

Knowledge Management Review 2004

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Abstract

This paper provides a review of Knowledge Management looking at the historic developments over the past twenty years and emphasising the multifaceted nature of the subject area. The objective is to create a broad sketch of Knowledge Management that could help people that consider adopting knowledge management understand better the various options available, their interrelationships and possibly their limitations.

The review also provides an introduction to the kBOS Applied Knowledge Engineering Methodology and as such highlights viewpoints, initiatives and projects that have influenced the kBOS approach and development. The main conclusion is that we urgently need methodological support not for building knowledge management solutions but for using knowledge management in business process management and business intelligence solutions.

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Why Knowledge Management

The Knowledge economy

Today we live in a global knowledge economy which means that wealth generation is predominantly based on knowledge based activities. As a consequence business success is critically dependent on the capabilities enterprises have to protect, develop and utilise their knowledge-or in other words business success is dependent on a company's knowledge management capability.

The emergences of a global knowledge economy and associated demands on business strategy have been well understood since the 1980's when the concepts and strategies associated with the learning organisation became popular. Then, the message was that "The emergence of a knowledge based economy requires a new synthesis of training, education and other forms of communication and learning under the single umbrella of the learning enterprise" [L T Perelman 84].

The learning enterprise was also seen as an intelligent enterprise capable of managing well knowledge based activities which were shown to be the key to productivity and wealth generation in over ¾ of all economic activity [Services restructure the economy - J B Quinn 92].

The theme, "Competitiveness through Enterprise Knowledge Development" which became prevalent throughout the early 1990s contains two basic questions - What? and How?

- a) **What** are the new sources of competitive advantage and the new competitive strategies?
- b) **How** can business processes be developed to implement successfully knowledge oriented strategies?

Answers on *what* were found on *Customer Focus*, acknowledged as the most important source of competitive advantage. It was often said that for companies to compete in the coming decades they must increase customer value by producing products that are of consistently high quality throughout the product's life, customised to local market needs, open to facilitate integration with other products, environmentally friendly and technically advanced.

Popular theories of how this was to be done pointed to business process management implementing customer focus based strategies possibly as part of Total Quality Management. In this context organisational quality was defined as "the totality of features and characteristics of an organisation that bear on it's ability to provide, on a sustainable basis, client satisfaction". [P.C.K. O'Ferrall 95]. In a quality oriented customer focus strategy, appropriate processes are designed and continuously improved with respect to time to market and other critical success factors. Such continuous improvement use the basic evaluation and traceability concepts and techniques from the quality system. However, the need for rapid adaptation or what could be simply described as "faster improvement" creates demands for new approaches such as the learning organisation. By defining organisational learning as "the intentional use of learning processes at the individual, group and system level to continuously transform the organisation in a direction that is increasingly satisfying to it's mission and strategies" the need to do what most successful companies have been doing for years in a more efficient and effective manner was labelled knowledge management.

In the second half of the 1990's, the 'knowledge economy' and the 'information society' became recognised as the cornerstones of the global economy. A world development report in 1998 stated that "for countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living- more than lands, tools and labour".

More recently, the World Bank's prospective document for Knowledge Assessment suggests the importance for countries to analyse their capabilities for participating in the knowledge revolution. United Nation member states are undergoing fundamental changes with important implications for

how knowledge assets are acquired, sourced, created and utilised. Similar considerations are applicable at the enterprise level and many leading organisations and business networks have been increasingly investing in knowledge management. Both at a national and enterprise level, knowledge assets represent the foundation of competencies and capabilities that are deemed essential for growth, competitive advantage, human capital development and quality of life.

The motivation for adopting Knowledge Management

Knowledge Management (KM) involves business, cultural and technological approaches that support the development and exploitation of knowledge assets.

Research on the economics of knowledge has changed our views from that of the 1960's. We no longer think of knowledge as public good but a key national or company asset which is however difficult to measure, reproduce, diffuse, develop and use efficiently. The knowledge economy differs from the traditional economy in several key aspects:

- The knowledge economy is not characterised by scarcity, but rather by abundance. Unlike most resources that deplete when used, knowledge actually grows through application;
- The impact of location is diminished. Virtual marketplaces and virtual organizations can be created offering global reach and benefits associated with speed, agility and round the clock operation;
- Knowledge enhanced products or services can command price premiums over comparable products with low embedded knowledge or knowledge intensity;
- Knowledge assets remain difficult to account for in balance sheets.

