

Knowledge Management for Sustainable Construction Competitiveness Final Report July 2004

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INTRODUCTION

This is the final report of a two-year comprehensive study, undertaken between July 2002 and July 2004, entitled 'Knowledge Management for Sustainable Construction Competitiveness'. The project was funded by the Department of Trade and Industry (DTI) as part of the Partners in Innovation Programme (PII).

The primary aims of the study were to investigate the challenges associated with the management of knowledge resources and capabilities for construction. Also, to establish how effective the strategies for managing these resources and capabilities are at contributing to project success and sustained organisational competitiveness.

The targeted objectives for addressing the above aims were:

1. To identify the specific features of knowledge production in the construction industry, i.e. identifying the key types of knowledge resources and capabilities relevant to the sector (e.g. theoretical, construction, engineering and design knowledge, plus experiential knowledge, etc.), the triggers of knowledge production and the challenges associated with producing 'new' knowledge.
2. To investigate and document the main challenges (including economic, social, technological, environmental) associated with the implementation, exploitation and embedding of knowledge management practices within construction organisations of varying sizes and specialisms.
3. To examine and document the different approaches (including processes and technologies) used for knowledge production, absorption (across boundaries), capture and retrieval, transfer, sharing, exploitation and for measuring and comparing knowledge management performance; together with their relative effectiveness as knowledge management tools. In addition, investigate and document the vagaries of factors that lead to successful knowledge management practices in different sizes of organisations and in organisations that are at different levels of knowledge management implementation.

4. To explore knowledge management practices in other sectors (e.g. manufacturing, finance, IT, retail) with the view of documenting good and best practices for the benefit of the construction industry.
5. To examine the backgrounds and on-going training and skills of knowledge management specialists; map out their career paths; and examine and document the impact of this new role on the future of the construction industry.
6. Produce a study report, which could be used as a policy document and would influence the direction of both government and those concerned with improving the industry's performance.
7. Produce training material on knowledge management and disseminate the outputs of the study on knowledge management widely in the industry.

The outputs of the study include reports for construction organisations and policy makers, fact sheets, training materials for workshops, seminars and CPD purposes; journal and conference articles. The dedicated web-site for detailed information on the study and for disseminating some of the study outputs is: <http://www.knowledgemanagement.uk.net>

WORK PACKAGE SUMMARIES

Each work package undertaken during the two year span of this project has been outlined below including the key results and outcomes derived from these individual pieces of work. Each of the full work package reports is available and they have been put on the CD ROM appended to this report.

WP1 Knowledge production, resources and capabilities

WP1 was undertaken to determine the specific features of knowledge production in the construction industry. In undertaking this work, the project team set out to identify the key types of knowledge resources and capabilities relevant to the sector (e.g. theoretical, construction, engineering and design knowledge, plus experiential knowledge, etc.); the triggers of knowledge production; and the challenges associated with producing 'new' knowledge. A copy of the full WP1 report can be found on the CD ROM associated with this document.

Knowledge production in the construction industry

Knowledge production is a sub-process of the knowledge management process. (The knowledge management process also involves knowledge sharing across boundaries, capture/storage, synthesis and application.) The objectives of WP1 were to:

- Examine and identify the specific characteristics of knowledge production in the construction industry; and
- Document the key types of knowledge resources and capabilities relevant to the sector.

It has been established that the main triggers of knowledge production are:

