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Abstract

Recent developments in Internet technology and the World Wide Web have the potential of making the product development process truly integrated, simultaneous, flexible, and responsive. However, little is known about how the Web can be effectively used for new product development. Based on the premise that Internet technology can be an agent of enterprise information integration, information enabled organization, and customer responsiveness, we develop a reference model which lays out the scope and benefits of using the Web for new product development. We also develop an implementation framework that informs product development managers about a variety of Web technologies that can be used for Web-based product development.

Introduction

Considerable research effort has been devoted to understanding ways to make the new product development process more effective and efficient, i.e., it should lead to the development of innovative, high quality, and successful products in the shortest possible time. In recent years, several new ways have been suggested for improving new product development such as through the use of cross-functional teams, simultaneous or parallel product development, computer-aided design, quality function deployment, customer focused product development, supplier involvement, and so forth (Crawford 1996). While these efforts have no doubt led to many meaningful insights for improving the new product development process, an opportunity has surfaced with the recent developments in Internet technology and the World Wide Web, which if meaningfully exploited, can substantially change new product development as we know it and bring manifold improvements in its effectiveness and efficiency. However, not much is known about how the Web can be effectively used for new product development. For instance, Hameri and Nihitila's (1997) study mainly examines how the Internet can be used to exchange CAD files. Similarly, Iansiti and MacCormack (1997) largely focus on how firms like Netscape, Microsoft, and Fiat have used the Web to seek inputs from internal and external customers of their products in order to improve product concepts/designs as well as the flexibility of the product development process.

Traditionally, the use of information technology in new product development (NPD) refers to using computers to do certain tasks that were previously being done manually. Computer-aided design (CAD) is a good example of information technology replacing manual preparation of engineering drawings. However, deploying Web for new product development goes beyond simply automating manual tasks with the help of computers. The Web is an integrating technology which can cut across traditional functional and organizational boundaries and encompass other external partners such as suppliers, distributors, etc.. The Web can, in fact, create an information enabled product development organization, i.e., an organization where either certain operations would not have existed without the use of the Web or would have been highly inefficient in its absence (e.g., virtual product development teams). Considering the vast potential of this technology, instead of asking the question "where in the product development process should the Web be used," a more appropriate question would be "what can Web-based product development help firms achieve?"

Web-Based New Product Development

There are two basic reasons that make new product development an appropriate context for exploiting the benefits of the World-Wide Web. *First*, modern day new product development is a complex activity that cuts across departmental as well as organizational boundaries and spills over to supply chain partners (e.g., suppliers and sometimes even suppliers' suppliers) and other extended enterprise partners (e.g., technology providers, alliance partners, distributors, lead customers, research labs, etc.). As noted before, the Web is an integrating technology which can span traditional functional and organizational boundaries. *Second*, diverse computing platforms employed by firms generally make it difficult to share product development information in the form of computer files between different departments/divisions of a business as well as between the firm and its external partners. But since the Internet and Web technologies are independent of the computing platform, they are excellent for the purpose of integrating diverse product development information resources within a firm and across organizations.

The three basic principles that we employ to model Web-based New Product Development systems are: the Enterprise Information Integration Principle, the Extended Enterprise Principle, and the Responsiveness to Customers Principle (Hsu and Pant 1997; Pant 1997). Enterprise Information Integration Principle is concerned with the role of information technology in enabling the networking of multiple, diverse organizational processes and integrates diverse information resources across multiple functions. Consequently, the application of modern information technology to the NPD process allows a different view of the NPD process to emerge – that of a process, inherently complex, but well integrated with other functions and processes through information technology. The Extended Enterprise Principle states that an integrated enterprise is also effectively connected with its external constituencies and the Web is the agent of this integration. The extended enterprise principle is particularly relevant to new product development activity which relies on inputs from and interaction with a number of external partners like suppliers, technology providers, alliance partners, distributors, lead customers, research labs, etc. And finally, Responsiveness to Customers Principle is based upon the fact that the Web has the potential of helping individuals involved in new product development to get in direct and immediate contact with customers and, thereby, enhancing responsiveness towards customers.

