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VIRTUAL COLLABORATIVE DESIGN TEAMS IN THE PREMINV EXEPERIMENTAL PLATFORM

George Stelică DRĂGOI, Costel Emil COTEȚ, Luminița ROȘU, Sebastian ROȘU, Gabriela PĂTRAȘCU

Abstract: *This paper presents a synthesis of the CESICED project issues. This project provides an open platform for collaborative design. It aims at developing a data model that can be reached using external computer services (i.e. expert applications) related to virtual product development. The first part of the paper deals with the concepts proposed to link the dimensions as the information kernel of the project. The model based on specific references aims at being enough generic to be connected to any kind of computer services. The second part of the paper presents the global software architecture of the CESICED platform.*

Key words: *virtual teams, collaborative design, virtual networks, knowledge management, outsourcing.*

1. INTRODUCTION

The goal of product agility customization design is to satisfy individual requirements and provide products at the lowest cost, the best quality and the shortest time, in which configuration design and variant design are the primary methods. Abundant design knowledge is needed, and cases and designers' experiences should be maximally utilized to shorten product development cycles. Therefore it is necessary to collect and manage the design knowledge generated from the product agility customization design process, and thus provide a good mechanism of knowledge accumulation and reuse so as to support designers' decision making.

Compared with the traditional product designs, collaborative product design is much more knowledge-intensive, i.e. product agility customization design embodies much more knowledge and knowledge-based activities of designing products are becoming the primary parts of enterprises attempting to meet customers' needs and create the greatest potential for competitive advantage. Designers are not only exchanging geometric data, but more general knowledge about design and design process, including specifications, design rules, constraints, rationale, etc [1]. In this situation, the need for an integrated knowledge resource management environment to support the representation, capture, sharing, and reuse of design knowledge among designers becomes more critical [2]. The engineering design community has been developing new classes of tools to support product data management (PDM), which are making progress toward the next generation of engineering design support tools.

Today, engineering product development is a knowledge intensive creative action. The whole product development process will access and capture quite lots of knowledge about design and design process. Design catalogue is used to capture and store engineering product design knowledge [2]. Ontology is also employed to aid acquire product knowledge, since ontology provides an explicit scheme of structuring knowledge content according to coherent concepts. Many kinds of knowledge acquisition method are integrated with work in product design process, which satisfies its requirements of knowledge [3]. In addition, web-based computer aided design technologies are becoming new product development methods driven by customer requirements, which needs to capture the relative knowledge through Internet/Intranet environment [4]. Web-based information platform provides abundant information resource for product innovation development. However, the traditional knowledge acquisition methods have not met the requirements of knowledge capturing, disposal, and use in the Internet/Intranet environment. So many researchers begin to study how to quickly acquire knowledge by internet technologies. A great deal of technical data and information including experience generated from product development exists in the form of files, communications, meeting notes and Emails, in which, design semantic information, such as design intent, design rationale, etc. is regarded as the important knowledge resource and the basis of new product development and the past product improvement. There are abundant product knowledge resource, but designers usually do not know where to find the right design knowledge, how to understand the original design purpose, how to reuse design methods, and so on. The main reason is that the technical data and information can not be effectively organized, stored, and accumulated due to lack of methods and tools of knowledge acquisition, which leads to many efforts spent on retrieval.

2. VIRTUAL COLLABORATIVE DESIGN TEAMS

Recent research has focused more on implementing knowledge management in organizations, which identify knowledge as a new weapon in competitive war [1]. The value of knowledge can be recognized if organizations use the knowledge resources and make them available and accessible for other users. Knowledge management approaches are implemented in virtual organizations to change its classical paradigm with dynamic external environment change and provide effective services internally to meet market demand as well as enhance entire organizational services. Virtual teams have the advantage of global benefits because they have international partners in the area of business. All partners are, in a sense, experts in their own economy and each one contributes a large part to the virtual corporation, or group of corporate partners involved [2, 3]. Virtual organization is one of the potential and ideal places for knowledge management processes since knowledge is a 'culture' among teams or partners. Therefore, it becomes a suitable place to apply the knowledge management practice to support its functional and operational process [4]. Increasing product complexity, shrinking design cycle times, and explosive global competition are forcing organizations around the world to collaborate in ways not previously considered [5]. The virtual organization focuses around the idea of a group, which is not constrained by traditional boundaries of space and time. A strong virtual organization has to identify the strategic options for building the knowledge sharing culture in order to become competitive. In this context, the paper presents the potential implications of the knowledge sharing culture in virtual organizations and discusses the correlation between the management functions and the knowledge cycle. Further, this study focuses on the knowledge management systems applications and tools, particularly in virtual collaborative design teams.

