

Knowledge Management: Case Studies in SMEs and Evaluation of an Integrated Approach

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Abstract. To date, very few publications have been found that describe how small and medium enterprises (SMEs) are adopting knowledge management (KM). The same is true concerning attempts to develop a framework to help them implement it. To redress this, this paper presents the results of four case studies conducted in UK SMEs to examine their KM implementation effort. In addition, a new integrated framework developed by the authors was evaluated to determine its applicability in this business sector. The methodology employed to conduct the studies is described and each of the cases is then presented. The results are analysed and key lessons or findings gathered from the companies are highlighted. Comments received from the companies with respect to the integrated framework were positive and favourable. It is hoped that the information accrued from the case studies, together with the integrated framework, will help to pave the way for SMEs to accomplish KM.

Keywords: Knowledge management (KM); integrated approach; integrated framework; case studies; small and medium enterprises (SMEs).

1. Introduction

Knowledge is recognised as an important resource for sustaining competitive advantage, and so the field of knowledge management (KM) has received considerable interest from both academia and industry. It has now become a mainstream business function in many large organisations; Chief Knowledge Officer (CKO) positions are being established and most of these organisations have some sort of KM initiatives in place, including those in the consulting, professional services, automobile, pharmaceutical and oil industries (Davenport and Volpel, 2001). Large companies have been the forerunners in KM adoption and there are numerous descriptions of their experiences and practices in the literature (e.g., Petrash, 1996; Brand, 1998; Martiny, 1998; O'Dell *et al.*, 1999; Sharp, 2003;). In contrast, SMEs have trailed behind them and been slow to implement KM (Wong and Aspinwall, 2004a).

Research investigating the implementation of KM in the SME sector is scarce and it is rare to find case studies devoted to this aspect. In addition, various frameworks have been reported in the literature to help organisations embrace KM (e.g., Wiig *et al.*, 1997; APQC, 1999; Gore and Gore, 1999; Holsapple and Joshi, 2002; Jarrar, 2002) but a specific one designed and tailored to meet the needs and characteristics of SMEs was found to be lacking (Wong and Aspinwall, 2004b). A study of the issues relating to KM implementation in SMEs, as well as a review of the existing frameworks, can be found in Wong and Aspinwall (2004a, b), respectively.

This research has attempted to redress the imbalance in the literature by investigating how some UK SMEs have implemented or are applying KM principles, and by evaluating a proposed integrated framework for its applicability and suitability in this business sector. The methodology used to carry out the case studies is described in the initial part of the paper. Each of the cases will then be presented individually, detailing the company background, the key elements of KM implementation and their adoption approach. This section forms a major part of the paper because it provides valuable background information and the context under which KM has been implemented. Following this, the paper presents the initial evaluation results of an integrated framework, which was assessed by the case companies. Finally, the overall findings gathered and the insights gained from the research will be discussed.

2. General Background

A number of researchers have specifically used the case study technique to examine and explore KM in practice. For example, Pan and Scarbrough (1998) used this method to study the knowledge-sharing implementation process at the Buckman Laboratories from a socio-technical perspective. Rubenstein-Montano *et al.* (2001)

conducted a case study in the U.S. Social Security Administration, firstly to determine the employees' receptivity to KM, and secondly to evaluate the critical knowledge necessary for success. Likewise, this method was employed by Liebowitz (2003) to identify and describe a KM implementation plan at a U.S. technical government organisation, which would be useful to other companies when considering how to develop it. Davenport (1997) presented ten principles of KM and reported the results of four major case studies conducted in Hewlett Packard, Ernst and Young, Teltech and Microsoft. His effort had certainly helped to broaden the understanding of the KM field. Other examples include the one by Forcadell and Guadamillas (2002), Skok (2003), Storey and Barnett (2000) and Robertson and Hammersley (2000).

A case study offers a valid approach to research (Chetty, 1996; Gill and Johnson, 1997) by exploring and explaining a phenomenon. It is defined as an empirical enquiry that investigates a contemporary event within its real-life context, over which the investigator has little or no control (Yin, 2003). It is viewed not merely as a data collection technique, but a comprehensive research strategy. Essentially, a case study is the preferred method when dealing with the "how" and "why" questions of research (Yin, 2003). Since part of the objectives of this study is to determine how SMEs implement KM and how they work with knowledge issues, this method is believed to best fit the purpose.

3. Methodology

A case study protocol was developed to facilitate the extraction of information from the case companies. It contained all the questions to be asked and would act as a guide for the investigator. Following such a structure helps to improve the reliability of the study and minimise its biases. The protocol was basically divided into four major parts:

1. Background/general information
2. Key elements of KM implementation
3. Implementation approach
4. Evaluation of the framework

The first section was intended to capture the case company's background information such as its total number of employees, business activity, etc., as well as general issues associated with KM, such as its understanding by the company and the stimulus for practising it. The next part was concerned with the investigation of the key

elements of KM implementation, which, in this case, covered the following factors: strategies and activities, leadership and coordination, systems and tools, training, culture and motivation, and outcomes and measurement.

The third section examined the implementation approach adopted by the company. Questions were asked, for example, to determine whether a framework was used, and to identify what steps or activities were taken to implement KM. The final part was centred on the assessment of the proposed integrated framework in order to determine its applicability in the SME sector. The company was asked to rate certain criteria, which comprised those that have been embedded in its initial design such as being simple and easy to understand, systematic and well structured, comprehensive, represents guidance for implementation, etc. These are the criteria described by Wong and Aspinwall (2004b) as being important when developing a KM framework for SMEs, and so were taken into account when constructing the integrated framework. In addition, an open-ended question was also put forward to further determine its strengths and weaknesses, and to identify any opinion or comment that the company might have.

The number of case studies to be conducted is highly dependent on the resources and time available. The results from a single case study may be treated with scepticism, because they could reflect the uniqueness of a particular case. Conducting multiple case studies is analogous to following the logic of replicating multiple experiments, and hence the outcomes are often considered more powerful and convincing. There is no consensus or an absolute answer to how many cases should be conducted, but modest advice is to do at least two (Yin, 2003). Hence, the case study design employed in this research was a multiple-case holistic one, as described in Yin (2003). It was holistic in the sense that it aimed to examine a particular company's KM effort on a global perspective.

The selection criterion for the companies was that it should employ fewer than 250 employees, in accordance with the Commission of the European Communities' definition of SMEs (CEC, 2003). Since KM is a fairly new concept (Ndlela and du Toit, 2001), finding SMEs that understand it and have initiated it was very hard. Gaining their participation was also difficult, because the case study involved accessing their information, some of which could be confidential. The companies that had responded to an earlier KM survey conducted by the authors were contacted in the first instance through formal letters seeking their participation in the study. The response was poor and so reminder letters were sent, followed by e-mails and telephone calls. Many reasons were given for not being

able to take part, but eventually four companies agreed to do so. A new batch of SMEs was also contacted, but this did not yield any additional favourable response.

Two of the case companies were consultancy firms; the third was involved in construction and the last one in the chemical industry. For anonymity purposes, their identities are not revealed in this paper, and so they are referred to as Companies A, B, C and D. The cases cover both the service and manufacturing sectors, and thus it is hoped that the results from this research could be generalised to the SME sector rather than being limited to a particular business activity. All four case studies were carried out during June and July 2004. Interviews with the key person responsible for KM implementation were conducted in each company (they were the “Internal Consultant” in Company A, the Delivery Manager in Company B, the Finance Director in Company C and the Managing Director in Company D). In order to minimise biased responses, no sensitive or opinion-oriented questions were asked regarding their KM initiatives. Where permitted, relevant documents such as implementation plans and minutes of meetings were collected, and direct observation of their system was made in order to achieve “triangulation” (Gillham, 2000). Following the interviews, all transcripts were returned to the interviewees for their evaluation in order to check for accuracy and to avoid any undue bias in the contents.

