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A Collaborative Knowledge Management Tool for Product Innovation

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Abstract: In order to create and deliver innovative new products and services at an ever increasing rate, manufacturing enterprises must adopt a deliberate and systematic approach to managing the drivers of innovation. Managing the enterprise's knowledge base and converting intellectual capital into useful products and services is fast becoming the critical executive skill of the age. With this in mind, our research focuses on adopting a knowledge management approach to product innovation management. This paper introduces the concept of knowledge management for product innovation and presents a collaborative knowledge management tool specifically designed to enable product innovation management in a distributed manufacturing environment.

INTRODUCTION

Effective product innovation is imperative for the survival, growth and profitability of most design and manufacturing enterprises (Cooper et al, 1998). In the current dynamic manufacturing environment companies must innovate successfully if they wish remain competitive. Global competition, emerging technologies, and an ever increasing need for superior products in shorter time frames are all contributing forces driving organisations to adopt new and innovative approaches to product innovation. Much research has been undertaken in this area in an attempt to enhance the product innovation process in organisations (see Clark and Wheelwright, 1995; Crawford, 1996; Cooper et al, 1998). Despite considerable progress there is still significant room for improvement. We found that this is particularly evident in relation to communication, co-ordination and management issues. Product innovation is a complex, cross-functional and dynamic process, which is difficult to manage (Crawford, 1996). In order to operate effectively, timely, accurate and reliable information from many facets across the entire value chain must be available to product managers and co-ordinators to make informed decisions. In this view, information and knowledge are key resources that must be managed if improvement efforts are to succeed and businesses are to remain competitive in global markets.

As we enter this new era of business, the approach to managing product innovation is evolving rapidly. Manufacturing enterprises are paying more attention to the concept of managing their knowledge base across the entire value chain in order to increase competitive advantage (Davenport and Prusak, 1998, Sveiby, 1997). They are in the process of creating a distributed design and manufacturing environment that enables integrated product innovation. Suppliers and customers are becoming more and more involved in the process regardless of their location. The organisation's mission is to

provide the right information to the right person at the right time in the right format anywhere within the extended enterprise. In order to manage this process effectively, certain strategies and some specific technologies are required to create an enabling environment. One such strategy is finding effective methods for communication, co-operation and collaboration within the manufacturing enterprise and throughout the supply chain. The technologies that support such a strategy must be able to deal with distributed environments and databases, must ensure reliability and security and must be practical. With this in mind we have undertaken much research in this area. More specifically, we have designed and developed a GroupWare based knowledge management solution, based on our research, called Product Innovation Manager. Product Innovation Manager is specifically designed to facilitate the sharing and integration of product related information and knowledge in a distributed manufacturing environment. This paper introduces the concepts of knowledge management and how this can be used to enable product innovation management. It then presents the software solution and examines how it can facilitate product innovation management in a dynamic manufacturing environment.

ENTERPRISE KNOWLEDGE MANAGEMENT

Knowledge management can be defined as the process of creating, capturing and using knowledge to enhance organisational performance (Bassi, 1998). Parlbay (1997) 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 (1998) 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.*" In this view, knowledge management is considered to be a systematic and organised attempt to use knowledge within a company 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 to make knowledge accessible and reusable to the organisation.

According to Bassi (1998) knowledge management is a means to an end not an end in itself. Therefore, knowledge management initiatives must be linked to strategies. Strategy influences knowledge generation and use by providing a context for the perception and interpretation of the environment and a boundary to decision-making. Organisations need the focus of a well-defined knowledge management strategy in order to establish the appropriate priorities. Therefore, enterprises must develop, implement and improve proactive knowledge management strategies. Hansen et al (1999) argue that there are two different types of knowledge management strategies. The first is called the codification strategy, which focuses on the computer. In this instance, knowledge is carefully coded and stored on database systems where it can be accessed and used by others. The second strategy they identified is called the personalisation strategy. This strategy focuses on helping people communicate knowledge as opposed to storing it. Hansen et al (1999) note that the strategy chosen depends on how the company serves its clients, the economics of the business and the people it hires. We acknowledge that it is imperative to have a certain minimum critical codification of knowledge and information. In other words, it is important to represent or codify knowledge, which refers to the process of putting knowledge into various forms that can be accessed, leveraged and transferred. However, our research focuses more on connecting people to facilitate communication, collaboration and co-ordination. This is

crucial for effective product innovation management and this is discussed in more detail in the following sections.