This paper describes the application of a Collaborative Design System to optimize the Design of a product from a multidisciplinary perspective. Development teams involved in the product development are often geographically and temporally distributed. There is a high level of outsourcing, not only in the domain of manufacturing but also in the actual product development efforts. The cooperation often implies not just a simple made–to-order development but also a real collaboration among the companies involved in the definition of a new product. It is then possible to say that enterprises give rise to a special type of virtual enterprise, in which each company maintains the greatest flexibility and business independence. Each member contributes its specific core know-how to the virtual enterprise. In the virtual enterprising context, it is possible to define the term virtual teams as a temporary cooperative activity of independent and distributed partners concerned with the translation of customer requirements into system functionalities [6].

Also, today, what do you want in an e-teams with multidisciplinary optimization? First, for your enterprise: low risk, low cost, single point of support; reap benefits as soon as possible, ready for unpredictable demand and growth, future capabilities.

Secondly, for your customers: excellent response time, ability to build competitive advantages from a wide variety of applications (use specialized products for unique features, integrate them for seamless customer support etc), ensure optimal customer experience to build loyalty, customer trust (security features build trust: validate who is doing business with whom; secure financial transactions, protect internal assets, halt spread of viruses, protect against hackers), high availability etc.

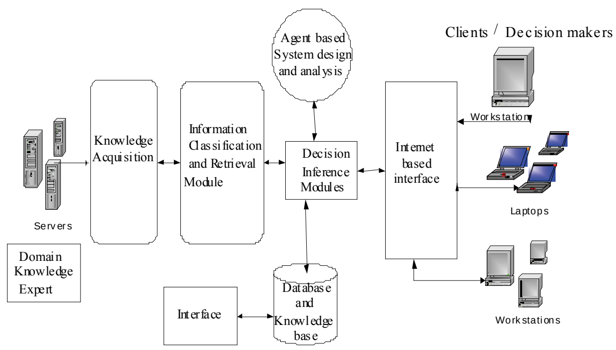

Fig. 1. CESICED: general system architecture for a system geographically dispersed.

The CESICED environment (Fig. 1) enables the achievement of concurrent engineering goals.

It allows their various simulation and modeling tools on the different platforms to inter-operate through the Collaborative Design System of the products. One of these goals is to bring engineers from the various disciplines, servicemen, and even customers early in the product development process to access Design of the product concurrently.

On the technical level, achieving these goals depends on integrating the modelling and simulation tools used by the different engineering disciplines in the areas of design, analysis, manufacturing etc. The different tools may also reside on heterogeneous platforms geographically dispersed.

A virtual product development by the virtual teams in a virtual enterprise is a temporary alliance of teams that come together to share skills, abilities and resources in order to attend a project opportunity and whose cooperation is supported by computer network and adequate tools, competencies and special application software [3].

Virtual Enterprise operates as nodes in a network. A different architecture, engineer and construction organization, a fresh virtual team [5], is needed every time for every new project. Innovative techniques to co-ordinate and manage information, resources and documents need to be developed to integrate successfully and reduce lead times, increase quality and keep within budget constraints. Consequently, the partners in the virtual enterprise need to exchange legacy data and migrate with other systems outside their own secure corporate boundary. In order to achieve collaboration between different actors in the Virtual Enterprise, there needs to be common processes supporting the distributed product development process.

3. A CESICED GENERAL OVERVIEW

A hierarchical network design (Fig. 2) model breaks the complex problem of network design into smaller, more manageable problems. Each level or tier, in the hierarchy addresses a different set of problems so that network hardware and software can be optimized to perform specific roles. Devices at the lowest tier of the hierarchy are designed to accept traffic into a network and then pass traffic up to the higher layers [6].