4. Results of Case Studies

4.1. Company A

4.1.1. Background and general information

Located in London, Company A is a management consultancy firm specialising in total working capital (TWC) processes improvement. TWC comprises three core components: supply chain, revenue and expenditure management, which are denoted as “forecast to fulfil”, “customer to cash” and “purchase to pay”, respectively, by the company. Optimising TWC processes helps to improve service quality, generate cash and reduce cost thus enabling organisations to attain their strategic goals. Since the company’s inception in 1975, it is now a leader in its industry, and has carried out consultancy for more than 500 clients, including Alcatel, British Petroleum, British Telecom, Ford, Hewlett-Packard and Motorola, to name but a few. In addition to its headquarters in London, the company also has offices in New York and Singapore. Despite its global operating nature, it only employs around 160 employees in total, and therefore is a medium-sized firm.

The term KM is perceived by the company as capturing, storing, transforming and disseminating information within the organisation. In-house KM implementation began in the early 1990s. Being a consultancy firm, its professional staff are constantly required to deliver pragmatic solutions in an increasingly complex and competitive economic landscape. Hence, one of the key stimuli for practising KM was to improve its competitive advantage. Other reasons given were to promote efficiency and innovation.

4.1.2. Key elements of KM implementation

The company has a strategy for KM, i.e., to build a comprehensive storage of information and knowledge that will help to deliver sustainable business advantage. Its goal is to have as much relevant information as possible including client background, project descriptions and outcomes, best practices, reusable knowledge, etc. By having a comprehensive repository, consultants can use it in sales and consultation processes. As such, the primary focus of the company’s KM initiative is to capture and store knowledge into repositories in order to share it across the organisation.

An important element of KM implementation is the extent of commitment and support given by top management. Top-level managers in the company clearly understand the KM concept, and are extremely focused and committed to it. They participate actively in KM by proposing new ideas to improve it, overseeing that employees are doing it correctly and ensuring that knowledge is captured into repositories. The necessary budgets and resources are also provided for its implementation. This helps to send a clear message across the organisation that KM is of key importance.

The initiative was started and championed by an Internal Consultant (an employee of the company), with the help of other Managers and Directors. His main roles and responsibilities in KM are to plan the structure and content of the repositories, capture, store and disseminate organisational knowledge, and ensure the consistency of entries, maintenance and cleansing on a day-to-day basis. In addition, he is also responsible for the coordination and development of tools and knowledge relevant to the company’s capabilities. He is assisted by the IT department to administer and develop the software application that supports KM. There is also a Global Organisational Management Team (GOMT) in place, consisting of all Project Directors, three Operation Directors and four Practice Leaders, which oversees the KM effort. Its roles include monitoring and approving information submitted to the knowledge repository in order to ensure that it is in line

with the organisation's methodology, as well as developing new ideas. Interestingly, formal designations such as Chief Knowledge Officer, Chief Learning Officer, etc., are not used in this company.

The company has made significant advances in building a KM system based on a Lotus Notes platform. Within it, there are two key databases, called Collective Memory (CM) and Capability Knowledge Base (CKB), which were developed individually. The CM acts as a repository for past projects' related information, e.g., clients' data, projects' plans, proposals and descriptions, presentations to clients, overview of results and benefits gained by them, etc. The CKB, on the other hand, is intended to be used as a repository for all knowledge or experience that has been developed, and which could be reused in delivering projects. This may take many different forms such as generic process maps, best practice models, templates, checklists, questionnaires, training courses materials and so forth. As well as the internally generated materials, there is also information about, and links to, sources of knowledge beyond the company; examples of this include published books and useful websites.

Every employee can, and is encouraged to contribute knowledge into the repositories. In the submission process, employees will first create a draft entry. This entails filling in templates, structuring the knowledge according to the required format and attaching any relevant file. The knowledge will then be pending for approval. The GOMT members will review it and give their comments and opinions. Once approved, its format will be checked before it is added to the repository. In order to retrieve knowledge, employees can search using the following categories: approved date, author, knowledge type, language, keyword, industrial sector, capability area, material type, etc.

A key premise of KM is that people themselves are important repositories of knowledge. Hence, besides putting knowledge into computers, providing "pointers" to people who are knowledgeable is also crucial. The company operates both a so-called Accreditation Database and a HR Portal. The former comprises a set of competency profiles, describing the skills, knowledge and expertise of employees. Each of them is responsible for writing his/her own profile, posting it onto the database and updating it. In addition, the database also displays the ratings of their performance in terms of the following competency areas: supply chain, expenditure and revenue management, business process improvement, software and language. A rating scale of 0 – 4 is used for this purpose (0 = no knowledge, 1 = basic, 2 = competent with support, 3 = advanced knowledge, 4 = specialist expert). The HR portal, on the other hand, provides more basic details of employees, such as their extension and mobile numbers,

e-mail address and location. In short, the Accreditation Database describes the topics in which people are expert, whereas the HR Portal acts as a means for contacting people.

No formal and specific training programme pertaining to KM is conducted, but the company may look into it in the future. In spite of this, new employees during their induction week would be indirectly trained on how to use the Lotus Notes and create an entry into the databases. A supportive culture is among one of the main pillars of KM in the company. There is a high level of trust among employees, and they are not sceptical about the intentions and behaviours of others. This underlies their willingness to contribute their knowledge into the databases and to share it. Employees are encouraged to have the freedom to learn and to develop new ideas. In addition, multidisciplinary team-based projects, involving experienced and inexperienced people from different backgrounds also provide numerous opportunities for knowledge sharing.

An incentive scheme is an important determinant of behaviour. In this respect, the company does not operate any reward system to encourage people to practise KM. Top management, however, recognise employees who add knowledge into the databases, for example, through the use of simple methods such as a regular "pat on the back". In addition, all employees are required to set work objectives that they will achieve, which could include KM. Their performance against these objectives is reviewed as part of the formal appraisal process.

The results and benefits gained from KM are not quantitatively assessed. Over the years, the consultancy market has become increasingly competitive, but the company has remained profitable. Although it is hard to determine causality, the company felt that KM has contributed to the minimisation of the "reinvention of wheels" and the strengthening of its position as a niche market player. There is also no systematic indicator in place to measure the performance of the KM effort. However, regular reviews are undertaken by top management to check the quality of knowledge deposited into the repositories and its dissemination within the organisation.

4.1.3. *Implementation approach*

When asked about whether the company has any framework for implementing KM, the answer was, "formal processes and procedures are in place". Documents that described these were confidential, and thus they were not disclosed. In general, the steps or activities conducted to implement KM were indicated and provided by the company. Since the main focus of its KM initiative is on capturing knowledge into repositories, its approach

Table 1. Implementation approach of company A.

Phase	Activities Involved
Plan	Identify the knowledge area to be captured into the repository Plan the structure and content of the repository
Design	Design the actual system
Test	Pilot test the use of the system
Review	Review the test result Where appropriate, changes and modifications will be made
Go live	Implement the use of the system
Monitor	Monitor performance on a continuous basis

is primarily centred on this aspect. The steps taken are best summarised through a series of phases as shown in Table 1.

