

ENTERPRISE KNOWLEDGE MANAGEMENT

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ABSTRACT

The knowledge-based theory of a firm suggests that knowledge is the only remaining sustainable resource that can provide competitive advantage in dynamic environments. Knowledge is a key resource that must be actively managed if manufacturing companies wish to achieve success in the decades ahead. Knowledge management refers to the ability to capture and leverage what employees know in order to share efficiencies or create innovative new products, processes or systems. It is an emerging discipline that promotes an integrated approach to identifying, managing and sharing all of an enterprise's information assets. However, research indicates that manufacturing enterprises are not exploiting the full potential of knowledge management tools and techniques. In other words, they are finding it difficult to implement knowledge based practices. This failure can be attributed to organisations' lack of understanding of ways in which knowledge workers communicate and operate through social processes of collaborating, sharing knowledge and building on each other's ideas. With this in mind, this paper aims to provide a better understanding of the concept of knowledge and knowledge related issues in a manufacturing environment. More specifically, it discusses how actively managing knowledge can enable product and process innovation by ensuring that appropriate, accurate, reliable and timely information and knowledge is being applied to decisions. The knowledge process is identified and examined in some detail. The substantive element of the research centres on establishing the design goals or functional requirements needed to build a knowledge management solution for product innovation. This Groupware based information system is being designed specifically to facilitate the sharing and integration of product related information and knowledge in a manufacturing environment.

KEYWORDS: Knowledge Management, Knowledge Process, Information System

1. INTRODUCTION

In an era characterised by changing customer requirements, decreasing product life cycles and complex systems and processes, knowledge centric activities are becoming the primary source of sustainable competitive advantage in manufacturing organisations [1,2,3,]. This includes activities such as product design and development. In this view, knowledge is a key resource that must be managed if improvement efforts are to succeed and businesses are to remain competitive in global markets. Successful manufacturing companies today are distinguished by their ability to consistently generate and capture new knowledge, disseminate it to the relevant points of action and embody it into their systems processes and products. Simply put, their success lies more in the company's intellectual and systems capabilities than in its physical assets. Managing human intellect and converting it into useful products and services is

fast becoming a critical component of competitive success. In other words, in order to add real value to their organisations, managers must seek to identify, manage and leverage the company's knowledge base.

Drucker [1] believes that the great management task of this century will be to make knowledge work productive. Davenport et al [3] also state that organisations' core competencies will centre around managing knowledge and knowledge workers in the future. They add that industrial growth and productivity gains will depend heavily on improvements in knowledge work. Thus, a viable approach is critically needed for improving knowledge work. However, managing knowledge is intricate, complex and often very difficult and consequently companies are finding it difficult to implement knowledge based practices. Wiig [4] provides a list of knowledge related problems found in organisations. These include;

- Knowledge is not managed as a valuable asset
- There is insufficient knowledge at the point of action
- Learning opportunities are often missed or not exploited
- Knowledge transfer is confined
- There is often an unnecessary division of tasks and decisions

There is little evidence (anecdotal, empirical or otherwise) to suggest that adequate provision is made for promoting, capturing, sharing and disseminating knowledge in organisations. Also, as knowledge management initiatives and systems are just beginning to appear in organisations, there is little research and field data to guide the development and implementation of such systems or to guide the expectations of the potential benefits of such systems. This paper attempts to address some of these issues. We aim to provide a better understanding of knowledge and knowledge related issues. The essential element of the research centres on establishing the design goals or functional requirements needed to build a knowledge management solution for product innovation. This Groupware based information system is being designed specifically to facilitate the sharing and integration of product related information and knowledge in a manufacturing environment.