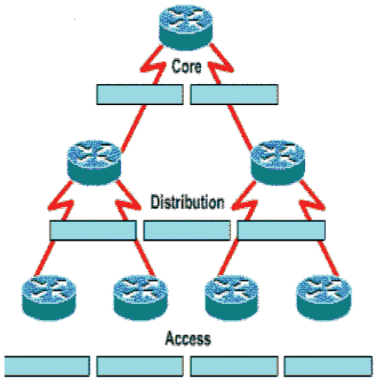

Fig. 2. A hierarchical network design.

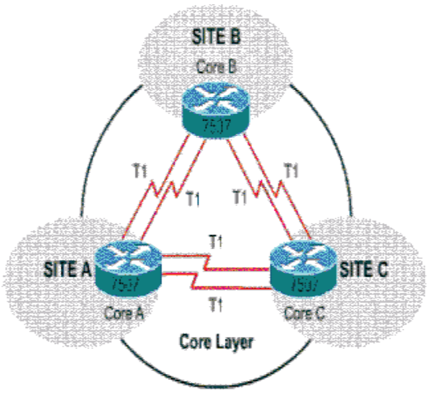

Fig. 3. The core of the CESICED network.

The core of the network (Fig. 3) has one purpose: to provide an optimized and reliable transport structure by forwarding traffic at very high speeds. In other words, the core layer should switch packets as fast as possible. Devices at this layer should not be burdened with access-list checking, data encryption, address translation, or any other process that stands in the way of switching packets at top speed [6].

The distribution layer (Fig. 4) sits between the access and core layers and helps differentiate the core from the rest of the network. The purpose of this layer is to provide boundary definition by using access lists and other filters to limit what gets into the core. Therefore, this layer defines policy for the network. A policy is an approach to handling certain kinds of traffic, including routing updates, route summaries, Virtual Local Area Network (VLAN) traffic, and address aggregation. You can use policies to secure networks.

The access layer (Fig. 5) feeds traffic into the network and performs network entry control. End users access the network via the access layer. As a network's "front door", the access layer employs access lists designed to prevent unauthorized users from gaining entry. The access layer can also give remote sites access to the network via a wide-area technology, such as Frame Relay, ISDN, or leased lines. A reliable and available network provides users with 24-hours-a-day access.

In a highly reliable and available network (Fig. 2), fault tolerance and redundancy make outages and failures invisible to the end user. The high-end devices and telecommunication links that ensure this kind of performance come with a steep price tag.

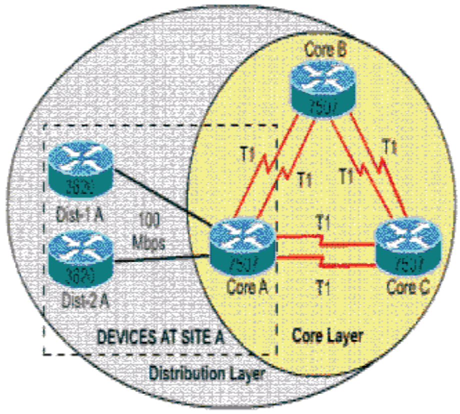

Fig. 4. The distribution layer in the CESICED.

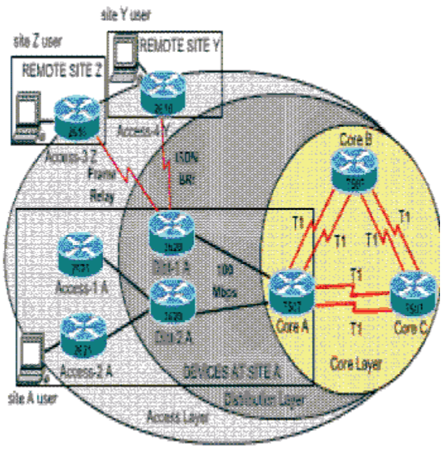

Fig. 5. The access layer in the CESICED platform.