At the outset, the company identified the knowledge area that needed to be captured, and planned the structure and content of the repository. With the help of its IT department, the repository was then designed, including its structure, its interface layout, the necessary templates, etc. Following this, the system draft was piloted by other employees of the company to obtain their feedback and to gauge its appropriateness and functionality. The test results were reviewed, and, if needed, further modifications, developments and refinements were made.

The next phase involved rolling out and formalising the use of the system. Finally, monitoring was conducted to ensure that employees added knowledge to it, and that there was consistency in the entries and maintenance of knowledge. To date, the company has been successful in operating with the CM and CKB repositories. It is now planning to introduce another database that will capture relevant information specifically for benchmarking purposes. The interviewee pointed out that it is important not to accomplish too much at once, but rather do one thing at a time while keeping in mind the big picture and strategy, in order not to drain the company's resources.

4.2. Company B

4.2.1. Background and general information

The second case study was conducted in another consulting firm, located in Hampshire. It is a small company with only 30 full-time employees. It provides business consultancy and software development services through a consulting (delivery) team comprising analysts and consultants, headed by a Delivery Manager who reports directly to the Managing Director. Its clients are primarily the government and large organisations that are involved

in the defence and energy sectors. With over 15 years of experience in the field, it is a thriving company, bringing demonstrable benefits and success to its customers.

KM is understood by the company as “knowing what knowledge we have and where it is, and keeping it up to date (both explicit and tacit)”. The company began its KM journey in April 2003. At the start, it adopted a top down view of KM, looking at it broadly and from a theoretical perspective to identify what it should encompass. Following this approach, however, resulted in too wide a scope for the company to implement, since KM entails multiple facets and aspects. It then undertook a different approach by examining what information and knowledge it already had and how to further leverage them to gain benefits. The running and completion of various consultancy projects has produced all kinds of information, such as reports, models, lessons learnt, good work practices, hints and tips to do things easier, etc. However, most of this information has been “put into cold storage” without a systematic means to incorporate it into other projects and to broadcast it to the consultants. Hence, the main reason that drove the implementation of KM was to improve this situation, so that the delivery team could work “smarter”.

4.2.2. Key elements of KM implementation

The company does not have a formal strategy for KM, but recognises that its goal is to deliver better project performance and a more advantageous way of working. The KM initiative revolves around the following activities: identification, structuring and capturing of knowledge, sharing it (particularly within the delivery team, and with the sales and marketing, and strategy team) and keeping it up to date. The company has identified seven key knowledge areas or domains in which the above activities would be performed. These are: *Soft System Methodology, Operational Analysis, Requirements Elicitation, Software and Tools, Data Analysis, Domain, and Mood*.

Top management has given its full support to the KM effort in the company. The Managing Director understands the KM concept and sees the potential benefits from its implementation. He has provided the necessary resources to enable the relevant activities to be undertaken. The whole initiative was championed by the Delivery Manager, who identified and allocated a Knowledge Manager and a deputy to each of the seven key knowledge areas. It should be noted that these are secondary jobs assigned to the consultants themselves, and are not newly recruited personnel for the purpose of implementing KM. Together, they represent a robust team that determines the terms of reference, identifies areas of responsibilities

and coordinates the KM initiative. Among other responsibilities, the Knowledge Managers and their assistants are expected to:

1. Collect documentation/literature in their knowledge area and to do this in a consistent way.
2. Ensure the availability of documentation/literature and direct staff to relevant sources and/or Subject Matter Experts where appropriate.
3. Ensure that relevant information is available to interested parties, subject to security and commercial constraints.
4. Provide a “front desk” point of contact for staff with queries regarding their knowledge area.
5. Be prepared to act as a Subject Matter Expert who can participate in internal problem solving regarding their knowledge domain.
6. Actively seek lessons learned or project close out information.
7. Develop, write and promote best practices.
8. Identify areas where additional information is required.
9. Bring interesting material to the attention of those who may find it useful.
10. Keep up to date in their subject area.

Other specific roles that support the KM initiative are an Information Manager and a Network Manager. The former is mainly tasked with coordinating the storage of information, organising it properly and packaging it in a consistent manner in order to generate a coherent company-wide library. The latter is focused on issues such as providing the infrastructure, search engine and security.

In terms of a technological system, the company has previously used Lotus Notes only. Besides using it for scheduling tasks, setting diaries, configuring reminders, etc., it keeps information related to projects and finance. However, as the amount of information increased, the company adopted server databases that are accessible

through its intranet. They are divided into the following categories: company, sales and marketing, monitoring, defence, energy and temporary. The types of things that are kept in them include documents, reports, policies, best practices, test specifications, models, methodologies, etc. Their constituents are briefly described in Table 2.

The seven key knowledge areas identified are for the defence and energy databases. In order to make information more easily retrievable, the company implemented a standardised domain guide for each of the areas. Broadly, each guide contains the following items:

1. Introduction or overview of a knowledge area.
2. Summary of the folders’ classification scheme and their contents.
3. A list of essential reading.
4. A list of supplementary reading.
5. A set of keywords for internal searches (those that have been used to classify documents held internally in the databases).
6. A set of keywords for external web searches (those that have been found to return fruitful results on web search engines).

The titles of documents or folders, for example, are expressed as “links” to open them or to direct the users to their location in the databases. In essence, a domain guide basically helps to structure and organise a knowledge area, thus facilitating the users to understand and search for its contents.

No formal training was conducted to support KM. Its understanding and visibility, however, were heightened through an awareness campaign, during which presentations were given to all the employees regarding what is KM, who are responsible for what and how to perform it. The attributes of the company’s culture that are deemed to support KM are collaboration, innovation and communication. Every consultant collaborates with and helps the others to succeed, and is highly motivated to pass on information and share his/her knowledge. In terms

Table 2. Databases in company B.

Databases	Constituents
Company	Company’s background, business plans, policies, etc.
Sales and marketing	Sales and marketing information, client details, etc.
Monitoring	Information on projects performance such as their benefit, profit and loss
Defence	Projects’ information, models, software application, government furnished information, etc., pertaining to the defence sector
Energy	Projects’ information, models, software application, government furnished information, etc., pertaining to the energy sector
Temporary	Miscellaneous information

of innovativeness, employees are encouraged to develop new ideas continuously, ask questions and push boundaries to enquire why and how. The company has also strived to nurture effective communication between its employees. Face to face meetings, shared sessions and presentations are frequently conducted to ensure that employees are kept informed of progress and that knowledge is disseminated.

The company does not provide any incentive to get people involved in KM. According to the Delivery Manager, everyone in the company is very enthusiastic about the initiative. They understand it and appreciate that it is needed in order to work smarter and to deliver better project performance. This core belief has underpinned the employees' motivation to act positively. Although the benefits attained so far with respect to KM have not been systematically assessed, the company felt that since its implementation, more employees were sharing knowledge with each other and there was an increased cross-pollination of ideas. The company has yet to measure the performance of its KM initiative, but said that this would be done in the future. Despite this, the KM team agreed to update and present the results of its initiative to the rest of the delivery team at least twice in the year and to the sales people at least four times in the same period.

4.2.3. *Implementation approach*

With regard to a framework for implementing KM, the Delivery Manager drew the schematic shown in Fig. 1 to represent the company's approach.