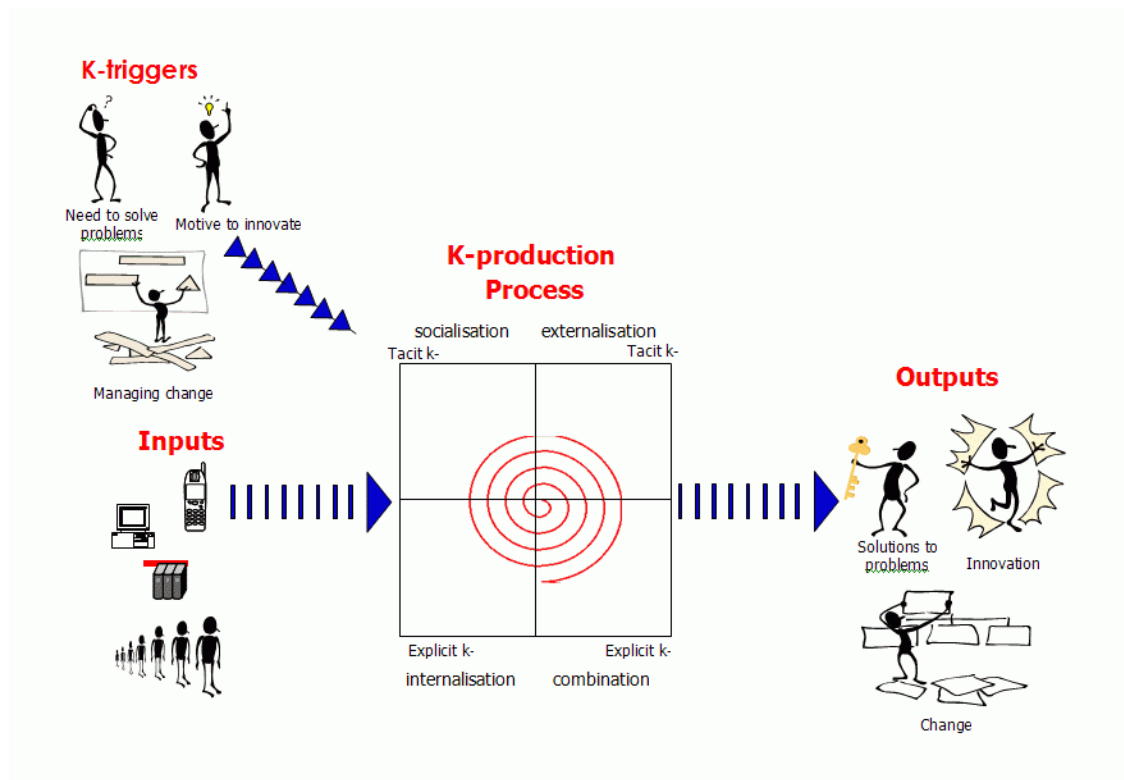
- Problem solving;
- Innovation; and
- Managing change.

The main sources upon which individuals draw to produce new knowledge are:

- Other individuals;
- The project team/supply chain;
- Organisational routines;
- Repositories;
- Communities of practice; and
- Knowledge gate-keepers.

Dimensions of a knowledge production environment

Knowledge production is a complex process. It can occur through a number of ways:



Organisational capabilities play a vital role in this regard. Construction organisations primarily produce knowledge through transforming existing knowledge and reflective practice.

WP2 A systematic analysis of knowledge practice in other sectors

WP2 represents an analysis of knowledge processes in construction and other chosen sectors and is based on original research conducted in 2003. The full report can be found on the CD ROM associated with this document.

The report acknowledges that the transfer of lessons learned between sectors requires an awareness of differences between these contexts. In this instance construction is compared with software & computing services, manufacturing and agriculture.

The approach adopted emphasises the value of addressing the complexity of knowledge, while acknowledging the challenges this poses. There is an emphasis on process and capability, as well as resources and assets.

The research assumes that key knowledge processes occur informally (as well as formally) under a knowledge management banner. This assumption was supported by the findings. The companies studied were chosen specifically to provide a cross section of organisational size and types in each sector. Informal knowledge processes were found in all sectors. Formal knowledge management had been introduced in all sectors with the notable exception of agriculture.

The sources of knowledge and information drawn upon in solving specific problems and generating ideas varied between sectors. Software developers search the internet widely, whilst manufacturing organisations rely on internal expertise and farmers on external networks. Construction organisations favour internal knowledge sources or knowledge sources within their supply chain. Indeed knowledge acquisition through experience was particularly emphasised in construction.

For more general knowledge acquisition, the farmers, manufacturing organisations and IT companies used extensive external knowledge networks. The manufacturing organisations particularly tended to use wide external knowledge networks for strategic objectives, such as moving into new markets.