2. UNDERSTANDING KNOWLEDGE WORK

Contemporary business systems have become more knowledge intensive and this specialisation of work leads to an increasing need for knowledge workers. In this type of organisational structure what flows most between knowledge workers is information and data as opposed to physical material. This is depicted in the new, virtual value chain as illustrated in Figure 1. In this view, the intangible activities of the virtual value chain are replacing the material activities of Porter's physical value chain. This illustrates a shift from visible and tangible assets (e.g. materials, production machinery and hardware) to invisible assets and intangible assets (e.g. creativity, competence and skill). Knowledge workers convert information to knowledge, using their own competencies, sometimes with the help of suppliers of information or specialised knowledge. Not only do knowledge workers use their knowledge to interpret incoming information, but they also create new knowledge as well. Knowledge work it is performed by professional or skilled workers with a high level of expertise and competence.

Knowledge workers' value is acquired through formal education. Such people understand how to learn and will continue to learn throughout their productive lives. What is learned and how it is applied will determine competitive success. Knowledge workers need to be challenged

to achieve and they often prefer demands to be made on them by knowledge rather than bosses. They favour performance-oriented organisations or task driven ones to authority driven organisations. According to Takeuchi [5] knowledge workers now constitute 35-40% of the workforce and he adds that they will become the leading social group. Therefore, organisations' core competencies must focus on managing knowledge and knowledge workers. Furthermore, industrial growth and productivity gains will depend heavily on improvements in knowledge work.

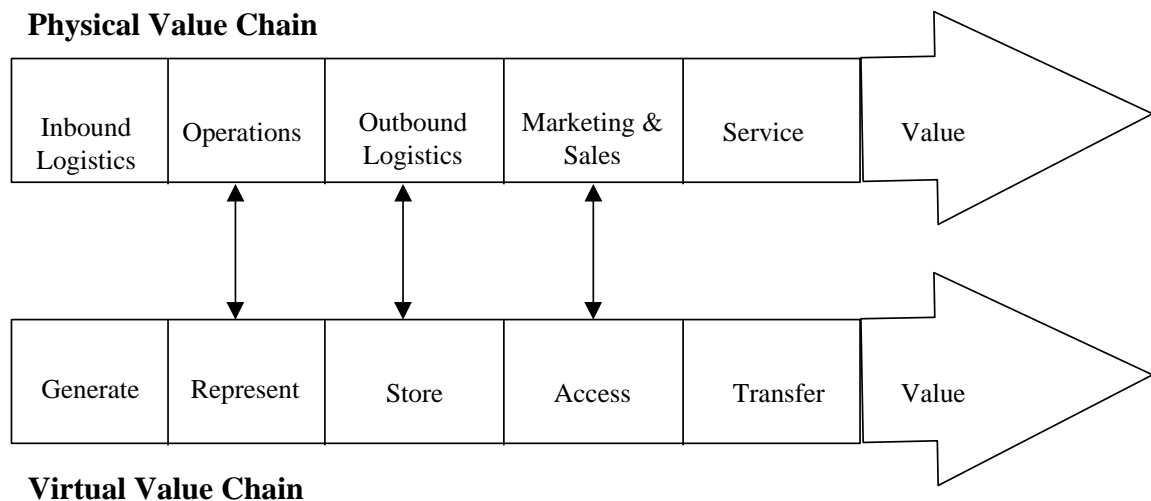


Figure 1. The Virtual Value Chain adapted from Rayport, and Sviokla [6]

3. DEFINING KNOWLEDGE MANAGEMENT

Many Information Technology journals define knowledge management in terms of understanding the relationships of data, identifying and documenting rules for managing data and assuring that data are accurate and maintain integrity. However, knowledge should not be viewed simply as data or information that can be stored in the computer as it also involves emotions, values or hunches [7]. Knowledge management is an emerging discipline which aims to leverage know how across the entire organisation. It is a capability that allows organisations to leverage their collective knowledge to improve performance and this capability must be built over time. Bassi [7] defines knowledge management as the process of creating, capturing and using knowledge to enhance organisational performance. Blake [8] believes it is “... *the process of capturing a company's collective expertise wherever it resides and distributing it to wherever it can help produce the biggest payoffs*”. Parlbay [9] also believes that knowledge management is the discipline of capturing knowledge based competencies, storing and disseminating them for the benefit of the organisation as a whole. Ruggles [10] considers knowledge management as, “*an approach to adding or creating value by more actively leveraging the know how, experience and judgement resident within, and in many cases, outside the organisation.*” Taking these definitions into consideration knowledge management can be considered to be a systematic and organised attempt to use knowledge within an organisation to transform its ability to generate, store and use knowledge in order to improve performance. In short, the overriding purpose of enterprise knowledge management is (a) to ensure that organisations have sufficient and