KNOWLEDGE MANAGEMENT AND PRODUCT INNOVATION

The product innovation process can be described as an information transformation process where information is gathered, processed and transferred in a creative way. Vast amounts of information and knowledge are required by designers and developers to integrate customer requirements, ideas, problems and design changes. In addition, the effective management of multiple projects requires the easy integration of information from many project plans. The right information must be made available to the right place, at the right time, and in the right format. Without access to accurate, relevant and up to date information mistakes or misjudgements will continually be made on many aspects of the product's design, development and co-ordination. Furthermore, not only are they continually acquired, created and processed but both knowledge and information must also be transferred from one activity to another and between the relevant players involved in the product innovation process. Therefore, knowledge sharing is a vital and basic necessity for product innovation management. Frequent communication increases the amount of information and knowledge shared. In this view, more communication and collaboration usually yields more information and knowledge.

According to Jones and Jordan (1998), knowledge sharing and transfer depends on personal networks and the willingness of individuals to share. A great deal of what people learn and therefore what the organisation comes to know results from interaction among and between team members. Manufacturing enterprises leverage individual talents into collective achievements (i.e. new products and services) through networks of people who collaborate. Consequently, they are beginning to reorganise reporting lines and organisational structures not around traditional tasks or functional departments, but around communities of practice (Neef, 1997). Communities of practice are informal networks in which experience is shared among the members. These networks are not only mechanisms for communicating they also help to advance collective understanding by providing a forum for discussion and collaboration. In doing so, they create value for their individual members as well as the organisation. Communities of practice leverage knowledge through organisational pull rather than information push. They are organic networks in the sense that they evolve as a result of the informal interaction of the members over time as the knowledge base evolves as well (Patton and Carlsen, 1998). Organisations need to build systems to support and enable communities of practice. Technology such as e-mail, teleconferencing systems and GroupWare solutions have enabled the creation of these networks regardless of location.

KNOWLEDGE MANAGEMENT TOOLS

Technology is a powerful enabler to knowledge management objectives. It can be said that the goal of a knowledge management tool is not to manage knowledge by itself but to facilitate the automation and implementation of elements in the knowledge process. Tools such as data access, on-line analytical processing, and the use of the Internet and GroupWare systems for decision support and knowledge management are becoming the cornerstones of modern management. Such technologies can have a significant impact on product innovation. More specifically, benefits include:

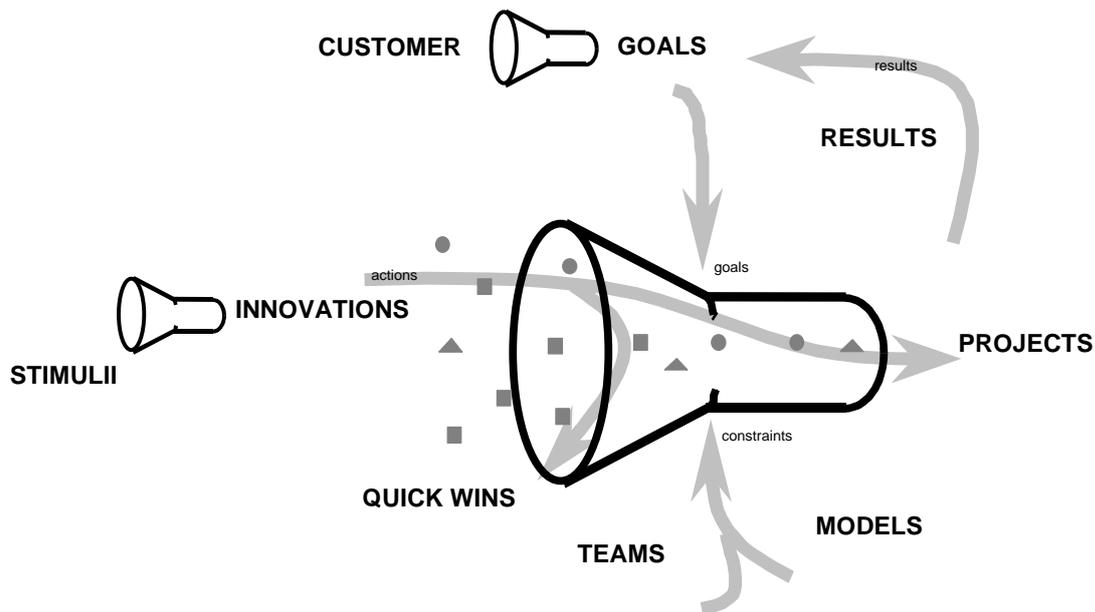
- Automating repetitive tasks.
- Managing large amounts of information.
- Reliably executing transactions.
- Enforcing operating policies, rules or methodologies.
- Increasing user productivity.
- Reducing operating costs.