Many innovative companies have long appreciated the value for knowledge to enhance their products and customer service and to provide business intelligence. The level of interest has grown dramatically during recent years as enterprises recognise that they operate in a knowledge economy and that knowledge is their most valuable asset. The key motivating forces for KM adoption are listed next.

Competitive advantage

Many organisations rely on knowledge to create their strategic advantage through creating the *capacity to excel* in carefully selected areas and/or by creating *innovation capabilities*.

KM enables organisations to optimise the exploitation of intellectual capital that is frequently dispersed, fragmented, and can be easily lost. Companies applying knowledge management methods have found that through knowledge management they can create better conditions for innovative work leading to the development of new products and services faster and better. Successful process or product innovation is the primary means of delivering customer value determined by:

- improved product quality;
- improved customer service;
- reduced cycle time;
- reduced cost to the customer.

Performance Optimisation and Risk Minimisation

In today's fast moving and highly competitive environment a business's agility and adaptability are appearing high on most agendas. To achieve this business flexibility firstly one has to clearly and accurately understand what key processes and tasks affect the current business performance before improvements actions can be identified and optimised given the prevailing investment and other constraints. Performance optimisation should ideally also provide risk minimisation.

Knowledge can command a premium price in the market

Applied know-how can enhance the value (and hence the price) of products and services. Improved customer services can be delivered through personalisation and faster customer response if customer related knowledge is effectively managed. Additionally approaching real time customer problem solving is always specially rewarded.

Operational effectiveness and efficiency

Knowledge management platforms enable companies to quickly and effectively leverage the intellectual capital and digital assets throughout their organisation enabling them to make better decisions and to shorten response times.

Companies can increase their sales and revenues and reduce drastically their operational costs by taking the knowledge from their best performers and applying it in similar situations elsewhere. They can also create value by measuring and improving key processes and reducing costs by identifying low value, non-strategic, redundant, or poorly performing processes, projects or products.

The productivity of individual users can be increased in the following knowledge-oriented tasks: information search and retrieval, location and communication with experts, avoidance of work duplication, reduction in face-to-face meetings.

Facilitating business change

What makes business performance problematic is management failure in one of the following:

- Failure in managing internal processes
- Failure to adjust interaction in the face of change in the external environment

Organisations often deal with change spasmodically and often far too late. Without effective mechanisms in place to capture knowledge of experienced employees, organisations are either reluctant to make necessary change or have to pay again for knowledge they once had on tap after restructuring or downsizing. In contrast with a knowledge management system, the change process can become part of knowledge development that leads to gradual and evolutionary changes as part of normal operation.

A Knowledge Management Overview

Defining Knowledge and Knowledge Management

There is no universal definition of Knowledge Management, just as there is no agreement as to what constitutes knowledge in the first place.

The distinction between the three terms – data, information and knowledge is relevant to establish a common understanding of terms and concepts used in knowledge management. First, data represents facts, parameters or statistics that can be analysed to produce information. Information is data related to a particular context which creates meaning. In other words data represent facts and becomes information when embedded in a context of relevance to a recipient. In contrast to data that can be characterised as a property of *things*, knowledge is a property of *agents* (people or computer systems) predisposing them to act in particular way in circumstances defined by the context.

In contrast to information, knowledge can not be directly observed; its existence can only be inferred from the actions of agents. Importantly, knowledge involves the mental processes of comprehension, understanding and learning and involves interaction of individuals with their environment. Some experts include wisdom and insight in their definitions of knowledge.

Knowledge Management is about the protection development and exploitation of knowledge assets. KM encompasses theories, models, processes and tools that support the efficient and effective evaluation, acquisition, dissemination, development and exploitation of knowledge resources in business processes and business decision making.

Knowledge assets

The fundamental principle of the Knowledge Economy is to regard **knowledge as assets** and indeed possibly the most valuable assets the organisation posses. Knowledge Assets (also referred as Intellectual Assets) are the organisation's intangible assets that relate to knowledge including intellectual property.

Knowledge assets are the knowledge regarding markets, customers, products and technologies, that a business owns (or needs to develop as part of its strategic plan) and use to implement business processes efficiently and effectively.