appropriate knowledge to support their operations and (b) to ensure that they optimise the knowledge resources available to them.

4. THE KNOWLEDGE PROCESS

The knowledge process usually involves several stages or sub-processes. The key stages in this process are; (1) generate knowledge, (2) represent and embed knowledge, (3) store knowledge, (4) access knowledge and finally, (5) transfer knowledge. These are illustrated in Figure 2 and examined in more detail below. In order to successfully manage knowledge, enterprises should focus on these five activities.

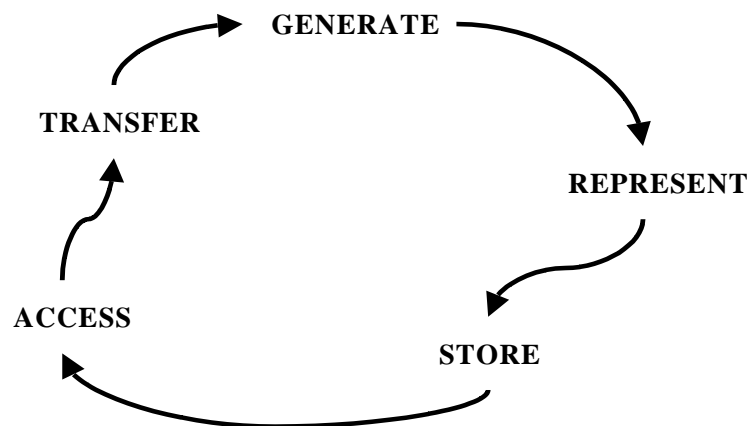


Figure 2. The Knowledge Process

4.1 Generate

Knowledge generation includes the creation of new ideas, the recognition of new patterns, the synthesis of separate disciplines and the development of new products and processes. It encompasses both creating new knowledge and acquiring existing knowledge from somewhere else. According to Nonaka and Takeuchi [2] organisational knowledge creation is a never ending, iterative process. They add that this process is not confined within the organisation, but it also takes place between organisations. Knowledge (or facts and information) can be obtained by activities such as; scanning the external environment, capturing the voice of the customer, undertaking research and development, etc. Often the most fruitful knowledge generation for product innovation involves identifying problems and suggesting solutions to rectify them.

4.2 Represent

In order to reuse knowledge some form of representation of knowledge must take place. Knowledge representation or codification is the process of putting knowledge into various forms that can be accessed, leveraged and transferred. Representations can range from strict and formal codification (such as policies and procedures) to an archive of tacit elements (such as stories and lessons learned). Tools such as knowledge maps help address where to find knowledge within and between organisations. They are designed to help people to find what they need to know whether it is a person, place or thing. Knowledge maps are also used to sketch the knowledge

flows within a process, from acquisition (including generation) through development, storage and transfer.

4.3 Store

Organisational memory incorporates both hard data such as numbers, facts, figures, and rules as well as soft information such as tacit knowledge, expertise, experiences, anecdotes, critical incidents, stories, artifacts, and details about strategic decisions. It is important to have mechanisms, which can store and retrieve all kinds of data, information and knowledge. Most organisations have various kinds of information systems such as inventory control systems, budgetary systems, and administrative systems to store "hard" data or facts, but do not have similar systems to capture "softer" information and knowledge. Ideas generated by employees in the course of their work are rarely shared beyond a small group of colleagues or team members. It seems that greater organisational learning can occur if these experiences and narratives are stored electronically for future reference.