The implementation process in the company began by looking at a real problem that it had. Consultants felt that they were unsure of how up-to-date and relevant was the information on the company's databases, that they were "reinventing the wheel" in their work and keeping information in their own computer rather than passing it on. The Delivery Manager firstly planned and identified the scope, knowledge areas, timescale and managers for implementing KM. In terms of the scope, the company started with the defence and energy databases, because they are the most important, and as mentioned earlier, seven key knowledge areas were identified. The company staggered the KM initiative into different phases, according to a workable timescale. Knowledge Managers were selected voluntarily from among the consultants who were more competent, experienced and skilful. These were put into a team to discuss and agree their terms of reference and a work plan. In the next stage, the activities to be conducted for the initiative were identified. These were:

1. Identifying what information was, at that time, held in the defence and energy databases.
2. Deciding whether or not it was useful and in a format that could be readily used.
3. Removing duplicate, obsolete and irrelevant information.
4. Establishing the structure of each of the new knowledge areas — introduction, summary of the classification scheme, essential reading, etc.
5. Moving the information into the knowledge areas.
6. Communicating to the rest of the delivery team and the company as a whole.
7. Continuous updating of information and knowledge.

After implementing these steps, a review was necessary to determine performance. At the time of the study, the team had not carried this out but the outcome could well indicate the need for adjustments to improve the situation or a different problem could emerge that warrants a new programme to be undertaken.

The company will, in the future, widen the scope of its KM initiative by addressing its sales and marketing database. This is deemed crucial since consultants in the delivery team are constantly sharing knowledge with the sales and marketing people and accessing their information. Progressively, the remaining databases will then be dealt with. At the moment, the company does not have a powerful search engine to locate knowledge, but it plans to employ one in order to find "needles in haystacks". It is also considering and planning formal measures to be used to evaluate its KM initiative. In addition, it hinted that it may formalise a standard practice for KM, and develop a directory of experts.

4.3. *Company C*

4.3.1. *Background and general information*

The third case study was performed in a construction company situated in the West Midlands. It has 78 employees and is hence a medium-sized firm. It acts as a managing contractor for construction projects that manages a chain of smaller companies and people to carry out the on-site work. Specifically, work undertaken encompasses new build, refurbishment, restoration and modernisation for both the public and private sectors. It is not directly involved in design work, and thus it does not employ architects or engineers. Typical employees of the company include contracts managers, estimators, surveyors, buyers, site managers and supervisors, accounts and administrative staff, etc. Since its founding in 1969, it has enjoyed tremendous growth and expansion through the provision of high-quality projects to its clients.

KM is perceived by the company as basically covering all the processes such as capturing, disseminating,

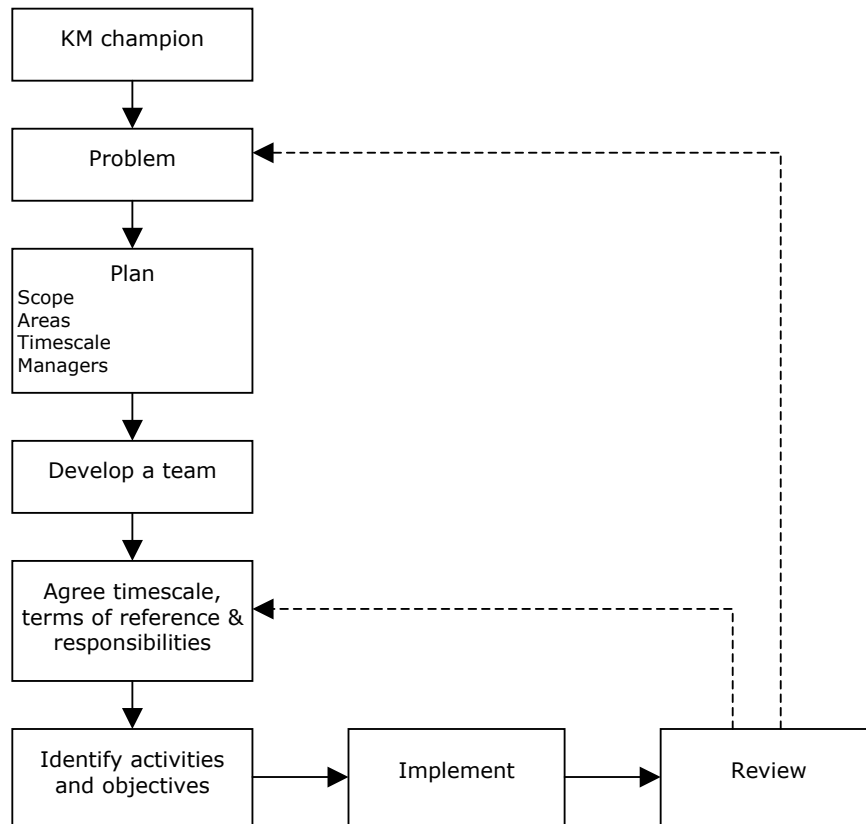


Fig. 1. Implementation approach of company B.

sharing and utilising knowledge and making sure that the right people are receiving it. It is viewed as a continuous process, and can be undertaken from an IT or a non-IT perspective. The core reasons for practising it are to run the company effectively and to improve the performance and quality of its projects. Without the proper sharing of knowledge, for example, the company may be highly vulnerable to safety and health risks when performing construction work. KM implementation in the organisation has been an evolutionary process, building on past experience, and thus it is not possible to identify a clear start date. Certification to the ISO 9002 quality standard in 1992 helped the company to formalise the documenting and recording of information and knowledge. Broadly, the company feels that the standard has provided a good basis from which to launch its KM effort.

4.3.2. Key elements of KM implementation

The company's approach to KM has predominantly been centred on the human and soft aspects. Its current strategy is geared towards structuring the technological path for performing KM and generating a formal company-wide policy. At the time of the case study visit, the company was planning and working on a collaborative

system to facilitate knowledge sharing among its internal employees, and between them and external parties (such as clients, architects, structural engineers, etc). The goal of this initiative is to improve the sharing of tacit knowledge, as well as the transfer of explicit and documented information.

With respect to top management support and commitment, all the directors and managers are fully committed to this initiative. They agree to implement it, provide the necessary budget and resources, and are enthusiastic about achieving its aim. They clearly see the benefits that can be gained from its implementation, and thus it is fully driven from the top. A team that is part of the general management structure and spearheaded by the Finance Director was formed to execute the initiative. Its main tasks and responsibilities were to choose the right knowledge sharing system, implement it and ensure that it did what it was expected to do. However, no formal role for KM such as a Knowledge Manager is established. This is because the company feels that KM in general should be managed by individuals, making it their personal responsibility and an integral part of their daily routines. The company may look into establishing such a position in the future, if it expands further and the volume of information increases.

In terms of a technological system, the company has some electronic databases in personal computers as well as in a shared server. The things that are stored in the databases include the company's information, manuals, policies, quality procedures, best practices, projects' descriptions, contracts, marketing and competitors' information, and details of employees, customers and suppliers. Within the company, the internet is also made accessible to employees. The "to be" knowledge sharing system is still in its early development stage, and so no further detail was provided.

There is no training conducted to explain the concept of knowledge and KM. However, awareness training on IT is being conducted because it is deemed important for many construction employees who are not very well versed in computers. This training covers very basic issues such as how to use computers, spreadsheets, word documents and e-mails. Formal training is expected to be provided by the external vendor on how to operate the knowledge sharing system. It will mainly be attended by those employees involved in construction projects and working on-site.