The larger organisations had invested considerable resources in formal knowledge management projects. Knowledge management systems common to large organisations across the sectors focus on communication and knowledge sharing, and systems that facilitate expertise location with the aim of knowledge re-use. A list of factors that were critical to the success of formal knowledge management initiatives can be found in the full work package report associated with this document.

WP3 Techniques and technologies for knowledge management

The WP3 report on 'Techniques and Technologies for Knowledge Management' addresses the third project objective by documenting the different techniques and technologies currently used in the development of knowledge management strategies. The full report can be found on the CD ROM associated with this document.

The key objectives of WP3 were to:

- Identify and document the different types of techniques and technologies for knowledge management used by organisations;
- Identify existing methods for selecting techniques and technologies for knowledge management; and
- Examine and document the strengths and successes of these technologies and techniques.

This piece of work examines the tools used for knowledge management. These tools can be IT-based or non-IT-based. A review of the non-IT tools (knowledge management techniques) and IT tools (knowledge management technologies) can be found in full on the CD ROM associated with this publication, examples are given below:

| Knowledge Management Tools | |
|----------------------------|----------------------|
| <i>Techniques</i> | <i>Technologies</i> |
| Brainstorming | Data and text mining |
| Communities of practice | Groupware |
| Face to face interactions | Intranets |
| Knowledge gatekeepers | Extranets |
| Recruitment | Knowledge bases |
| Training | Taxonomy/ontology |

The full report also presents the approaches currently used for selecting the most appropriate tools for an organisation and also identifies the limitations in the existing approaches. It further offers guidelines for the better selection of knowledge management tools.

The following are the main recommendations and conclusions of WP3:

- The term 'tools' for knowledge management is used very loosely in industrial settings, with very few practitioners providing a definition for this. Too often knowledge management 'tools' is used to mean only IT tools. There is a need for a better understanding of the IT and non-IT tools, their differences and characteristics.
- A host of technologies (IT-based) and techniques (non-IT based) exist for knowledge management in organisations. In the main, the selection of appropriate technologies appears to follow a more structured approach than the selection of techniques for knowledge management.
- In industrial settings, there are two main approaches for selecting appropriate knowledge management technologies. The first approach is based on knowledge management 'sub-processes'. The second approach is based on 'technology families'. The former appears more popular as it allows the 'users' to identify sub-processes that they need to manage and then select the most appropriate technologies geared for the need of the identified sub-processes.
- In construction organisations, the potential benefits of technologies and techniques for KM are not fully understood. There is the need for a better understanding of the benefits of technologies for knowledge management among construction practitioners.
- There is a need for some guidance in the approaches employed by organisations for selecting appropriate technologies and techniques for knowledge management.
- The construction industry will benefit from the documentation of the efficacy of different technologies and techniques for knowledge management in given contexts, together with a framework for evaluating the performance of knowledge management technologies and techniques.

WP4 Knowledge management specialists

WP4 addresses the fifth project objective by examining the backgrounds, skills, and on-going training of knowledge management specialists. The key objectives of WP4 were to:

- Map out the career paths of knowledge management specialists; and
- Examine and document the impact of this new role on the future of the construction industry.

Twenty knowledge management specialists were interviewed from a cross section of the construction industry and the results of these interviews are summarised within this report.

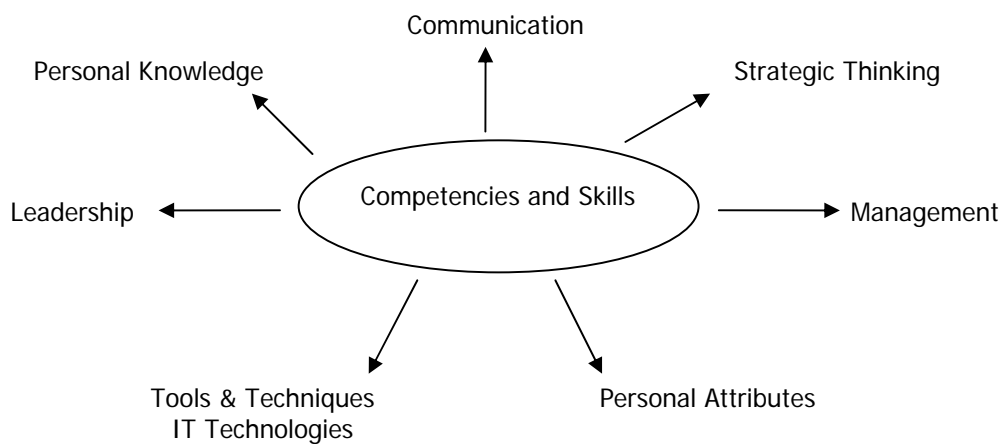
The full report, which can be found on the CD ROM associated with this document, provides an outline of the questions asked during the one-to-one interviews, and the reasons for covering them. The report then presents the results of these interviews, providing a summary where appropriate, of the types of individual taking on responsibility for knowledge management within organisations, their training and background, and then addresses development of the role of knowledge management specialist and perceptions on how this may change over the next five years. The following are the main conclusions of this report:

It was established that most knowledge management specialists operating within the UK construction industry are:

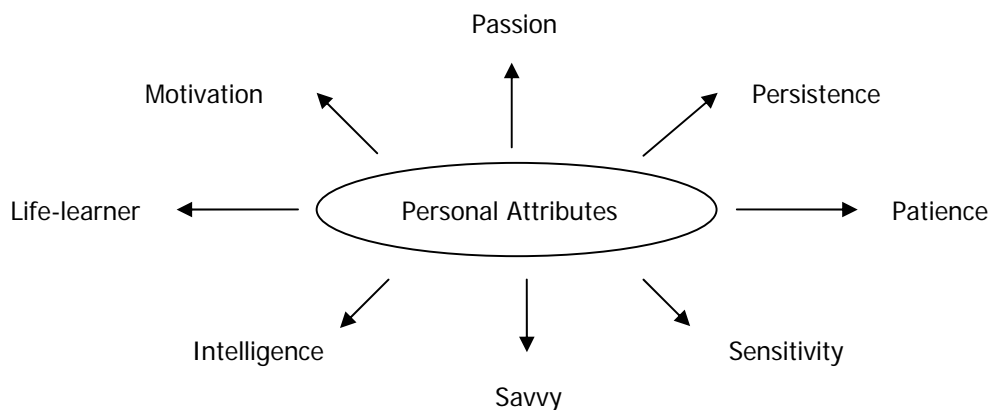
- First generation knowledge management specialists;
- In senior management positions where their appointment was made by the CEO;
- Established construction professionals with seniority and respect help to get the job done;
- Have a working knowledge of the organisation in which they are employed (its structure and practices), established over a decade or more; and
- Motivated by challenge not formal push-factors.

It was determined that the key competences and skills required to be a successful knowledge management specialist include: good quality communication; strategic thinking; management; leadership; personal knowledge; personal attributes; appropriate tools and techniques; and IT literacy.

**Key competences and skills picked out by
knowledge management specialists interviewed**



**The main personal attributes picked out by
knowledge management specialists interviewed**



Despite seniority and board level support, knowledge management specialists report that it is difficult for the 'trickle-down effect' to take place and colleagues to buy-in to some knowledge management initiatives. They also faced other challenges. The most significant of these were:

- Time and cost constraints;
- Organisational culture; and
- Failure to provide a tangible demonstration of the value of knowledge management during the early days/months.

Perceived factors shaping the future role of the knowledge management specialists within the construction industry in the UK fall into two categories, namely:

- Communication and culture: the need for improved dialogue and communication within and between organisations to support collaborative working; and
- E-commerce and IT developments.

These knowledge management specialists are starting to have an impact on the way organisations go about their business. As such it is agreed that knowledge management is part of the culture change taking place within the industry, and that this will not be an overnight success, but take time. Introduction to knowledge management within the university and college syllabus will help speed up the process.

Recent encouragements (the UK government's prerequisite to achieve industry-wide improvements and the desire of individual organisations to seek competitive advantage) will support and go some way to making the case for knowledge management.

Changing people's behaviour is cited as the biggest impediment to knowledge transfer within organisations. Ironically, it is only after the technology exists that many organisations realise how vital the people factors are.