Explicit and tacit knowledge

Knowledge-based assets are often categorised as explicit or tacit. **Explicit knowledge** consists of anything that can be documented, archived and codified (e.g. knowledge held by designs, manuals etc often referred to as corporate memory).

Much harder to manage is **tacit knowledge**, or the personal know-how which cannot be described and is primarily manifested through the results of actions. Tacit knowledge resides in relationships, usually complex social relationships, and is implicit in the organisational culture.

In traditional perceptions of the role of knowledge in business organizations, *tacit knowledge* is often viewed as the real key to getting things done and creating new value. Thus, we often encounter an emphasis on the "learning organization" and other approaches that stress learning by doing through experience and action and generation of new knowledge through managed interaction.

Knowledge networks

Organisations store in computers (in the form of processes, instructions and data bases) only a small fraction of the knowledge needed to run an enterprise. A figure of 10%-30% is the estimated range. The rest is the tacit knowledge in people's heads which is the key to an organisation's ability to

innovate and respond in a flexible and timely manner to dynamic challenges. The role of knowledge networks is to facilitate tacit knowledge growth.

Knowledge networks provide the means for local or global knowledge diffusion. Diffusion occurs through interaction which is influenced by the network structure. Both empirical and theoretical studies have shown that network characteristics have a significant impact on how fast knowledge grows.

A key feature of a knowledge network is **the 'capacity for knowledge absorption'** by the members of the knowledge network. Knowledge diffusion works better if the knowledge level of sender and receiver of knowledge is similar.

The second important factor in knowledge diffusion is the knowledge base associated with a specific industrial sector.

Spatial clustering generates high knowledge growth rates in industries characterised by highly tacit knowledge and high potential for technological innovation. The opposite is true in industries where codified knowledge is important and in such cases special knowledge clustering could have a negative effect.

Knowledge networking IT systems provide the means of combining individuals' knowledge in the pursuit of personal and organizational objectives. In the simplest form knowledge networking supports person-to-person communications resulting in the development of new knowledge. More advanced computer conferences (forums, bulletin boards, reviews) can create a level and quality of debate not normally achievable within the conventional work environment.

Knowledge Management history revisited

Early KM history

The roots of knowledge management can be found in the management theories of the 1950's, particularly in the work of Professor P Drucker who has created a vision of management centered in the belief that the most important asset of any organization is its people. Drucker's book *Landmarks of Tomorrow* published in 1959 explores the philosophical shift from a Cartesian universe of mechanical cause to a new universe of pattern, purpose, and process. In *The Age of Discontinuity* (1968) Drucker discusses the new knowledge based universe characterised by mass education and its implications in work, leisure, and leadership.

An early landmark in the history of the development of knowledge management was the research on industrial dynamics [J. Forrester 1961]. Industrial dynamics provided theories and frameworks which address the interactions between technological and economic change and emphasised the importance of learning processes to help managers develop a more systematic and dynamic perspective.

In the 1980's the Information Technology and Information systems communities started to discuss information assets and the systems view of the organisation. The need to address both the social and technical interactions in the organisational system was highlighted- notable example is the book *Managing Strategic Change: Technical, Political, and Cultural Dynamics* (1983) by Tichy.

The growing importance of information and explicit knowledge as organisational resource was stressed in the work of P Strassmann. In the book *The Transformation of Work in the Electronic Age* (1985) information technology is looked at from three perspectives: individual, organisational and societal.

C Argyris, C Bartlett, and D Leonard-Barton of Harvard Business School have examined various facets of managing knowledge. In fact, Leonard-Barton's well-known case study of Chaparral Steel, a company which has had an effective knowledge management strategy in place since the mid-1970s, inspired the research documented in her *Wellsprings of Knowledge – Building and Sustaining Sources of Innovation* (Harvard Business School Press, 1995). Everett Rogers' work at Stanford in the diffusion of innovation and Thomas Allen's research at MIT in information and technology transfer, both of which date from the late 1970s, have also contributed to our understanding of how knowledge is produced, used, and diffused within organisations. The interest in the learning perspective of business strategy was reinforced by the perception that the success of Japanese companies is attributed to their ability to adapt quickly by learning fast from experiences [Nanaka and Johanson 1985]. By the late 1980s, the importance of knowledge as a competitive asset was apparent and theories and research were reaching maturity levels.