The culture at the company is one that promotes effective communication and interaction between employees. In the past, when the company was smaller, all the employees sat together in the same office which resulted in substantive knowledge sharing. Following its expansion and move into new premises, steps were taken to locate groups of employees who need to be in regular contact, closer together. One example given was locating the construction and surveying people in the same office in order to improve communication. The working of cross-disciplinary or functional project teams is also instrumental in facilitating knowledge sharing. Employees trust each other and sharing knowledge is viewed as "power". They appreciate that in a construction project, nobody can act in isolation, otherwise it would fail. In addition, they are encouraged to ask questions and are given the freedom to learn.

A recognition scheme forms an important element in promoting favourable behaviours and actions. Employees will be marked against certain performance criteria in their projects, one of which is how they interact and share knowledge with both internal and external people. A monetary bonus is given to reflect their performance, and this helps to encourage them to disseminate and share knowledge more widely. Good KM practices have led to improved work efficiency for the company. It is hoped that the implementation of the knowledge sharing system will augment this and eventually lead to increased productivity and innovation. The company plans, in the future, to measure efficiency in terms of the cost of administering

a project, before and after implementing the system in order to evaluate its performance.

4.3.3. *Implementation approach*

Although KM has been part of the company's working philosophy from the outset, a framework was not used to guide its implementation. However, the company did recognise its importance and said that they would develop one. With respect to what steps and activities were conducted to adopt KM, the implementation of the knowledge sharing system was taken as a basis for the mechanism involved, although it had not been completed at the time of the case study. A team was first formed, which carried out an audit on existing work practices to identify their inefficiencies, problems and ways to improve them through KM. Bearing these in mind, the team developed a strategy that was converted into an operational initiative, i.e., building the knowledge sharing system, and laid down the goal to be achieved. In order to ensure that the system fulfilled its objective, the team proceeded to set out its requirements in terms of how it would function, its technological platform, technical specifications and cost.

Resources' scarcity is signalled by the company as an obstacle to the implementation of the system. The availability of time is considered as the main issue since all its employees are fully utilised in their jobs. The assistance of external consultants or solution providers is sought and care will be exercised in choosing a system that is affordable in order not to spread the company's financial resources too thinly. At the time of conducting this research, the phase of contacting providers and reviewing their proposals had been reached. After selecting the provider, the next stage will entail establishing the system and providing training to employees. Management recognises that the initiative has to be rolled out in a gradual and orderly manner, rather than doing it on an all out basis. Following implementation, monitoring and evaluation will be carried out. In summary, the steps for implementing the initiative are shown in Fig. 2.

4.4. *Company D*

4.4.1. *Background and general information*

The fourth company visited was a small chemical company, situated in Warwick. It was established in 1987 and now has 26 employees. Its business activity is the design, manufacture and distribution of epoxy resins, polyurethane systems and RTV silicone rubbers for application in specific niche areas such as mould making,

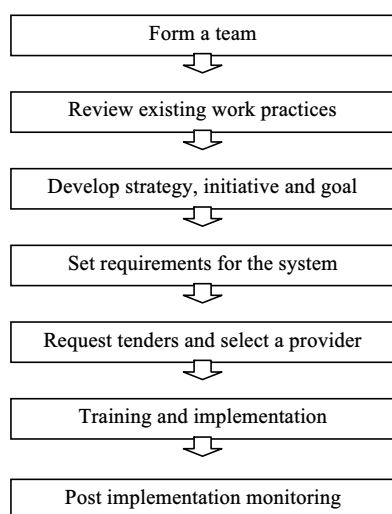


Fig. 2. Implementation approach of company C.

tooling, rapid prototyping and electronic encapsulation. Besides manufacturing, finance, sales and marketing, it has an in-house R&D department consisting of three scientists, since it is involved in the design and formulation of chemicals. Its customer base is wide ranging, covering companies in the automotive, aerospace, electronic, ceramic industries, etc., such as Rover, Jaguar and British Aerospace.

The Managing Director has a good global understanding of knowledge and KM. From a more specific perspective of his business nature, he views knowledge particularly as being the chemical formula of products and the process to produce them. KM is perceived as recording, analysing and generating knowledge, i.e., the formula. The KM implementation process in the company dates back to 1998. The reason given for implementing it was “the company is built on knowledge and survives on it”. KM is seen as a vehicle that helps the company both to react quickly in a rapidly moving market, and to provide responsive and innovative products that meet customers’ needs. Ultimately, it is hoped that the turnover and profit of the organisation will increase. The Managing Director also recognises that most of the formulae currently being used are held in the heads of the Scientists, and if they leave, the company will suffer a brain drain. This has also prompted the implementation of KM so that the formulae are all captured and not lost.

4.4.2. Key elements of KM implementation

The company’s primary KM strategy is to complete and finalise a formulation or R&D database. At the time of conducting the case study, the final database was yet to

be implemented, but all the necessary planning and refinements had been made. Its main functions are to record and store information on suppliers, raw materials and finished products, and to enable the analysis and generation of a formula for a finished product requested by the customer. Its goal is to shorten new product development time from the existing 2 months (average), to within 2 weeks. It is envisioned that the final database will be implemented and run by the end of this year.

Total support and commitment from top management provides one of the mainstays for the KM initiative. The Managing Director himself acts as its driver and actively participates in every stage of the implementation process. Financial resources are provided, although the database costs a significant proportion of the turnover. A group was formed, comprising himself as leader with three of the Scientists, to coordinate the KM initiative. Their main tasks are to design the concept of the database, set out the requirements of the system, contact vendors, input data into the database, update and maintain it, etc. Interestingly, there is no formal or specific position assigned to KM, nor does the company have an IT department or specialist. It relies on one external company that deals with the software, and another that handles the hardware and physical security aspects.

The formulation database is construed as a KM system in the company. The following information will be kept in it:

1. Suppliers — their name, address, contact details, etc.
2. Raw materials — their name, formula, cost, physical, mechanical and chemical properties such as colour, viscosity, acidity, reactivity, etc.
3. Existing finished products — their name, formula, cost, physical, mechanical and chemical properties such as hardness, elongation, tensile strength, elasticity, viscosity, pot life, etc.

Each finished product has its own unique formula, which is a combination and synthesis of various raw materials. Users can query the database to find the formula to be used for manufacturing a particular product. By keying in the properties or characteristics of a product, as requested by the customer, the database will analyse this information and then generate the formula. If the properties match those of an existing product, its known formula will be shown. Otherwise, the database will perform pertinent knowledge processing based on intelligent systems to generate a “starting formula” to produce it. This term is used because IT may possess limitations in this respect to produce a precise formula; human interventions may be needed to conduct experiments and tests to come out

with a better one. The database also has the capability to search for say, what raw materials are produced by a particular supplier or vice versa. Since it stores information that is confidential, i.e., formulae, it will not be made accessible through the intranet or the internet. It will be a stand-alone application in one computer, password protected and only accessed by authorised people. The computer will be physically secured to safeguard it from being stolen.

Once the database is installed, appropriate training will be conducted by the external software company. It will basically address issues such as how to input suppliers', raw materials' and finished products' information into the database, how to search for information, etc. It will only be attended by the KM team and a few relevant people, but not all the employees. In general, the company has an open culture, where there is a free flow of company-wide and specific information, except those related to formulae. It has weekly team meetings to ensure that information is passed from the top to the bottom and that feedback is channelled the other way, thus ensuring two-way communication. However, the culture within the R&D department is somewhat different. Scientists in the department do not really like the database, because generally they are egoistic and individualistic. Moreover, the "owning a breakthrough" syndrome has also made them less susceptible to work in teams and share knowledge.