4.4 Access

Knowledge and information are located in many different places in an organisation. Knowledge such as best practice accounts, lessons learned and experience can be found in the heads of professionals, managers and engineers while, customer information, reports and procedures are often scattered across paper files and computer media. This is particularly evident in the product development process. It is imperative to integrate these systems, databases and applications to support knowledge management objectives. Technology in the form of data dictionaries and online databases facilitate the integration of systems knowledge and information. Organisational knowledge management uses repositories and improved access to make critical knowledge available wherever and whenever it is needed. Hypermedia-based information systems are highly beneficial in areas that deal with large, complex, richly connected, and cross-referenced bodies of information.

4.5 Transfer

Knowledge transfer is designed to enable the flow of knowledge among and between individuals and groups. The cornerstone of management lies in being able to effectively communicate policies, procedures, technical reference and quality standards, all of which form an organisation's asset of knowledge based information. Knowledge transfer or distribution refers to the process by which an organisation shares this knowledge and information among members, thereby promoting learning and producing new knowledge or understanding. Much learning and innovation takes place in informal networks, often called "communities of practice". GroupWare or collaborative systems facilitate these networks. They allow the joint construction and distribution of experiences and insights and enable the creation of social networks. Thus, they not only support communication but also collaboration.

5. DESIGN GOALS FOR A KNOWLEDGE MANAGEMENT SYSTEM

The development of systems to assist in managing knowledge has received considerable attention in recent years [3, 4, 9, 10]. Tools can be defined as technologies, which support the performance of activities or actions. Therefore, knowledge management tools can be defined as technologies, which promote and enable the knowledge process in order to improve decision making [10]. In this view, facilities that help generate, capture, represent, store and transfer

knowledge and information are essential elements of such a system. Knowledge management tools can also be used to clarify assumptions, speed up communications, elicit tacit knowledge, and construct histories of insights. In some cases they may be able to automate certain kinds of work. Nevertheless, the role of the tool is purely an enabler with the onus on humans to conduct knowledge activities. Knowledge management tools are designed to ease the burden of work and to allow resources to be applied effectively to tasks for which they are most suited. Not all tools are computer based but much emphasis is placed on them due to their dynamic capabilities, quick evolution, and organisational impacts. Our research focuses on developing a knowledge management system called Product Innovation Manager (PIM) to support collaborative product innovation. In order to design and develop such a system we ascertained the available strategic options and examined the various knowledge management problems faced by product development teams and their managers. These requirements were captured and translated into design goals. This section focuses on; (a) introducing the strategic choice available to us and; (b) outlining the design goals for Product Innovation Manager.

Hansen et al [11] propose two types of strategies for harnessing corporate knowledge namely codification and personalisation. The codification strategy focuses on computers. In this instance knowledge is carefully coded and stored on database systems where it can be accessed and used by others. On the other hand, the personalisation strategy focuses on enabling social networks in order to help people communicate knowledge as opposed to storing it. Research in product development suggests that new products seldom begin from scratch but rather each new development is built from an existing product or platform. Therefore, not only is it necessary to facilitate collaborative work but it is also essential to be able to access and reuse previous work and lessons learned. With this in mind, we believe that the right balance must be found between appropriate codification of knowledge (such as logging problems) and personalisation (such as working in teams).

The PIM software is a client based lotus notes application that provides a holistic and integrated approach to the knowledge process. It identifies the key elements of the process and integrates them effectively. The groupware platform enables us to build systems (codification) based around the concept of virtual workgroups. By selecting this technology, adopting its design architecture and building a suitable application a synthesis is achieved between the 'hard' and 'soft' elements of change. The remainder of this section outlines the functional requirements for PIM. As a result of our research we have identified six design goals for the system. These are (a) enterprise connectivity and integration; (b) requirement driven design; (c) effective use of information and knowledge; (d) integrated product realisation; (e) promote transparency and traceability and finally (f) enable project portfolio management. These are introduced and discussed in more detail below.