WP5 Training materials and toolkit

The aim of WP5 was to produce training materials drawing on the findings of WP1-4. The project team responded to guidance from the project Steering Committee and after exploring several avenues focused WP5 development on the knowledge issues related to *learning between projects* within the construction industry.

The need for training material that addressed learning between projects was apparent in the findings from WP2 which suggest that construction practitioners are concerned about duplicated effort, repeated mistakes and lost opportunities for sharing lessons learned. Some organisations reported failed attempts at 'capturing' knowledge in databases or through post project reviews. Others, particularly representatives from small organisations, were concerned about losing the knowledge embodied within key people in the business; improving peoples' learning between projects may provide a more holistic solution to sharing knowledge across the business.

The WP5 training package seeks to meet the following learning objectives. After using the training material, the user should be able to:

- Have a better understanding of the potential benefits of learning between projects;
- Describe a range of processes that may improve learning between projects; and
- Identify potential barriers and challenges that may inhibit this learning between projects.

The training material was designed to be a stand-alone tool, requiring no facilitation or additional supporting material. It can be delivered on either CD-ROM or via the website: <http://www.knowledgemanagement.uk.net>

The WP5 deliverable is a functioning prototype that provides proof of concept.

The design of the training material comprises six sections:

1. The first introduces the topic and attempts to cast the issue of learning between projects in the terms of the experiences of the construction practitioner;
2. The second asks simple questions that encourage the user to think, and write down, both (a) ways in which knowledge is transferred between projects, and (b) different types of knowledge. Further information is available via hyperlinks, in increasing levels of detail, if the user demands it;
3. The third section uses the case study method to highlight the barriers to learning between projects, and in so doing, explores which methods of learning between projects are suited to which business contexts;
4. The fourth uses a decision tree to enable the user to explore ways in which mentoring might be successfully and realistically used to facilitate learning;
5. The fifth offers the user three self assessment activities that enable them to reflect upon how far they have got towards reaching the learning objectives; and
6. Finally, there is a concluding section that will provide additional information, such as the other project outputs and will direct the interested user to further sources of information.

The aim was to deliver a training experience that provides variety and stimulates interest in the user, rather than producing a comprehensive 'text' on learning in construction businesses.

CONCLUSIONS

Knowledge management production, tools and techniques

The construction industry is a knowledge based industry and the production of knowledge is vital for organisations and their project teams.

A variety of factors or triggers provide impetus for knowledge production in the construction industry. The main triggers of knowledge production are the need to address and solve problems; managing change; and managing innovation.

There are different sources that individuals and organisations draw upon for knowledge production. These can be internal or external to the organisation. The main sources are:

- Other individuals;
- The project team/supply chain;
- Organisational routines;
- Repositories;
- Communities of practice; and
- Knowledge gate-keepers.

In construction organisations, the potential benefits of technologies for knowledge management are not fully understood. There is a need for a better understanding of the benefits of technologies for knowledge management among construction practitioners.

In addition most organisations do not have a structured approach for the selection of knowledge management technologies and techniques. It is mainly a reactive approach in response to business needs. In some companies specially appointed members of staff review different knowledge management technologies and select the ones that best meet their business needs (knowledge management specialists).

The high cost of specialist IT tools has been the main deterrent for their adoption; however company intranets are a widely used technology for most of the knowledge management sub-processes.

Knowledge Management Success Factors

The success of knowledge management can be attributed to the nature of the tools and techniques being used to develop knowledge management initiatives. These have also added value to individual projects and include:

- Simplicity of initiatives introduced;
- Users interface with a human not an IT system;
- Regular evaluations (both quantitative and qualitative);
- Effectiveness of the knowledge management champion or specialist;
- Successful internal marketing; and
- Incentives or rewards for knowledge sharing and re-use.

A checklist was produced based on the findings of this part of the work and can be found in the complete WP3 report which provides a diagnostic tool that organisations may use to assess their own knowledge processes and initiatives against these findings.

Knowledge Management Specialists

Most knowledge management specialists operating within the UK construction industry were found to have similar competencies, skills and attributes. These were as follows:

- First generation knowledge management specialists;
- In senior management positions where their appointment was made by the CEO;
- Established construction professionals with seniority and respect help to get the job done;
- Have a working knowledge of the organisation in which they are employed (its structure and practices), established over a decade or more; and
- Motivated by challenge not formal push-factors.

