THE PREMINV PLATFORM FOR TRAINING IN MANAGEMENT AND ENGINEERING FOR VIRTUAL ENTREPRISE

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In the paper we define a hardware-software structure named "Platform for Training in Management and Engineering for Industrial Virtual Enterprises (PREMINV)", needed to train students, the future engineers, who must be able to work in the virtual enterprise (VE), imposed by the globalization of the manufacturing and competition. We emphasis on special skills requirements by the new VE environment. For this purpose is used the portal concept, referred to as Enterprise Information Portal (EIP) because provides the infrastructure for a much more active and personalized interactions with the user than a typical web site. There are presented the components of an EIP and the products that provides a portal framework for registration and integration of applications and data stores, using Internet/Extranet/Intranet infrastructures.

1. INTRODUCTION

In the new economy (Dragoi, Brissaud, 2001), the industrial society is penetrating evolving and existing markets of a consuming society with a variety of products market by the evolution of information and communication technologies. Many of these products are unique, some are derivatives of existing products, while others are integration of a number of different products. A critical aspect (see Figure 1) in the creation of these products is the understanding of an external user perception. Quantification of these understandings serves as the decision base for the quality properties to be synthesized in the product. Today's and tomorrow's product development is integrated with different disciplines at a high degree, i.e. marketing, product design, manufacturing, system design, sales, service and after market. The key is collaborative engineering, a tool for the converged enterprise (Dragoi, 2001) based on an open information model. The global market increases the need for common and collaborative processes and sharing information seamlessly between companies involved in a virtual enterprise. The new requirements are much more focused on collaborative processes that handle product definition data. Partners in the extended enterprise need to exchange legacy data and migrate with other systems outside their own secure corporate boundary. Companies work in collaborative processes within virtual organization to a large extent which means that information

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concerning product definition needs to be available, communicated and transferred in a not homogeneous information system environment (Tichkiewitch, 2001).

Figure 1 - A critical aspect in the creation of products

At the same time, each company wants to have a secure control and maintain the integrity of their own data. The development of information systems supporting this process is moving towards more open system architectures and by standardizing the information models describing the information. This activity is performed with different systems for different purposes, i.e. during product design, simulation is used to analyze and predict. Product and process engineers can simulate the product model in order to analyze the effects from different processes. Production engineers use discrete event simulation to analyze product realization. Off-line programming is used to make collision tests, reach ability tests and to generate machine code.

2. REQUIREMENTS FOR THE COLLABORATIVE ENGINEERING PROCESS

In the global market place (Guran, 2000), the customers, company and suppliers can be placed anywhere in the world. Various activities can be carried out at different geographical locations by using the infrastructures of Internet/Extranet/Intranet (see figure 2), associated to *customer-side* (Business-to-Customer/B2C), *internal-side* (Intra-Business/IB), and *supply-side* or *service providers* (Business-to-Business/B2B). The most important characteristics of manufacturing due to globalization are: a) customers are involved in production of parts during the life cycle, from design to usage and reusage; b) customers have access to data instantly; c) specialist/experts need to cooperate and collaborate with the customer and suppliers. The three kinds of business relationship mentioned above (B2C, B2B, IB), based on *information and communication technologies* (ICT), give competitive advantages for a company in the era of globalization and e-commerce: facilitates operative connections between business partners: suppliers, manufacturers, customers; represents an innovative and effective sales channel; improves accuracy and turnaround time of processes and reduces costs at the same time; makes business value/quotations more up-to-date and more transparent. The materialization of the paradigm of virtual enterprise (VE), enabled by recent developments in ICT, requires the definition and a reference architecture. It is generally accepted that VE is a temporary alliance of enterprises that come together to share skills and resources in order to attend a business opportunity and whose cooperation is supported by computer network and adequate ICT tools and special application software (Camarinha – Matos, 1997; Hoffman, 2000; Guran & Cote, 2000).

Figure 2 - Global Manufacturing and the kinds of Business Relationship: B2C, IB, B2B

Enterprises operate as nodes in a network of suppliers, customers, engineers and other specialized service providers. VE materialize by selecting skills and assets from different firms and synthesizing them into an apparently single business entity.