Network designers constantly have to balance the needs of users with the resources at hand. Multicast traffic can also consume a large amount of bandwidth. Multicast traffic is propagated to a specific group of users. Depending on the number of users in a multicast group or the type of application data contained in the multicast packet, this type of broadcast can consume most, if not all, of the network resources. As networks grow, so does the amount of broadcast traffic on the network. Excessive broadcasts reduce the bandwidth available to the end users and force end-user nodes to waste CPU cycles on unnecessary processes. In a worst-case scenario, broadcast storms can effectively shut down the network by monopolizing the available bandwidth. Two methods can address the broadcast issue for large switched LAN sites: the first option is to use routers to create many subnets and logically segment the traffic (This scenario can create a bottleneck in the network); a second option would be to implement virtual local area networks (VLAN's) within the switched network. A VLAN is a group of end devices that populate multiple physical LAN segments and switch ports; they communicate as if they were on a single LAN segment. One of the primary benefits of VLAN's is that LAN switches (by creating VLAN's) can be used to effectively contain broadcast traffic and manage traffic flows. In this case a design team is formed with members located at different geographic locations [7]. A virtual local area network is created for the project.

4. COLLABORATIVE DESIGN IN THE CESICED PLATFORM

In addition to the team's full-time members, the team also includes contributing members who are recruited for specific components of the project. As such, a core group is responsible for leading the project and a sub-group is involved in specific components of the project [7]. While the full time employees form the central core of the team, experts in the different problems of the project (control systems, mechanic systems, electronic systems, programmer's etc.) are also team members. Virtual teams for engineering design are becoming more commonly used in industry and the engineering education community must prepare graduates to be employed in such work environments. It is inevitable that multidisciplinary teams for product design, with members located in different geographic locations, will become more common place in the future. It is widely understood that successful design is often a highly collaborative team based activity [8]. As a result of a new product development paradigm, there is a greater need for software tools to effectively support the formal representation, collect and exchange of product information during the product development stage. The concept of virtual product development environment that is enabled by a new generation of Internet based services is discussed [1]. The Internet is a worldwide conglomerate of different networks that communicate among each other via a common protocol, independently of the hardware type used. Various network services can be used by everyone, either supplying or demanding them. However, the application-to-application communication problem still exists. Businesses have needed a standardized way for applications to communicate with one another over networks, no matter how those applications were originally implemented [3]. Web Services, the latest evolutionary step in distributed computing, represent exactly this solution by providing a standardized method of communication by means of which different applications can be integrated together in ways not possible before. Different applications can be made to call on each other's resources easily and reliably, and the different resources that applications already provide can be linked together to provide new sorts of resources and functionality. Moreover, the application integration becomes much more flexible because Web Services provide a form of communication that is not tied to any particular platform or programming language.

At the core, the Web Services represent a unit of business, application, or system functionality that can be accessed over the Web. Web Services are applicable to any type of Web environment [5], Internet, Intranet, or Extranet, and be focused on business-to consumer, business-to-business, department-to-department, or peer-to-peer communication.

5. CONCLUSION

The presented solution is based on CESICED platform that defines a standard for developing multi-tier, portable and platform neutral enterprise applications based on the technology of Web Services. Striving to discover the main problems of collaborative product data management, the theoretical backgrounds in the particular research area were analyzed, and interviews with the members of the design departments of SMS companies were carried out.

The benefits of using Web Service technology as a core IT platform for the CESICED, have been identified. They comprise minimized processing times and costs and the improvement of the following features: *functionality* (system supporting and/or fully automating product development); *process*; *integration* (system to (internal or external) system communication); *usability* (effortless communication between the human user and the system); *security* (protection of the enterprise knowledge); *flexibility* (easily adjustable to a fast-changing business environment).

The IBM Rational software solutions [9] implemented in the CESICED platform aligns projects and resources with business priorities. It is about planning and managing projects individually and as a comprehensive portfolio of assets which must meet enterprise objectives.

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Authors:

Ph.D. Eng. George Stelică DRĂGOI, Associate Professor, "Politehnica" University of Bucharest, Mechanics and Mechatronics Department, E-mail: gdragoi@mix.mmi.pub.ro

Ph.D. Eng. Costel Emil COTEŢ, Lecturer, University Politehnica of Bucharest, Machine and Manufacturing Systems Deprtment, E-mail: costel@mix.mmi.pub.ro

Eng. Gabriela PĂTRAŞCU, Engineer, "Politehnica" University of Bucharest, Machine and Manufacturing Systems Deprtment, E-mail: gabi@mix.mmi.pub.ro