Good quality communication; strategic thinking; management; leadership; personal knowledge; personal attributes; tools & techniques; and IT literacy make for a successful knowledge management specialist.

RECOMMENDATIONS

Structure and formality

Organisations produce knowledge at different rates to meet organisational needs. There is some evidence that a more concerted and formal approach, in places, may improve organisational knowledge management. For example, more formal meetings, brainstorming exercises, and better reflective and focused group sessions could be useful.

Training

With the organisational capabilities playing a vital role in knowledge management, organisations have an important role to play in improving the skills and competencies of their work-force. Appropriate and focused training programmes (e.g. CPD events, other short courses, in-house programmes such as mentoring, coaching, job rotation) are important.

Business improvement

With problem solving, innovation and managing change being the main triggers of knowledge management, organisations should focus more on these issues and consider appropriate strategies for dealing with them. Organisations need to exploit a variety of sources and the identification of appropriate sources is not only important but vital.

People factors

Individuals are important sources of tacit knowledge and therefore organisations need to put in place incentives with which to encourage employees to share knowledge, thereby contributing to the wider knowledge management strategy of the organisation. An environment which supports 'trust building', promotes collaborative forms of working, reduces confrontational practices, and embraces change; favours knowledge management. Organisations and individuals should strive towards creating that sort of an environment.

CHALLENGES

Buy –in

Despite seniority and board level support, knowledge management specialists report that it is difficult for the 'trickle-down effect' to take place and colleagues to buy-in to some knowledge management initiatives.

This is an important issue and there appear to be mixed messages. CEOs believe enough in the value of knowledge management to take an active role and interest in deploying knowledge management specialists, but frequently do not see tangible returns that justify significant cash investment. It appears that although those in charge understand that knowledge is highly people-based, they focus on funding technology.

The main challenges remain much the same:

- Changing people's behaviour; and
- Finding ways to measure the value and performance of knowledge assets.

This may change as word gets out and those in charge attend meetings such as 'Doing the Knowledge' where other organisations show the benefits of initiating, supporting and implementing sometimes costly (initial outlay) knowledge management initiatives.

IT and training

Determining what knowledge should be managed has become less of a concern. Attempts seem to be in place to manage any and all knowledge, with the assistance of IT.

IT literacy is a big hurdle. For example construction contractors will be forced to be IT literate or they will not be able to tender for jobs in the not too distant future. As a result, resources are allocated to IT initiatives, which it is found still drive knowledge management within UK construction, in order to out bid competitors and win work.

Staff training materials should include an overview of computer packages available e.g. groupware and decision support tools.

However awareness not training appears to be the key. A greater understanding of how the business works, coupled with an understanding of how knowledge (both IT and people based) can be used and manipulated is required in order to gain competitive advantage. Interestingly some forward-thinking organisations have started using knowledge to their advantage by packaging it and turning it into goods and services for other organisations to buy. It will be interesting to see whether this innovative use of organisations' intellectual assets expands.

Finance

Calculating the impact of these changes also remains a problem. Many of the knowledge management specialists interviewed cite long-term organisation-wide goals as methods of measurement. Knowledge management specialists are unlikely to get the resources they need until they can persuasively demonstrate the return in investment; it is believed this day is coming. The survival of the knowledge management specialist within UK construction may depend on making that economic case, assisted by organisations exhibiting competitive advantage through such investment.

In event the most talented and dedicated knowledge management specialist is unlikely to make much headway in a large organisation without resources at his/her disposal. However, convincing others of the value of sharing knowledge probably depends more on powers of persuasion than on big budgets.

Culture change

Results of this research suggest that people within the organisations studied have frequently shown a reluctance to change their ways of working, not embracing knowledge management and the culture change required to facilitate its full effect. Employees are still reluctant to use these new products to share what they know with each other, with their colleagues or even to obtain new knowledge themselves that they can profitably apply to their work (despite financial incentives).

Effectively changing people's behaviour and calculating the economic benefits of knowledge work are important unfinished business for the knowledge management specialist.