Although this problem has not been successfully overcome, the company operates a formal performance appraisal scheme that considers certain criteria that promote KM. These criteria are teamwork and the number of products developed. All the Scientists are required to set their personal targets for these elements through a discussion process with the Managing Director. If they achieve their targets, they will be rewarded with a monetary bonus or promotion as part of their performance review. The company has been operating with a few *a priori* and simpler versions of the database, even though the final one has not been rolled out. On the basis of their use, benefits such as easier access to knowledge and faster product development time are noticeable. In the future, the company plans to use an index of the number of products developed to measure the performance of its KM initiative.

4.4.3. Implementation approach

Due to limited resources, the company first started a systematic paper-based repository for recording information on suppliers, raw materials, finished products and formulae. It then changed this to an electronic database using Microsoft Excel and over time, various improved versions

of the database were progressively adopted such as one which was based on Microsoft Visual FoxPro. Finally, it decided to implement a full repository integrated with intelligent systems. The company has a framework in place to guide the implementation of this project, but it was not made available to the interviewer. In spite of this, the activities involved were described by the Managing Director and are summarised in Fig. 3.

The KM team first planned the structure and concept of the full database, assessed how much data would be kept in it and addressed other necessary issues. The team then proceeded to search for companies that could provide a solution that fitted the requirements. Research was carried out to identify such companies and an advertisement was posted on the internet. Replies were received from a few vendors and eventually one was selected. The team and the vendor discussed the detailed specifications of the full database, and an agreement was reached. The vendor has developed various trial or beta versions of the database and each of them has been piloted by the team. This was done to assess how well the "model" had been developed and to allow improvements and refinements to be made before finalising it. The team was awaiting the final version of the database at the time of conducting the case study. Once it is completed, it will be installed in the company and some preliminary trial data will be input into it for training purposes prior to entering the full set. Finally, it will be rolled out to the company, and its use and performance will be monitored.

5. Initial Evaluation of the Framework

The final part of the case study dealt with an initial evaluation of the integrated framework, but before presenting the results, its background and mechanism will be explained. It was built on an initial novel framework that guides the implementation of KM in SMEs (Wong and Aspinwall, 2004b). The layout of the initial approach was slightly modified to improve its simplicity and structure, but its underlying contents remained the same. A new building block on critical success factors that underpin the adoption of KM was added (Block E), based on the results of an earlier survey conducted in SMEs (Wong and Aspinwall, 2004c). The integrated framework is shown in Fig. 4.

The implementation process begins with the formation of a KM coordinating group, undertaking certain roles and responsibilities as listed in Block A. While these elements can be grouped under a few headings such as plan, do, check and act, doing so will be somewhat

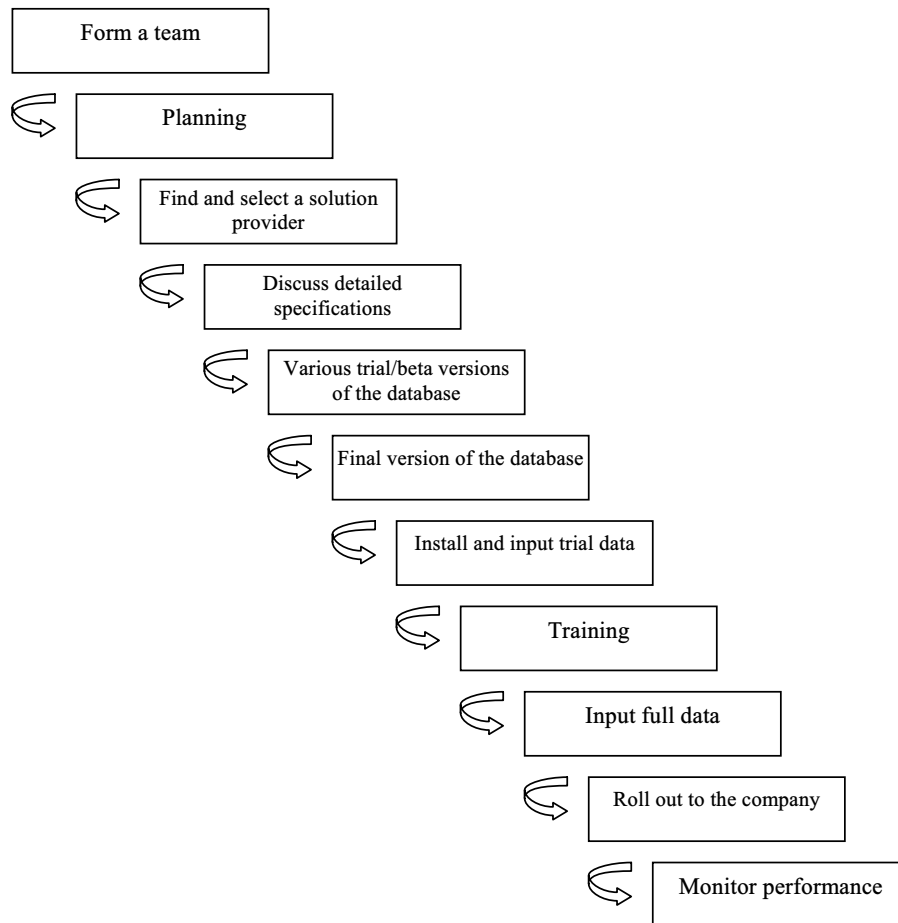


Fig. 3. Implementation approach of company D.

controversial since they can possibly fit into more than one of the categories depending on individual discretion. The group should play its roles competently and translate its action plan into actual initiatives, programmes or projects, usually involving one or more of the activities listed in Block B. It is crucial that the execution of these initiatives addresses both tacit and explicit knowledge, as well as focusing on both people and technology. Once an initiative is selected or decided upon, Block C provides a guide consisting of a series of developmental phases to launch and deploy it effectively. Tools and techniques (classified as hard and soft) to support it are provided in Block D and their selection should be based on their uses and purposes. Finally, Block E shows a set of critical factors that should be put into effect in order to ensure the success of the initiative.

Having explained the integrated framework, the outcome of its evaluation carried out during the case studies will be discussed. Table 3 shows the quantitative ratings on a scale of 1–5 of the performance criteria given by the

respondents of the case companies, and their overall mean scores.

As can be seen, none of the companies disagreed or strongly disagreed with any of the criteria. All of them strongly concurred that the framework provides a generic perspective towards implementing KM, and is not meant to prescribe a strict or definitive answer. Three of them strongly agreed that it represents guidance for implementation as well as being comprehensive, incorporating all the necessary constructs and elements. Besides providing a way forward, it was also perceived as giving an insight into what is KM, since the mean score was 4.00. In addition, the simplicity that has been built into its design was acknowledged by the companies. The criterion, “systematic and well structured” has the lowest mean score, but since the value was close to the “agree” level, it was felt to be satisfactory. On average, the companies favourably agreed that the framework is indeed feasible and applicable. The discussion that follows will be centred on the comments, opinions, suggestions and critiques given by each individual company.

