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A Web Enabled Solution for Managing Distributed Product Innovation

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Abstract: New organisational forms such as strategic partnerships and networks are replacing simple market based transactions and traditional bureaucratic, hierarchical organisations. Consequently, a new conception of product design and development will focus on managing strategic partnerships and facilitating communication, collaboration and co-ordination in a distributed work environment. This paper examines some of these issues. First, the changing business environment is considered. Then, the shifting workforce paradigm is examined. Within these new forms the changing role of information communication technology is discussed. Finally, we present a web-enabled solution called Product Innovation Manager (PIM) which is specifically designed to enable effective product innovation in today's dynamic environment.

1. Introduction

We are experiencing a major discontinuity in the world economy. This transformation is described by various terms in the literature notably, "*the move towards the post industrial society*" [1], "*the emergence of the knowledge society*" [2] or "*the rise of the knowledge based economy*" [3]. Contemporary business systems have become more knowledge intensive. Much work now consists of converting information to knowledge, using skills, competencies and specialised knowledge. According to Sveiby [4], an organisations intangible assets are more important than their tangible assets. Some of the major driving forces behind this transformation include:

- **Globalisation:** This refers to the emergence of cross border activity and global markets. In recent years, world trade has expanded and international markets have become more accessible. Customers, suppliers and competitors can now come from any corner of the earth.
- **Information communication technology:** The growing breadth and depth of information communication technology enables information to be communicated instantaneously within and between organisations. Furthermore, the ever declining cost for information processing has made technology and information ubiquitous [5].
- **Growth of knowledge intensive work:** Organisations are developing innovative products and services in shorter time frames, causing an increase in knowledge work and a gradual replacement of capital and labour intensive firms by knowledge intensive firms. Consequently, there is a rapidly growing interest in managing knowledge and the intellectual capital that it creates as a new source of competitive advantage.

This transition has a major impact on today's manufacturing enterprises. In order to survive in this new era of business, they must change the way they do business. Timeliness and responsiveness are now critical to success. This is particularly evident in the product innovation process where development cycles are now being measured in days and weeks. Consequently, new and more complex organisational forms are evolving every day. They are becoming increasingly distributed, flexible and responsive to environmental and market changes. The new forms show an ongoing transformation of value chains. It is becoming more difficult to accurately delineate their borders. The trend is towards virtual supply chains and flexible structures. Many terms such as the virtual enterprise, the next generation manufacturing enterprise, the knowledge-based organisation and the networked organisation have been used to articulate the structure for the 21st century global manufacturing enterprise. The new organisation focuses on core competencies and emphasises partnerships between firms, teamwork among members of the organisation often with members from two or more co-operating firms, sharing of responsibility for developing converging and overlapping technologies and often less emphasis on formal control systems. As a result of this transition, certain strategies and some specific technologies are required to create an enabling environment. More specifically, effective methods to facilitate communication, co-operation and collaboration throughout the enterprise and the supply chain are needed. 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.

The aim of this paper is to examine the new workforce paradigm and address the need for a coherent communication solution that leverages the universal communication environments of intranets, extranets and the internet to enable connectivity across the inherently complex organisational and geographic boundaries. A web-enabled solution called Product Innovation Manager is then presented which we are currently developing based on our research. This Groupware based information system is being developed specifically to facilitate the sharing and integration of product related information and knowledge in a distributed manufacturing environment. This system will benefit industry by enabling (a) seamless co-ordination of distributed product innovation projects, (b) effective deployment the project goals, strategies and key customer requirements (c) proficient knowledge capture and reuse and finally (d) exemplary visibility and clarity. Such benefits will be discussed in more detail in section 4. The next section identifies and examines the new workforce paradigm that is currently emerging.

2. The New Workforce Paradigm: The Networked Organisation

As result of the changes described above we are experiencing a radical shift in the way the workforce is organised. The balance of work is moving from stable, physically collocated functions to dynamic, competency-based, electronically collocated business networks. Virtual teams create value by synthesising information and knowledge across geographies and organisations in order to create new products and services. Work is organised around value adding projects that are carried out by small multi-skilled self managed teams. Teams co-ordinate their efforts through free and open communications nourished by trust and shared values, enabled by frequent meetings and supported by digital networks. Consequently, a new organisational form is emerging that promises to complement this new way of working. It is called the networked organisation. According to Kanter [6], networked organisations can provide companies with the linkages needed for international success.

Simply put, networks incorporate a confederation of specialists and they are often used to maximise competencies in areas such as new product development. New product design, development and deployment requires unique core competencies. Thus, several small specialist companies can increase their potential customer base by forming a network and pooling their resources. Networks are lauded to promote knowledge sharing, learning and change. They are characterised by flexibility, specialisation, and emphasis on relationship management instead of market transactions. These organisational forms were pioneered in industries such as fashion and computers where markets often span geographic boundaries, technology is complex, products change quickly and doing everything yourself is impossible. Network structures emphasise multidisciplinary work arrangements linking people and activities across formal organisational boundaries, less clearly defined authority patterns and continuous, flexible and multi-directional communication patterns.