Knowledge Management in the 90s

The wider acceptance and popularity of knowledge management by business organisations was triggered by the work of Peter Senge on the Learning Enterprise from the beginning of the 90s. The "dogma" of the learning organisation of the future will be vision, values and mental models" (Senge 1990a).

In his book "The fifth discipline"(1992) Senge proposed five new "component technologies" each providing a vital dimension in building organisations that can truly learn. The five disciplines were **Systems thinking, Personal Mastery, Mental Models, Building Shared Vision and Team Learning**. "Enterprises are systems governed by invisible interactions, which often take years to fully play out their effects on each other. Mastery is used to mean a special level of proficiency through deep commitment to lifelong learning based on continually clarifying and deepening personal vision and understanding. "Mental models" are defined as deeply ingrained assumptions, generalisations, or even pictures or images that influence how we understand the world and how we take action. The practice of shared vision involves the skills of unearthing shared "pictures of the future" that foster genuine commitment and bind people together around a common identity and sense of destiny. Team learning is vital because teams, not individuals, are the fundamental learning unit in modern organisations and when teams are truly learning, not only are they producing extraordinary results but the individual members are growing more rapidly than could have occurred otherwise."

Closely related work includes using system dynamics models to support cognitive processes related to evolution control problem solving [Morecroft94] and Sakaiya's *The Knowledge Value Revolution* which advances two premises: first that people readily consume plentiful resources; and they treasure those resources they consider rare.

The theme of a changing world into one dominated by a service economy and therefore knowledge based activities provide the motivation for the "Intelligent Enterprise" [J B Quinn 1992]. The key concept introduced in the Intelligent Enterprise is the management of enterprise systems by focusing on human and technology interaction at the **service activity level**.

Knowledge management was introduced in the popular press in 1991, when Tom Stewart published "Brainpower" in Fortune magazine. Perhaps the most widely read work to date is I Nonaka's and Hirotaka Takeuchi's *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation* (1995).

The Learning Enterprise was seen in the 90's as an extension of **Business Process Reengineering** (BPR) which advocated radical improvement in business performance as measured by cycle time, quality, cost and customer focus through redesign of business processes. BPR, even though with questionable success, addressed the demands of the customer driven market and fuelled a number of customer focus strategies. Notable examples included the Service break through [Heske H. 1990], Customer Driven Company [Whitelley 1991], Lean [Womack 1990] and Time Based [Stalk 1990].

In the beginning of the 90's many initiatives and research projects started in the area of knowledge management. A consortium of U.S. companies started the Initiative for Managing Knowledge Assets in 1989.

In Europe the **Foundation for Enterprise Knowledge Development** –FEND was established in London in 1992 by leading enterprises and Universities. FEND focused its research in Enterprise Knowledge Development exploring the use of business models as a key mechanism in different aspects of knowledge management. This work provided an important influence on the development of the Applied Knowledge Engineering principles.

By the mid-1990s, knowledge management initiatives were flourishing, and importantly a number of European, and Japanese firms had instituted focused knowledge management programs. The International Knowledge Management Network (IKMN), begun in Europe in 1989, went online in 1994 and was soon joined by the U.S.-based Knowledge Management Forum and other KM-related groups and publications. In 1994 the IKMN published the results of a knowledge management survey conducted among European firms, and the European Community began offering funding for KM-related projects through the ESPRIT program in 1995.

The Knowledge Management perspectives

Multidiscipline domain

Knowledge management draws insights, theories and practices from a wide range of disciplines and technologies:

- **Cognitive science:** insights from how we learn and use know-how are used in tools and techniques for gathering and transferring knowledge;
- **Information and Communication Technology:** including expert systems, artificial intelligence and knowledge base management systems , object-oriented information modelling, computer-supported collaborative work (groupware), hypermedia systems, content management, decision support systems, simulation, intelligent planning, e-learning, electronic publishing technology, help-desk technology, and the Semantic Web;
- **Library and education science;**
- **Management and Organisational science:** The science of managing organisations increasingly deals with the need to manage knowledge — often explicitly;
- **Economics:** defining the characteristics of the knowledge economy.

