, penetration of IT has contributed considerably towards creating a more receptive environment for KM and Organisational Learning. The move away from adversarial contracting has had a major impact on the industry and the willingness of its members to work positively together. Without such a changed culture, effective organisational learning across the whole supply chain would be extremely difficult. Partnering is especially important as a means of improving organisational learning. The increasing move towards Design-Build is another example of a procurement route that is encouraging the greater pooling of information and knowledge. These contractual and cultural changes in the industry, have had a wider impact in the industry. There is now a much greater willingness to embrace new ideas such as organisational learning. Changing an industry like construction will not be a quick event. It would be a mistake to underestimate the importance of cultural factors in the adoption of KM and Organisational Learning.

Information Technology

Efforts have been being made to promote the wider and more effective use of IT in Construction for years. Much has been achieved, though much also has not. In general the industry lags behind many in manufacturing. Culture and the project nature within the industry; and the low level of capitalisation and frequent lack of perceived business benefit have held back the widespread adoption of IT tools.

KM has been recognised as something that the IT systems should be supporting in the industry. The 1995 report ‘Construct IT – Bridging the Gap’¹³ stated that ‘an industry-wide online knowledge base should be set up to allow systematic capture and distribution of information around the industry’ and a subsequent set of reports reviewed the practical implementation of this and other recommendations. This was intended to cover inter-company generic information, but clearly such a resource would be expected to be useful in capturing specific information for use within a company on its own Intranet/Document Management system.

In 1997 a research project: Construction Industry Online Knowledge Base was conducted by several UK major contractors (Alfred McAlpine, AMEC, Balfour Beatty, Bovis, Costain, Kvaerner, Laing, Mowlem, Tarmac, Taywood), CICA and BRE to explore these issues. This addressed on-line information requirements (generic rather than project-related) and examined the procedures that contractors currently use. The main types of information were those relating to, products, product-related software, codes, standards and regulations, safety and health, design guidance, on-line databases, technical papers and databases, supplier/vendor registration forms and pricing information. A road map of information flows and media used was produced. Only 10% of existing flows were electronic at that time¹⁴.

Recommendations and conclusions included:

- KB solutions are needed to ensure results obtained from online searches are appropriate, correct and derived from a suitable source.

- One cannot rely upon large numbers of Internet connections being available in a construction context – some companies have a very deliberate policy of restricting Web access to their staff. (This is to be expected to become less of a problem with time)
- Issues of standardisation, structuring, legal access, copyright and liability are important.

Several of the contractors produced scenarios of typical information flows for different users and different types of information¹⁵.

IT offers considerable promise of facilitating KM and Organisational Learning in construction. Databases allow huge quantities of data and information to be captured and made available. Telecommunications are allowing substantial increases in information exchange and knowledge sharing. The increased awareness of business processes, and the importance of the way IT can interact with process reengineering, is providing further insight into ways that IT can contribute to performance improvement. The greater use of Multimedia together with Distance or Flexible Learning, delivered via CD ROM or internet based technology, is linking with this to add powerfully to the way organisations are creating technology based learning programmes. Bovis for example has created a CD/intranet based training programme that leads to “points” and can ultimately build to the award of a Masters degree. Kvaerner Construction¹⁵ has a number of Computer Based Training (CBT) and Web Based Training (WBT) programmes.

CONCLUSION

We have reviewed the current state of play in research in KM and Organisational Learning in general and in construction. As stated, the subjects of "knowledge" and "IT" are developing rapidly and many academics and industrialists are currently working in many of the subjects discussed.

We have seen that explicit knowledge is the most common type of knowledge. It is 'readily available' and can be codified and structured in a way that makes it easily transmissible, while, tacit knowledge is hard to articulate with formal language. It is personal knowledge embedded in individual experience and involves intangible factors such as personal belief, perspectives, and values. In addition, we have seen that there are various ways that knowledge can be generated, represented, and transferred. The importance of sharing knowledge and the creation and implementation of a knowledge environment and using knowledge workers by an organisation has been emphasised as an important part of any effective KM strategy.

KM draws from existing resources that an organisation already has in place, e.g. a good information systems management, organisational change management, and human resources management practices. Many organisations need to expand or improve existing practices, such as a good library, a textual database system, or even effective education programmes, to install an effective to KM strategy. The organisation needs to recognise that an effective KM strategy needs work along multiple fronts i.e. technology, organisation, and culture. We have explored the importance of KM within the construction industry. As the IT tools develop and the construction industry moves towards developing KM, as is the trend now, we believe the industry will see an increase in efficiency, quality, and the use of organisational knowledge. There is a need to find ways to re-use good practice (design solutions, standard details, how to avoid common problems and thus prevent defects etc). In order for this to happen it is essential that we find ways whereby construction practitioners with knowledge of the most important problems facing them can formulate these problems in such a way that IT

professionals can find appropriate techniques and create tools. Cultural and technical developments coupled with construction management's understanding of KM makes organisational learning in construction an achievable goal.

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