Baets (1998) argues that building a knowledge management tool in order to support decision making and management should best be based on a connectionist approach. In other words, building closely connected networks of people. Such networks of individuals are lauded to generate more knowledge of a higher quality than any individual can. Furthermore, individual use of information technology is moving gradually to group use (i.e. group decision support systems, networks for exchange and electronic discussion). In recent years, the World Wide Web has enjoyed explosive growth and has become a major force in network computing. The Web is a highly interactive communication super highway. It is a natural GroupWare highway, where individuals can work together to generate ideas, discuss problems, and make decisions regardless of location.

PRODUCT INNOVATION MANAGER

Product Innovation Manager (PIM) is a collaborative knowledge management tool developed to encourage a systematic approach to product innovation management. It is designed specifically for R&D or product managers wishing to co-ordinate numerous product development projects simultaneously. The main objective of PIM is to enable a participative approach and maximise the effort and resources that are expended on new product development. Product Innovation Manager enables a dynamic framework for stimulating and capturing abstract ideas and translating them into concrete functional specifications and ultimately successful projects. It also considers both proactive and reactive problem resolution. The goal is to help generate, collate and integrate disparate pieces of information (i.e. complaints, requirements, ideas and problems) and translate them into successful product specifications. Product Innovation Manager allows innovations to be synthesised, filtered and prioritised taking into consideration the organisations' goals, requirements and constraints.

Figure 1 Product Innovation Manager



Product Innovation Manager can be visualised through the development funnel that is illustrated in Figure 1. The funnel presents a holistic view of the process of innovation and may be used to illustrate the core modules of the software solution. The front end the funnel concentrates on the idea generation stage of the product innovation process. Environmental scanning, gap analysis and other techniques such as failure mode and effect analysis (FMEA) are used to facilitate proactive idea generation, which in turn helps to identify potential opportunities for new product development. The tool also incorporates a facility for reactive problem resolution. These innovations (i.e. ideas and problems) may represent small-scale redesigns or product enhancements, as well as ideas for large-scale radical innovations. The funnel also incorporates stage gate functionality. In this view, the output from one stage or phase of the innovation process undergoes screening or filtering before it proceeds to the next stage. Screening refers to the process of testing whether concepts should be developed into products. It includes risk analysis, financial metrics, concept testing, and portfolio analysis. Therefore, innovations can be either dropped immediately, amalgamated into others, filtered or developed further.

Innovations that lead to continuous improvements need not flow fully into the funnel and can be implemented immediately by the individuals or teams concerned. These are referred to as "quick wins". Innovations that require more substantial resources flow into the funnel until they become constrained by a number of important factors such as customer requirements, organisations goals models, teams available to work on the project and the resources necessary to finance and support the project. Projects, which fit with these constraining factors, are deemed viable and eventually progress to the planning stage where the project is prioritised, a sponsor appointed and resources assigned for implementation. At this stage the project follows the typical process of project management where effective techniques such as Gantt Charts and scheduling are used to support these activities. The project is evaluated using tailored scorecards at key stages of its implementation and these results are used to influence the continuous development of the organisation's goals and strategies.

Figure 2 illustrates the many functions or roles involved in the product innovation process. It also highlights how these team members can interact with the system in a distributed environment.