Sproull and Kiesler [7] adopt a socio-technical systems approach to defining networked organisations. In their opinion, the technological view is one in which computers are connected to one another through an information transport medium that carries bundles of information. While the human view is one in which people are connected to one another in diverse forums to exchange ideas and other resources. Central to the networked organisation is the concept of partnership. An enterprise partnership can be defined as a collaborative alliance of independent enterprises such as customers, suppliers, competitors, service providers etc. They aim to obtain competitive advantage from sharing knowledge expertise and resources. Enterprise networks share the following common characteristics:

- They are composed of a series of bilateral relationships, which tend to be horizontal rather than vertical
- They are adaptive. In other words, they have the ability to reconfigure themselves quickly to meet changed conditions.
- Leadership is value driven. In other words, it tends to be based on competence and personality rather than on social and organisational position.
- Power turns over frequently and more easily than in bureaucracy, changing hands as new circumstances arise that require new skills.
- Information communication technology (ICT) provides them with new platforms to collaborate efficiently.

Moving to this new workforce paradigm demands support structures to enable communication, collaboration and project co-ordination. For example, in the product innovation process, effective communication structures are essential to integrate the knowledge and skills required to design, develop and deploy a successful product. Communication always has been a fundamental problem in complex projects [8]. Costly breakdowns in communications often occur even in the traditional world of collocated groups engaging in physically oriented activities. However, in a distributed environment where team members are spread across geographical boundaries, it is imperative to make substantial efforts to ensure adequate and effective communication. Consequently, the next section explores the changing role of information communication technology in order to enable this new workforce paradigm.

3. Information Communication Technology for Virtual Teams

Organisational computing is evolving from centralised processing to inter and intra connected systems [9]. The internet has emerged as a practical and cost effective infrastructure for linking product development team members with each other and key

customers and suppliers. Although electronic data interchange (EDI) has existed for several decades to facilitate business to business information exchange it has increased dramatically since the widespread adoption of the world wide web [10]. 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 where individuals can work together to generate ideas, discuss problems, and make decisions whether they are in the same room, or halfway around the world. For example, web enabled groupware systems, desktop video-conferencing and collaborative document authoring enable distributed development teams to communicate electronically. This provides an efficient approach to asynchronous communication and the management of project data and documents. Furthermore, the facilities offered by shared workspace technology allows product developers who are separated geographically to share and discuss text, calculations and graphical information synchronously over computer networks, through a common computer interface called the shared workspace.

According to De' and Mathew [11], web technologies constitute a set of technologies related to the three main components of the web: the client, the server and the network. Client ware incorporates client terminals, browsers, encryption software etc. A recent trend in client machines is to have "thin clients", that is client machines that have small permanent storage and very few applications loaded on them. Such machines rely fully on the server to provide all software applications. They are a less expensive hardware option that provide almost the entire functionality of a regular client PC. The web server is a software application that resides on the local server computer and routes the interactions between the client and remote servers. Finally, network ware consists of all hardware, software and cable ware, either leased or proprietary and message carrier services. The application of client server technology is becoming increasingly popular in today's organisations and is continuously gaining market share. For example, International Data Corporation, a market research firm, report that US mid sized companies (i.e. those earning between \$50 million and \$1 billion per annum) are estimated to have spent \$201 million on client server technologies in 1996. They predict that this figure is likely to jump to \$968 million in 2001.

In sum, web enabled information communication technologies offer the potential to significantly improve product quality and to reduce the cost and time-scale of design projects involving parties with a widespread geographic area. Networked operations are now a reality as companies are exploiting this electronic medium to distribute, disseminate and communicate information in house and across organisational boundaries.

4. Product Innovation Manager

We are currently developing a software solution called Product Innovation Manager (PIM). PIM is a web enabled collaborative tool which is being developed to encourage a systematic approach to product innovation management. It is designed specifically for product managers wishing to co-ordinate numerous product development projects simultaneously. The main objective of PIM is to enable a participative approach to product innovation 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 incorporates a stage gate facility which

allows innovations to be synthesised, filtered and prioritised taking into consideration the network's goals, requirements and constraints.

PIM is specifically designed to address today's workforce paradigm components. It provides the tools needed to co-ordinate the workforce, and provides seamless information about all product design and development options. The tool can also support multiple users across the entire product innovation process. This is illustrated in Figure 1.