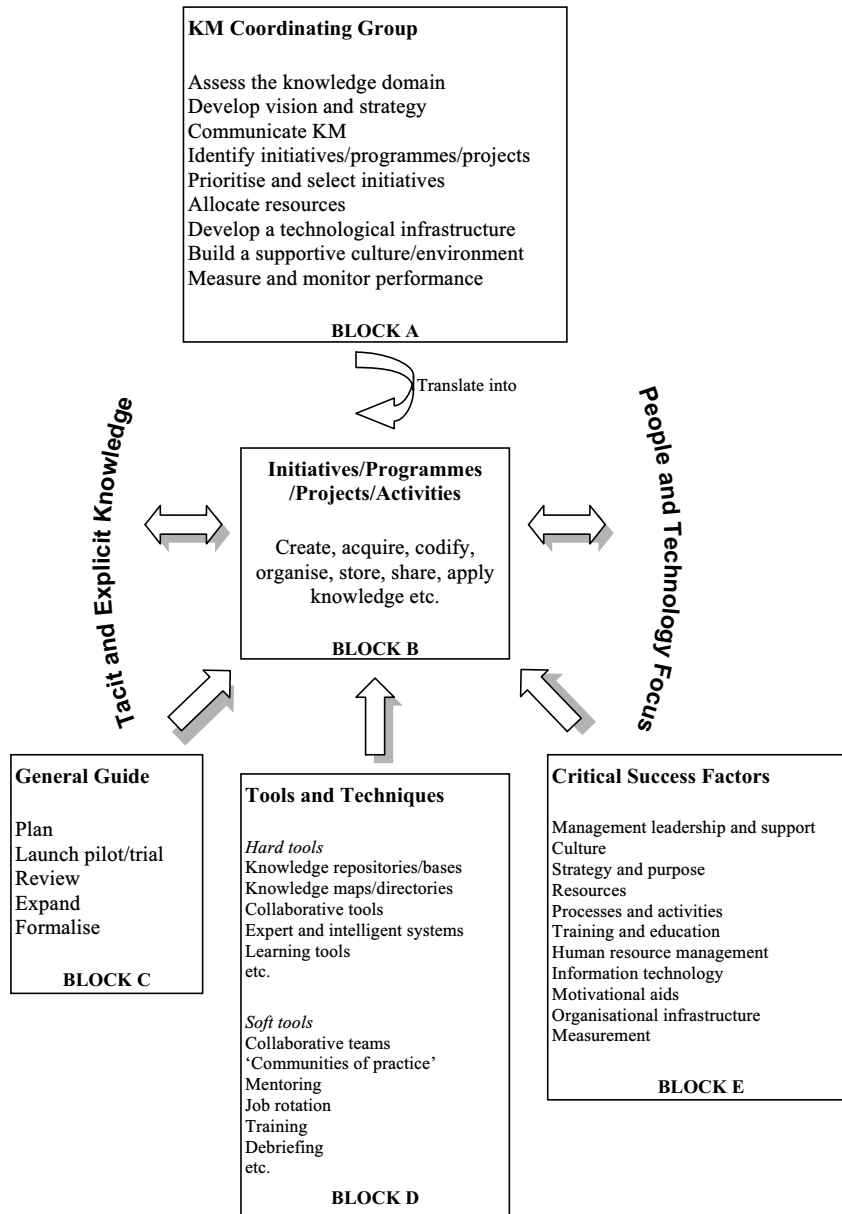


Fig. 4. An integrated framework for KM implementation.

Table 3. Ratings for the evaluation of the framework.

Criteria	Individual Company's Rating				Mean Score
	A	B	C	D	
Simple and easy to understand	4	5	4	4	4.25
Systematic and well structured	4	4	4	3	3.75
Comprehensive	5	5	5	3	4.50
General (not prescriptive)	5	5	5	5	5.00
Represents guidance for implementation	5	5	4	5	4.75
Answers "what is" KM and "how to" do it	5	4	3	4	4.00
Feasible	5	5	4	4	4.50
Applicable	5	5	4	4	4.50

Note: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

5.1. *Company A*

The company's overall perception of the framework was positive, with a view that it represents a sensible approach towards accomplishing KM in an organisation. The respondent thought that it was well developed, with a clear satisfactory structure. The detail was perceived as sufficient, since it covered as much as was possible with respect to KM implementation and no suggestion was made to add any element or constituent. He agreed with the roles and tasks that should be undertaken by the coordinating group (Block A), as well as the series of steps for deploying an initiative (Block C). Broadly, he raised the point that the success of KM requires a harmonised balance between technology and people. On the downside, he mentioned that the words "hard and soft tools" in Block D were quite confusing. Perhaps, he would have preferred to see the use of the terms, technological and non-technological tools. In terms of the initiatives and critical success factor blocks, no comment was given. In essence, he commended that one could easily follow the framework to conduct KM implementation in any SME.

5.2. *Company B*

In general, the framework was very well accepted by the company. The Delivery Manager agreed that a team is needed to coordinate KM and to ensure its effective implementation. Despite this, he pointed out that the framework would have higher credibility and value if it provided or included guidance on how to set up a team. In this respect, the authors fully recognise that a KM effort should be spearheaded by a person who is knowledgeable in the field as well as in the operation of the company, who will then set up the team. However, its composition and the number of members would have to be decided by the individual company depending on its needs and availability of resources. In particular, the Delivery Manager agreed with the stages for launching a KM initiative, starting small, reviewing and then expanding it. He also acknowledged the fact that companies may have different types of initiatives, and that various tools and techniques can be applied to support them. Overall, he stated that "I think it is a very good framework and I wished that I had it before I started our KM initiative". In his opinion, the framework could help him to do things better and it is certainly feasible and applicable to his company.

5.3. *Company C*

The first observation made by the company was that the framework does not include any time element

for accomplishing KM. This preconception could be attributable to the nature of its construction business, frequently dealing with project management diagrams that show the time duration and date for achieving a particular milestone. This issue is not considered in this research, since its primary aim is to build a framework for implementing KM, which has the characteristics and ingredients that fit the situation and context of SMEs.

Examining the time factor is beyond the scope of this research and would require a separate and specific study. The Director stated that the framework does give a general view of KM implementation and, hence, it helps to provide an appropriate prompt for SMEs to start it. Since the company's emphasis is to build a knowledge sharing system, he said the framework would give more value if it was bespoke to this initiative. Nevertheless, in the context of a general overview, he agreed that it could assist the company's KM implementation. He also complimented the comprehensiveness of the approach and he recognised that it is not easy to design a framework that looks simple, yet is inclusive.

5.4. *Company D*

Basically, the Managing Director considered the overall mechanism of the framework to be practicable for SMEs. One concern expressed was again regarding the timescale needed to conduct the activities and steps delineated in the framework. As mentioned earlier, this is not within the boundary of this piece of research. On the positive side, he foresaw that SMEs will not face any problem by following the framework as a guide to implement KM. No negative comment was raised on any of the building blocks, their contents and elements, and no recommendation was made to change or add anything. Overall, he seemed to be satisfied with the framework and was able to appreciate its applicability. Essentially, he said that "I am sure it will be of use to my company in future projects".

6. *Cross-Case Analysis and Discussion*

There exists a broad collection of tools and techniques that could be adopted to support KM. Their application will provide a good basis for cross-comparing the level of KM adoption of the case companies. The intention here is to identify how advanced they are in KM, rather than evaluating their performance. Hence, apart from enquiring directly about their technological system, they were asked to indicate from a list of tools, classified as technological centred and people oriented which they had used. Table 4 shows the results. As can be seen, a diverse range

Table 4. Technological and non-technological tools used by the companies.