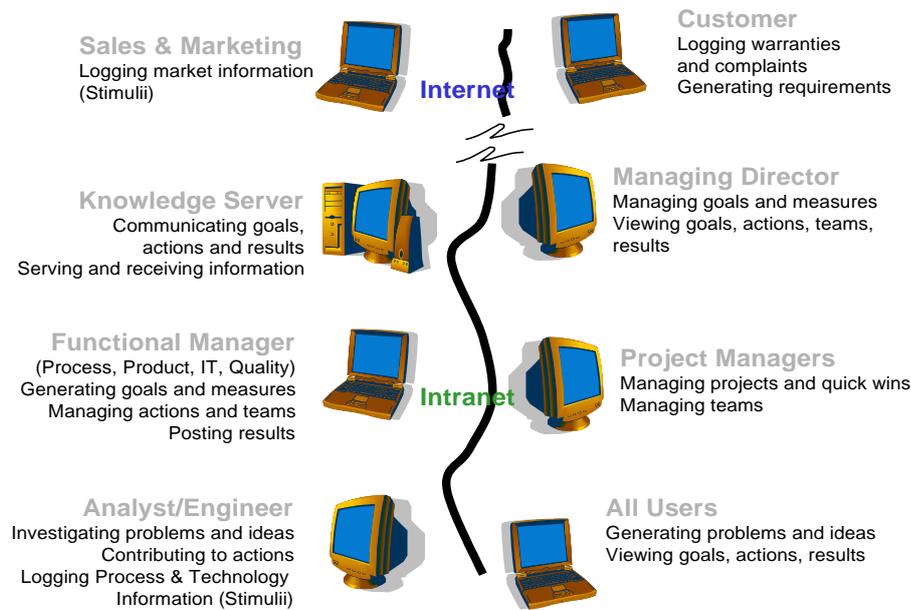


Figure 2 Functions interacting with Product Innovation Manager

FEATURES OF THE SOFTWARE

Product Innovation Manager incorporates many modules that support an integrated product innovation process. These modules represent stages in the product innovation process and are briefly introduced below.

Customers

The customer's module deals with customer relationship management. It is used to capture the voice of the customer so product developers can incorporate these requirements into their product designs. This module incorporates tools to elicit customer requirements, such as Kano questionnaires and feedback mechanisms such as complaints and warranty analysis. It provides a link to all relevant players in the supply chain.

Goals

The goals module deals with the strategic planning stage of the product innovation process. This is where the direction for the company's product innovation endeavours is identified and communicated so that all projects can be aligned with the strategic direction of the organisation. This module incorporates the operation's mission and vision, product innovation charter, strategies and performance measures. It permits everyone in the company to participate in the process as it facilitates brainstorming and group decision making.

Stimuli

This module enables external stimuli to be captured, gathered and recorded so that potential opportunities can be identified. More specifically, it enables employees to scan the external environment for new events that may have an impact on the way the product innovation process operates. This feature is effective in installing in all

knowledge workers the attitude of being on the lookout for opportunities and weaknesses in the current way of working.

Innovations

This module facilitates idea generation as well as problem identification. While concept generation tends to be spontaneous and creative, software tools can facilitate this process. For example, databases of idea associations can help product managers trigger new product features or ideas. They also help structure formal ideation and problem solving definition for the user. This feature empowers everybody to participate in idea generation and facilitates the cross fertilisation of ideas.

Quick Wins

This module acts as a stage gate in the product innovation management process. Here, actions are screened for alignment with the organisation's goals and constraints. The quick wins module of the software represents the route taken by approved innovations that do not require significant resources to implement. Such innovations invariably encompass small-scale product enhancements.

Teams

This module facilitates the effective co-ordination of team activities by organising and prioritising tasks, activities and deadlines. It can use an organisation's existing e-mail system to disseminate new or updated information and regular status reports between team members so everyone has access to complete, accurate and timely information. A performance review tool is also included in this module which incorporates skills, competencies and progress. It enables reward and appraisal systems to be linked to participation levels which can increase motivation towards change.

Models

The models module relates to the organisation's architecture. It defines the current and potential architecture in terms of process, function, information and product models. These models enable areas where innovative efforts should focus to be highlighted and prioritised. Furthermore, actions can be mapped to models to categorise and analyse the types of innovation flowing through the product innovation process.

Projects

This module permits the entire team to share project information effectively. It also enables project managers to structure workflow, and schedules, and to respond promptly and effectively to unplanned changes. It provides easy access to schedules, resource allocation information, and activity status information for all projects. This facility also provides the integration that enables managers throughout the firm to see how other schedules and events impact other projects underway. Using this facility managers can be aware of disrupted schedules and take steps to manage their individual projects effectively in response.

Results

This module deals with performance measurement and evaluation. It helps to ascertain whether the product development plans lead to the results envisioned. This is difficult because the relation between actions and results is quite often tenuous especially when the time elapsed between implementation of the action and the occurrence of results is

considerable. This feedback loop allows the organisation to develop a corporate conscience by learning from its experiences.

CONCLUSION

Successful product innovation management is lauded to be crucial to the advancement of design and manufacturing enterprises. However, this process is extremely complex and involves the effective management of many different activities. The knowledge-based theory of a firm suggests that knowledge is the only remaining sustainable resource that can provide competitive advantage in hyper competitive environments. Therefore, adopting a knowledge management approach to product innovation management can increase the likelihood of success. In this view, managers can add real value to their companies by identifying, managing and leveraging the company's intellectual base. Therefore, the development of a knowledge infrastructure is central to survival in this new era of business.

Knowledge management tools and techniques can facilitate the process of generating, structuring and sharing knowledge through the use of information technology. They are designed to ease the burden of work and to allow resources to be applied effectively to tasks for which they are most suited. This paper presents a GroupWare based knowledge management software solution specifically designed to enable effective product innovation management.

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