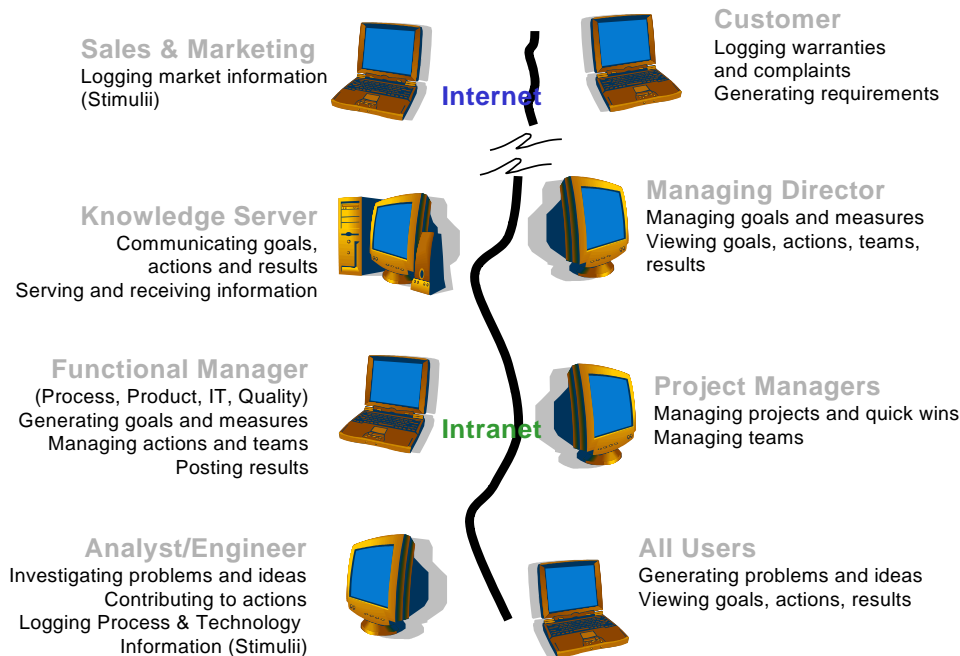


Figure 1 Distributed Users Interacting with Product Innovation Manager

Direct access technologies or self-service technologies allow workers to access records, documents and companies strategies and measures. This technology eliminates redundant paperwork, reduces the number of transactions and requests requiring staff intervention and decreases input errors. PIM can provide such productivity enhancing capabilities by using advanced technologies such as the browsers and the internet. With the new workforce paradigm focusing on teams and projects, the new system must support and bring efficiencies to these work group models. PIM can deliver significant competitive advantages to forward thinking organisations looking for a solution that supports the new workforce paradigm. The main benefits of the system include:

- **Connectivity and integration:** A major challenge in distributed product development is ensuring that project teams are focused in the same direction. PIM promotes the product strategy, which defines the aims and objectives of the product innovation effort in relation to the network's overall strategy.
- **Requirement driven design:** The software enables requirement driven design. The system enables the product development team to establish the voice of the customer and translate that value into the product concept.
- **Effective use of information and knowledge:** The development process involves synthesising and reusing existing knowledge. Consequently PIM supports 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).

- **Integrated product realisation:** The software also enables integrated product realisation. This 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 adopts a groupware platform to support a collaborative environment.
- **Promotes transparency and traceability:** PIM also promotes transparency and traceability. It allows issues, problems and assumptions to come 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.
- **Enables 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. Managers must maximise the value of the portfolio and seek the right balance of projects.

5. Conclusion

Increased cross border activity, growth in knowledge intensive work and developments in information communication technology have enabled the shift from hierarchical, bureaucratic organisations to decentralised networked organisations where information and decision making move horizontally. Recent attention paid to such organisational forms suggest that companies will need to become increasingly distributed, flexible and responsive to environmental and market changes in order to stay competitive. We believe that this has a major impact on activities such as new product development where organisations are forming networks, based on partnerships, to pool resources and maximise competencies and capabilities. Furthermore, we found that communication, collaboration and co-ordination are key elements in the foundation of creating a durable competitive advantage in a distributed environment. Consequently, new product development project teams need support technologies to facilitate communication, collaboration and co-ordination.

Much interest has risen in the use of web enabled computer based collaborative working technologies, which facilitate the creation and implementation of virtual development teams. Internet technologies enable internal and external constituents to work in tandem and collaborate efficiently unhindered by geographical constraints. The principle lesson we have learned is that internet based information communication technologies must be exploited to enable the new workforce paradigm. Consequently, we are currently developing a web-enabled solution called Product Innovation Manager (PIM) which is specifically designed to facilitate communication, collaboration and co-ordination in a distributed work environment. PIM allows information captured anywhere in the enterprise to be instantly available to workers across the extended value chain. This means groups can base their decisions on a much broader perspective than before. The system, however, must be subjected to further beta testing and applied in an industrial setting.

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