2.1 PREMINV general approach

To support this environment, the basic infrastructure for the PREMINV (Guran, 1999) must to consider two main modules: The *Internal Module*, that represents the autonomous unit of a particular company and includes the complete structure of the company's information (databases, information system etc.) and all the internal decision making processes; The *Cooperation Layer*, that contains all the functionality's for the interconnection between the company and the whole net/environment. This general approach of the PREMINV platform is illustrated in Figure 3. One typical business case for the collaborative work would be where company designs a product and other companies manufacture it. In this case the company A publish a virtual product to a shared area where the other companies can interact and use the virtual product for creating manufacturing information and request engineering change. The typical case is that company A has the product in an in-house *product data model* (PDM) system and wants to keep it there, but with the capability to publish selected information. Deficiencies in corporate organization and poor tool support have resulted in the past in low priority being assigned in many sector to cooperation between the disciplines of mechanical, electrical and control software engineering (Dragoi, 2001). The typical example is a mechatronic system. It implies the greatest possible integration of mechanical, electrical, computer and software components. Today, in order to permit a flexible response to customer requirements many products have been modularized in their design to the extend that entire areas of development such as, for example, the design of electrical

components can now be outsourced to external suppliers or service providers if required. A majority of consumers and investment goods produced in the engineering domain now consist of a number of modular mechanical, electrical and control software components.

Figure 3 - PREMINV general approach

For example, in the context of a mechatronic system, the idea is to find the best electromechanical system solution, not the best mechanical solution or the best electronic solution or the best control solution or the best software solution. The solution is the set of values for the variables, which either maximize or minimize, as desired, the value of the objective (Dragoi, Brissaud, 2000). Usually, the organizational and systematic division into mechanical, control software and electrical product development is the obstacle to creation of a common virtual product. The objective of this system was therefore to analyze the reasons for this and to create a corresponding approach for improvement. The ability to is needed to work with diverse multidiscipline teams members to successfully reach a goal objective. Multidiscipline is meant in a broad sense, not just engineering but also business, marketing, customers and suppliers, and the ability to clearly and logical communicate ideas, information and data to others in a way that engages the intended audience and addresses different learning styles. The process of generating ideas, which frequently emphasizes making and expressing meaningful new connections, thinking of many new and unusual possibilities, extending and elaborating on alternatives. This is creative thinking and the fundamental objective is turning the ideas into something of value in the marketplace. For a multidisciplinary group, the language of the system must do is independent of the languages of the disciplines, but is common to all. Thus, functional language should be a language of choice for multidisciplinary communication. Multidisciplinary optimization is a way of finding the best solution, given an objective and a set of constraints where the objective, the constraints, and the variables which affect the objective and constraints come from a knowledge base representing many disciplines.

3. AN INTERNET/INTRANET/EXTRANET BASED TOOL FOR CUSTOMER FOCUSED QUALITY

We propose in the PREMINV platform an Internet-Intranet-Extranet-based tool for customer focusing on quality. Its structure can be seen in Figure 4. The target of the

system is customer-focused quality: it manages relationships with customers, suppliers, distributors; it tracks both complaints, requests and activities resulting from these relationships and issues the corrective actions resulting from internal investigations and, it facilitates communication and provides an entire organization with consistent easy access to information. To develop such a tool, the first step consists in identifying customer segments: to select criteria to rank client segments and to rank the client segments. It improves previous designs, which had never been considered possible, and new demands possible to satisfy. It builds the database of customer segments. It allows a more aggressive attitude because of the possibilities offered by the technical advances. This step measures the customer perception of the product relative to the competition. Data collected from customers is stocked in the DataBase and is used as a reference for comparisons.

Figure 4 - A tool for customer focused quality

The Data-Base helps to verify that the list of requirements is significant for the customer population, capture additional customer requirements, discover strengths and weakness of the product and identify weaknesses in competitors' products (see Figure 5).