	Company			
	A	B	C	D
<i>Hard tools</i>				
Knowledge repository/base	/	/	/	/
Knowledge map/category	/	/	/	/
Directory of experts (yellow page)	/	/	/	/
Search (information retrieval)	/	/	/	/
Document management	/	/	/	/
Electronic discussion board/forum	/	/	/	/
E-mail	/	/	/	/
Multimedia conferencing	/	/	/	/
Instant messaging/chatting	/	/	/	/
Business intelligence	/	/	/	/
Customer relationship management	/	/	/	/
Help-desk	/	/	/	/
Knowledge portal	/	/	/	/
Data mining	/	/	/	/
Decision support	/	/	/	/
Workflow	/	/	/	/
E-learning	/	/	/	/
<i>Soft tools</i>				
Formal meeting	/	/	/	/
Informal gathering	/	/	/	/
Project team/group	/	/	/	/
“Community of practice”	/	/	/	/
Knowledge sharing session	/	/	/	/
Presentation session	/	/	/	/
Workshop	/	/	/	/
Mentoring	/	/	/	/
Job rotation	/	/	/	/
Training (on/off job)	/	/	/	/
Apprenticeship	/	/	/	/
Debriefing	/	/	/	/
Exit interview	/	/	/	/
Benchmarking	/	/	/	/

of KM tools have been applied by the companies. Knowledge bases, document management systems and e-mails were the most common, whereas workflow and e-learning systems were not used at all. In terms of soft tools, almost all of them have been put into practice by the companies. Companies A and D appear to be the more advanced in KM than the other two, since they have adopted a larger proportion of both categories of tools listed. Company B has more to do before it is on a par with A and D. Finally, although Company C is one of the best performers in adopting people-oriented tools, it is perceived as being the least advanced when it comes to applying technologies to underpin KM.

Some important points can be deduced from analysing the case study results. Firstly, the task of KM

is a continuous and never ending process. Knowledge is something that is not static and rigid. New knowledge is always emerging, employees' and professionals' needs for it are constantly changing, and old ones become obsolete. Moreover, management approaches, technologies, customers' requirements, the market and the environment are always evolving. In the case of Company A, for example, the addition, deletion and maintenance of knowledge are performed on a continual basis to ensure the value of the repositories. Company B also emphasised that knowledge should be updated continuously as circumstances change. Without doubt, the consistent sharing of knowledge is definitely crucial for the day-to-day work of all the case companies. KM is, therefore, an on-going issue that requires persistent effort to be accomplished.

Secondly, employing a hybrid human-technical perspective towards embracing KM is apparent. Besides relying on technological systems, the importance of people is recognised by the companies. As discussed earlier, both hard and soft tools are utilised by all of them to support KM. Technologies excel in the capturing and organising of information, as well as rapidly disseminating it to a broad population. Human beings, on the other hand, are more capable of understanding knowledge, interpreting and making sense of it within a broader context and creating new know-how. This is clearly shown in the case of Company D, which acknowledged that computers can never replace human minds in generating an accurate chemical formula. The Delivery Manager in Company B succinctly stated that technology is needed to store information and to locate it, but people are needed to understand, update and apply it. In fact, in Company C, its human resources are more important because its IT will be a waste if people do not use it.

Another point is that an incremental and gradual approach to implementing a KM initiative is favoured. Company B, for example, first started its initiative with its defence and energy databases because they are the most important. Upon completion, it will proceed with the sales database, and then with the remainder. Clearly, the company's strategy is to tackle its initiative by starting small, getting it right and then expanding. It is vital to launch a small-scale project first because its success will become a “proof of concept” that can be adopted in other parts of the organisation. In the case of Company D, its KM initiative has been staged over a number of years. Scarcity of resources was a concern, and so it started with a very simple version of the database, progressively changing to more sophisticated ones prior to implementing the full database based on intelligent systems. The

Managing Director described the approach as “dipping toes into the water, before jumping into it”. Company A also stressed the accomplishment of one aspect at a time, whereas Company C recognised the importance of rolling out its initiative in a gradual manner.

Having discussed the similarities in their KM implementation, it should be acknowledged that there were also substantial differences in their approaches. For example, while Company A’s initiative is centred on capturing knowledge into repositories for reuse, Company D’s initiative is focused on the recording, analysis and generation of knowledge, and the emphasis of Company C is mainly on sharing. Hence, there are considerable variations in the specific activities and steps taken in their implementation. The systems and tools employed by each of them are also dissimilar. Both of the consultancy firms are focusing on repositories or databases, whereas Company C is concentrating on a collaborative system, and Company D is relying on a knowledge base with the integration of intelligent systems. All these imply that KM can be practised in a number of ways, and different initiatives may be more suitable depending on the organisation under consideration. Arguably, the nature and situation of companies, their needs and necessities will influence why KM is undertaken, which in turn will determine what they do and how they do it. In this light, it suggests that when a framework is to be developed for use in the SME sector, in general, it should be as generic as possible. If it is too prescriptive, its applicability will be restricted to only a particular organisation or business activity.

In terms of the newly developed integrated framework, it is difficult to make a direct comparison or match with the implementation approach adopted by the case companies. If this had been the case, the framework would not be novel, and would have been an imitation of their approach. The evaluation carried out during the case studies indicated positive and encouraging results. Quantitatively, it received high ratings in all the performance criteria, and, qualitatively, favourable comments were offered by the companies. All of them agreed that it represents a feasible and applicable approach towards implementing KM. In particular, it recognises that SMEs are limited by their resources. It calls for an evolutionary, not a fully blown approach towards deploying an initiative, starting with planning, launching a pilot, reviewing, expanding and formalising (see Fig. 4). This is in alignment with the approach inferred from the case companies, as mentioned earlier. In addition, all of them acknowledged and utilised a human–technology perspective in the adoption of KM, an element that is also covered in the framework. Importantly, it provides a general overview for implementing KM, and does not prescribe strictly what

initiatives to undertake or which tools to use. This will be totally dependent upon the strategies, focus, problems, needs and priorities of SMEs. In essence, it represents a “cookbook” from which a detailed “recipe” can be created to accomplish KM.

7. Conclusions

Research on KM implementation in the SME sector has been neglected to a large extent. This is evident from the abundant cases in the published literature describing how various large organisations are practising and adopting it, but those for SMEs are very scarce. This paper has gone some way in addressing this by presenting case studies conducted in four different SMEs. In particular, their background, key elements of KM implementation and approach were examined. Important lessons drawn from them were highlighted and it was also shown that there are a number of ways in which KM can be “implanted”. Each individual case report provides important insights into how KM is being implemented in practice, rather than in theory. They are informative and will hopefully be beneficial to other SMEs that would like to embark on the KM journey. Arguably, they need role models from companies of similar size, not from their larger counterparts that are different in terms of characteristics and features. A novel integrated framework developed by the authors for KM implementation in the SME sector was also evaluated in the case studies. The overall results were very positive, thus providing evidence that it has been appropriately developed for application in this business sector.

One of the limitations of this research is that the framework has not been used in real-life situations. Future research could focus on applying it on a longitudinal basis in some SMEs, preferably those that are just about to start KM implementation. Through such studies, more valid evaluation results should be obtained. SMEs are the major backbone of the economy of many countries, but have always been left behind in the adoption of many advanced management philosophies. It is hoped that this framework will be useful to them and pave their way towards accomplishing KM.

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