Knowledge management themes

Knowledge management includes many different themes including identifying and mapping intellectual assets within the organization, generating new knowledge for competitive advantage, sharing best practices, benchmarking, building experience databases, making corporate information accessible at point of need and technology that enables all of the above — including groupware and intranets.

Related management strategies

Knowledge management is frequently connected with several well-known management strategies, practices, and business issues, including:

- Strategic planning
- Continuous improvement
- Organisational responsiveness and adaptability
- Risk management
- Benchmarking

A significant element of the business community also views knowledge management as a natural extension of Business Process Management.

KM Implementations

Where companies have actually applied knowledge management — and a growing number are doing so — implementations may range from massive efforts to change corporate culture to IT systems for accessing, controlling, and delivering information to employees and business partners.

We could classify KM implementations into two broad approaches:

- the social-centred approach, that mainly treats KM as a social communication process;
- the technology-centred approach, that focuses on knowledge artefacts, their creation, storage and reuse in IT systems.

The distinction is evident not only in KM implementations in companies, but also in supporting methodologies and tools.

Less frequent is the attempt to introduce a KM process and to integrate it with business processes and support information systems.

Knowledge Management IT systems

Recognition of the growing importance of organisational knowledge has been accompanied by concern over how to deal with exponential increases in the amount of available knowledge and increasing demands for adaptable products and processes. Information and communication technology provide an important part of the KM solution, in a variety of knowledge management aspects.

Early knowledge management support tools were hypertext/groupware applications and open distributed hypermedia tools. The 1980s also saw the development of systems for managing knowledge that relied on work done in artificial intelligence and expert systems, giving us such concepts as "knowledge acquisition," "knowledge engineering," "knowledge-base systems", and computer-based ontologies.

A notable example in this area was the **Enterprise project**. The Enterprise project in the beginning of the 1990's was the UK government's major initiative to promote the use of knowledge-based systems in enterprise modelling and provided significant know how in the development of kBOS. The Enterprise project focused on management innovation and the strategic use of IT to help manage change. Enterprise modelling was used to obtain an enterprise-wide view of an organisation which could then be used as a basis for taking decisions. During the Enterprise project, the Enterprise Toolset was developed. The Toolset uses executable process models to help users to perform their tasks. It was implemented using an agent-based architecture to integrate off-the-shelf tools in a plug-and-play style. The approach of the Enterprise project addresses the key problems of communication, process consistency, impacts of change on IT systems, and organisational responsiveness. The components of the Enterprise Toolset were: a **Procedure Builder** for capturing process models, an

Agent Toolkit for supporting the development of agents, a **Task Manager** for integration, visualisation, and support for process enactment, and an **Enterprise Ontology** for communication.

The Enterprise project was completed over 12 year ago. Yet despite the progress of IT technology in KM related areas as data mining and ontologies there are no KM tools, possibly with exception of kBOS, providing a truly integrated set of facilities to support the overall knowledge management process including integration with business processes.

Existing KM tools support various aspect of managing knowledge which fall under three categories:

- Knowledge acquisition tools;
- Knowledge sharing tools
- Knowledge development tools

Knowledge Acquisition Tools

- Packages for requirements analysis and knowledge engineering;
- Data Mining (or Knowledge Discovery) Software packages;
- Knowledge modelling concerned with explicit representations of knowledge including Ontologies, Enterprise Modelling, and Knowledge Management process;
- Tools for acquiring formal models and checking their structure; and, more recently, services and brokering on the Semantic Web.

Knowledge sharing tools

- Knowledge bases - best practices, expertise directories, market intelligence etc.
- Enterprise intranet portals providing a 'one-stop-shop' that gives access to explicit knowledge as well as connections to experts.
- Case-based retrieval of both structured and unstructured information;
- User profiling and information filtering;
- Personal Knowledge Manager and Personal Development Planning;
- Supported collaborative work (groupware);
- Document management, originally concerned primarily with managing the accessibility of images, now making content accessible and re-usable at the user level;
- Tools for thesaurus construction and controlled vocabularies to help manage knowledge;
- Semantic networks providing "hypertext without the content" but with far more systematic structure according to meaning;
- The Semantic Web aiming at providing knowledge-based services representing knowledge in web-compatible formats and implementing brokering agents that allow web services to be discovered and used.