Goals and Technology Analysis for Web-Based New Product Development

The above three principles lead to three categories of goals for Web-based NPD namely: (1) internal information integration goals, that are essentially related to the role of a corporate intranet in integrating myriad databases and transaction processing systems of a product development organization. Effective information integration is critical for the development of innovative and high quality products as well as for the reduction of product development cycle-time. For instance, development of an innovative product requires discovery of novel linkages between customer needs, technology, and the firm's resources (Kanter 1988; Van de Ven 1986). Novel linkages are more likely to be found if there is effective integration of diverse functional information (Kanter 1988; Van de Ven 1986). (2) extended NPD organization goals are related to the role of a corporate extranet (i.e., a Web-based information system that is designed to interlink an organization with its external partners) in integrating myriad databases and transaction processing systems of the extended product development organization and, lastly, (3) responsiveness to customers goals are related to the role of a public Internet as a world-wide universal user interface in bringing the product development organization closer to its end customers and distributors as well as enabling it to become more responsive to the needs of these individuals.

One important practical issues that need to be addressed by a firm before it begins to implement the goals included in the model for Web-based NPD is: among different types of Web-based technology applications, which are more appropriate for implementing these goals? This question is answered by looking at the potential of Web-technology applications for new product development. We divide these applications into five categories, namely, (1) non-Web applications (e.g. e-mail and ftp) which are two very easy to operate non-Web applications of the Internet that are already very popular. Besides transferring plain ASCII text, reasonable size non-textual data such as graphics (e.g., CAD files) and audio files (e.g., containing excerpts of customer interviews) can also be sent over the Internet as attachments to e-mail using what are called Multipurpose Internet Mail Extensions (MIME). For exchanging bigger CAD files, FTP is a more appropriate application. (2) static Web pages can greatly facilitate the NPD process as a means of communication and collaboration among different individuals involved in the project who can post their comments on the project through tools like bulletin boards. Such Web-pages are also useful tools for file interchange in a visual environment. For example, a project team can create an image map of an entire product or sub-assembly that it is designing. This image map can be hyperlinked to other objects, which can be a picture, a document, or a CAD file. As different parts of the image map point to other objects, navigation to the desired image/document/file becomes a lot easier. Static Web-pages can also be used to view three dimensional virtual models of the product concept or product design, which can be created using the virtual reality modeling language (VRML) (Tittle, 1997). (3) interactive Web pages enable two way communication between the user and the Web server. Consequently, if a product designer wants to get information about a newly developed product concept, and then would like to post back comments about the concept on the concept development Web-site, he/she can quickly do so through an interactive Web-page, and in real time. Similarly, files created by the design team can be accessed by manufacturing engineers, modified, and re-posted on the Web server of the design department. Interactive Web-pages can also be used to conduct a desk-top video-conference, e.g., members of a virtual team who are located at different sites can hold a brainstorming session. Like static Web-pages, interactive Web-pages can also be used to view three dimensional virtual models created by VRML. (4) Web to local database connectivity refers to using a Web page as an interface to a database. Some significant advantages of Web-database connectivity are: (i) different individuals involved in new product development can have access to the same latest information in the database either over a corporate

intranet or extranet (e.g., if the virtual product design team is geographically dispersed, the team can access and update the same database over the Internet), (ii) input from customers, vendors, and other product development constituents in such a scenario is captured in the product development database directly, and, (iii) product development constituents can access the product development database through Web pages and easily obtain the latest data in the format they want. (Ju, 1997) (5) Web to distributed database connectivity allows integration of databases distributed over a local area, wide area, or a global network. For example, if product development databases are actually distributed geographically, it is possible to connect these databases over the Internet. In that case, changes made in the product development database at one location will automatically be reflected in the database at another location. This functionality will impart true agility to the global NPD process.

Conclusions and Discussion

Based on the premise that Internet technology can be an agent of enterprise information integration, information enabled organization, and customer responsiveness, this paper describes the outline of a model which lays out the scope and benefits of using the Web for new product development. The model suggests that the use of the Web for NPD can make the product development process truly integrated, simultaneous, flexible, and responsive. We have also developed an implementation framework that informs product development managers about the five levels of Web-based applications for automating new product development. This model and the implementation framework have already been developed but could not be reported fully in this paper due to space constraints.

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