5.1 Enterprise connectivity and integration

A major challenge in product development is keeping everyone focused in the same direction. PIM must promote the product strategy, which defines the aims and objectives of the product innovation effort in relation to the company's overall strategy. This should focus and integrate team effort and permit delegation. More specifically, PIM should provide an infrastructure that drives the organisations strategies and their associated performance measures down the organisation to the operational level. It should also enable the integration of innovation data, which is crucial to the efficient operation of the system.

5.2 Requirement driven design

The software must enable requirement driven design. The product innovation process must be customer driven in order to sustain competitive advantage in international markets. A clear understanding of user needs is critical to product innovation and all operations must be driven by these needs. The system must enable the product development team to establish the voice of the customer and translate that value into the product concept. It must enable them to identify, understand and interpret user expectations, voiced desires and as yet unperceived needs. Requirements engineering enables organisations to be pro-active rather than reactive and assures product quality as defined by the customer and/or user.

5.3 Effective use of information and knowledge

The development process involves synthesising and reusing existing knowledge. Consequently PIM should support the knowledge process by helping to develop knowledge (i.e. identify, generate acquire information and knowledge); combine knowledge (i.e. find synergies, reuse existing knowledge); consolidate knowledge (i.e. prevent it from disappearing); and distribute knowledge (transfer it to the appropriate points of action).

5.4 Integrated product realisation

The software must enable integrated product realisation. Integrated product realisation provides, uses and develops all the necessary information essential to conceive, design and develop effective products, processes and systems. It incorporates the principles of concurrent engineering and computer integrated manufacturing in order to establish an interactive approach to the development of new products. More specifically, it involves the continuous and highly concurrent application of all necessary functions and organisational elements (e.g. customer, marketing, engineering, manufacturing and support). With this in mind the system should adopt a groupware platform to support a collaborative environment.

5.5 Promote transparency and traceability

PIM should promote transparency and traceability. By doing this every project becomes visible and every project team knows that it must continuously evaluate their performance and provide updates. It brings issues, problems and assumptions to the surface where they can be examined, analysed and rectified. Managers can take quick effective action to bring projects back in line if necessary. This visibility facilitates the necessary dialogue among project managers, ensures integrity in reporting and allows everybody to see how projects are progressing.

5.6 Enable project portfolio management

Success in product innovation depends on exploiting synergy among projects, such as reusing existing designs. In this view, attention moves from single isolated projects to the project family, or project portfolio. Portfolio management recognises that organisations' efforts to innovate will include the development of both radically new, innovative products as well as small scale, incremental redesigns. Managers must maximise the value of the portfolio and seek the right balance of projects. They must also ensure that the projects and the spending breakdown mirror the business's strategy. One of the key skills in effective innovation management is balancing the composition of this portfolio and matching it to the firm's competencies and capabilities in technology and markets.

6. CONCLUSION

Manufacturing organisations are increasingly dependent on knowledge and information in order to increase innovation, efficiency and effectiveness in their operations. Consequently, effective problem solving skills, better idea generation and enhanced decision making capabilities are replacing manual skills and long hours as their basis for adding value. This is particularly evident in processes such as product development, which depends more and more on the development, use, and distribution of these knowledge based competencies. As a result of this, a new paradigm often referred to as the “knowledge organisation” is emerging. Knowledge can be defined as the integration of ideas, experience, intuition, assertions, skills and lessons learned that have the potential to create value for a business by informing decisions and improving performance. In this view, knowledge is a key enabler to product development. However, in order for knowledge to be useful it must be available, accurate, effective and accessible.

Every organisation has a unique collection of knowledge assets and distinct business problems to which those assets must be applied. Therefore every knowledge management solution must be tailor made to the firm for which it is designed. Developing a knowledge management practice requires adopting a well balanced or holistic approach. This paper introduces the concept of knowledge and knowledge work in an industrial environment. It examines the knowledge processes and outlines the functional requirements or design goals for a knowledge management system to support the product innovation process.

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