Knowledge development tools

- Decision support systems bringing together insights from the fields of cognitive sciences, management sciences, computer sciences, operations research, and systems engineering in order to produce both computerised applications for helping knowledge workers in their performance of cognitive tasks, and to integrate such applications within the decision-making processes;
- Computer aided training and E-learning including on-line discussion and interactive supervision;
- Intelligent planning systems including Knowledge-Based Planning, Adaptive Systems Approaches to Planning (Genetic Algorithms and Neural Nets), Constraint Management Technology and Intelligent Agent Technology.

The Semantic Web and Ontologies

The Semantic web approach

The Semantic Web approach as envisioned by Tim Berners-Lee should provide automated information access based on machine-processable semantics of data and heuristics that use metadata. The explicit representation of the semantics of data, accompanied with domain theories (ontologies) should enable a Web that provides a more intelligent level of service to its users. In this context the semantic web will be the results of a web knowledge management system. Semantic Web technologies are still very much in their infancy. For the Semantic Web to become expressive enough to help us in a wide range of situations, it will become necessary to construct a powerful logical language for making inferences. There is a raging debate as to how and even whether this can be accomplished. When the Semantic Web becomes reality, complementary services to enterprise knowledge management will become available whilst the semantic web technologies are likely to be used in the next generation of KM tools.

Ontologies

Ontologies were developed in Artificial Intelligence to facilitate knowledge sharing and reuse. Recently ontologies have become widespread in fields such as intelligent information integration, cooperative information systems, information retrieval, electronic commerce, and knowledge management. In Artificial Intelligence, very often Ontology is defined as "*a formal, explicit specification of a conceptualisation*". The philosophical term means reasoning about something that exists in real world. On the other hand for knowledge-based systems, what "exists" is what can be represented. When the knowledge of a domain is represented in a declarative formalism, the set of objects that can be represented is called the universe of discourse. These objects in combination with the relationships that exist between them are represented in ontology. Thus, an ontology is a description (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents. Ontology definitions firstly relate the names of entities in the universe of discourse, as for example classes, relations, functions, or other objects, with texts that can be easily read by humans describing what the names indicate. Secondly, they relate the names of entities with proper axioms that limit the meaning, analysis, and use of these terms.

Ontologies obviously provide a core technology for knowledge management as they provide a shared and common understanding of a domain that can be communicated between people and heterogeneous application systems. It must, however, be remembered that Ontologies aim at consensual domain knowledge and their development is often a cooperative process involving many different people. This often results in a long development process and the results may have limited applicability given the assumption that each business organisation is unique. The usefulness of ontologies in generic domains is unquestionable and the emerging libraries of ontologies should provide an increasingly useful set of building blocks for KM solutions. *Metadata ontologies* like Dublin

Core will provide a vocabulary for describing the content of on-line information sources. For business management a set of ontologies is likely to be needed:

- *Reference ontologies*, to capture the *common* knowledge valid for enterprise systems irrespective of company location, size or sector.
- *Sectored ontologies* to capture *sector specific* knowledge
- *Specialist ontologies* to capture CSR knowledge valid under special conditions reflecting location, size and other influence factors.
- *Task ontologies* to provide specific terms for particular business tasks

KM Evaluation

Knowledge Management impact

Knowledge Management has reached maturity with growing pervasiveness in enterprises and institutions world wide. From 1997 to date, the growth of knowledge management in all different aspects has been exponential, with signs that from 2002 the rate of growth is slowing which can be regarded as a sign of maturity. A broad survey about the current and future knowledge management practice in Europe (2002/2003) by KPMG provides a good indication of the overall impact of KM in business organisations.

It should, however, be acknowledged that measurement of performance obtained from the early KM adaptors is not particularly good and this has possibly the motivating factor in serious criticism levelled at KM.

The broad KM impact – KPMG survey findings

The KPMG survey findings are representative of the way KM is used in business organisations and how businesses views the impact/benefits. The January 2003 findings reflect the interest and importance placed in KM but actual measurable benefits are only verified in only 36% of the cases.

- Business case for knowledge management
 - ▶ 80% consider knowledge a strategic asset;
 - ▶ 78% of respondents believe they are currently missing out on business opportunities by failing to successfully exploit available knowledge;
 - ▶ Companies estimate that, on average, 6% of revenue as a percentage of annual turnover or budget is being missed from failing to exploit knowledge effectively;
 - ▶ 51% state that involvement of the board members increased in the past three years
- Investments and returns
 - ▶ Average KM spending is less than 2% of revenues. ROI is difficult to quantify, but 27% report ROI above required company level, 9% report ROI at required company level, 64% say ROI is unknown.
 - ▶ Companies use knowledge management to realise synergies among units (83%), accelerate innovation (63%), achieve higher customer added value (74%), reduce costs (67%), improve quality (70%) and reduce exposure to risks (26%).
 - ▶ 50% report clear financial benefits and returns. Among the non-financial benefits, companies experienced quality improvement (73%), increased teamwork (68%) increased speed and responsiveness (64%) and better decision -making by frontline workers (55%).

A case against knowledge management

Tom Stewart in the case against knowledge management, Business 2.0, February 2002 states: "Technologists never evangelise without a disclaimer: technology is just an enabler. True enough and the disclaimer discloses part of the problem: enabling what? One flaw in knowledge management is that it often neglects to ask what knowledge to manage and towards what end. Knowledge management activities are all over the map: building databases, measuring intellectual capital, establishing corporate libraries, building intranets, sharing best practices, installing group ware, leading training programmes, leading cultural change, fostering collaboration, creating virtual organisations.

All of these are knowledge management and every functional and staff leader can lay claim to it. But no one claims the big question-why?"

The case against knowledge management by Tom Stewart reflects the difficulty of applying a broad range of management theories and IT technologies without the guidance of a coherent methodological framework. However, the multidisciplinary and broad nature of knowledge management cannot in itself be a criticism. Caution should be however exercised in being even more careful with KM solutions when specifying the problem the way KM will provide a solution and the tangible results that will provide the return on investment.

Poor performance of high technology spenders

Negative KM technology-performance statistics have been reported (Malhotra 2003) indicating renewed credibility crisis resulting from cost over runs and performance problems for major implementations (Anthes and Haffman 2003). Research studies have confirmed **a negative correlation between technology investments and business performance.**

Performance analysis of 7500 companies relative to their IT spending has revealed that:

- Companies with best performing IT investments are often most frugal IT spenders;
- The top 25 performers invested 0.8% of their revenues on IT in contrast to a overall average 3.7%;
- Highest IT spenders typically under perform by up to 50% compared to best in class peers.

Research on best performing US companies over the last years (Collins 2001) has discovered similar findings that high performance companies have lowest technological investment.

From Technology push to Strategy pull

The processing driven paradigm of KM has its focus on best practices, training and learning programmes, cultural change, collaboration and virtual enterprise. Implementation failures and cost and time overruns are directly attributed to this paradigm (Strassman 2003). The explanation for the poor performance of high technology spenders is attributed (Malhotra 2004) to the Technology Push approaches linked with Real Time Enterprise business models. It is argued that the mechanistic information processing orientation of this model generally prohibits diverse interpretations of information or multiple response options. The logic for processing specific information and associated responses are all pre-programmed, pre-configured and pre-determined.

According to Malhotra, the solution is a strategy pull model with "a built-in double loop process that enables a true sense and respond paradigm of KM". The strategy pull model should respond in real time by considering the holistic and collective effect of Real time deployment of technology and human infrastructure , utilisation in terms of what is done (processing) and Real time performance in terms of how it delivers business performance.

The way ahead

Despite the growing interest in knowledge management over the last twenty years and the undoubted importance of KM in the Knowledge Economy, progress can be characterised as single dimensional. In other words knowledge management has been developing as a discipline on its own as if it could provide solutions in isolation from the processes or decision support tools/applications where the knowledge (protected, developed, disseminated by KM) will be used.

We have identified the following requirements for the efficient and effective implementation of Knowledge Management in enterprises and other organisations:

- Establishment of a methodological framework for unified knowledge and process management solutions;

- Support for networking of knowledge management solutions;
- Establishment of an engineering discipline for designing and developing knowledge management solutions;
- Training to establish organisational conditions that render knowledge management effective;
- Development of continuous learning methods based on measurement and evaluation of processes and products and feedback handling.

To address these aspects of knowledge management, the kBOS Applied Knowledge Engineering methodology was developed and used in the development of the kBOS platform.