Figure 5 - DataBase of Customer segments

Competitors who should be selected are those successfully offering a similar product or service or those recommended by the customers. The system (Dragoi, Brissaud, 2001) has been designed to support and track several types of processes, including employee suggestion programs, continuous improvement, quality improvement teams (or any related team process), monitor team effectiveness using surveys, customer ideas, vendor feedback. Through a customizable workflow establishment of ownership, due date reporting and automatic insertion each customer is guaranteed a timely and through response. Continuous improvements occur when problems have been identified, root causes determined and solutions found. The DataBase functionality is customer complaints or request management, comprehensive customer profile with contact management, problem category, product defect and cause analyses, internal and external corrective action tracking, return authorization and field service tracking. The database features are based on fully web enabled, letter and email integration, attachment of related documents, used defined queries, extensive reporting and charting, reminder, past due and escalation notices, highly flexible and scalable, etc. The application overview presents a user-friendly interface aids in easy navigation. The menus can be accessed through the browser style buttons on the left side or can be accessed through the windows menu on the top. The menu can be customized to match local terminology and workflow. The account types are user defined and may include: customers, distributors, consumers, suppliers and others. Each Account View is composed of contacts and concerns. Their content can be customized to reflect local terminology and work process. Internal areas (see Figure 6) are concerned with process improvement, product defects and quality audits and are user-defined and can be based on departments, production lines etc. Concerns begin with a problem definition tab (optional tabs include: reference, products, returns, repairs, action requests, final resolution etc and the optional tabs include: activities, categories, comments, equipment etc). Action requests drive the problem resolution associated with each concern; types of actions can be defined, then tracked for timely completion. A corrective action request follows guideline and expects full

investigations and comprehensive reply i.e., problem statement, containment actions, findings, root causes analysis, preventive actions, permanent corrective actions, and follow-up verification.

Internal Area	Area Description	Location	Area Id
Marketing			
Assembly			
Service Center			
Distribution Center			
Fabrication			
Finish			
Packing			
Design			

Note: Internal Areas are user defined and can be based on departments, production lines, manufacturing facilities, etc! Internal Areas are generally concerned with process improvement, product defects and quality audits.

Figure 6 - Internal areas

The system includes an automatic insertion of database information. The first step consists in defining who the customers are, and then establishing the customer's needs and demands by direct dialogue. This is the basis to follow for each session work and it must be done without distorting the customer's desires. If this step seems trivial, let us consider the business model of today's large corporation compared with a small production company. For the large corporation, the development and production engineers and staff have little or no contact with the customer. The customer's original requirements have been filtered through the marketing department, before delivering to the development staff, and then to production. In many corporations, the development staff itself is a hierarchical structure. The designers of the product are far removed from the customer. There is a real need to ensure the customer's needs, when the "Voice of the Customer" is not misinterpreted or distorted. An extension of this view is achieved by using the portals, which are offering two Key advantages: a) a single access points to "multiple content" sources and services; b) a coherent, structured method for organizing the content sources and services available. For large organization or corporation, out of commercial domain, the portals have to present content and services to a segmented or selected group of Internet or Intranet users. In an enterprise context, a portal is often used to aggregate and organize the content and services of that particular enterprise for use by its employees, customers and business partners. In this situation a portal is referred as an *Enterprise Information Portal* (EIP), that provides the infrastructure for a much more active and personalized interaction with the user than a typical web site (Strugnell, 1999, Renadive, 1999). The components of the EIP can be defined as: internal content (orders, product information etc.), external content (news, stocks prices etc.), commerce capabilities (transactions, notifications etc.), multiple network and device support or real-time behaviour.

4. CONCLUSIONS

The needs of customer's segments and the context of use (Dragoi, Brissaud, 2000) are sorted into demanded quality, reliability issues, solutions, functions, failure modes and safety. All this information must be implemented in databases. The voice of customer context table should add the system resources to the Who? What? Where? When? How? Information (Dragoi, Brissaud, 2000). In today's competitive market, best quality and lower costs concerned for customer satisfaction are critical success factors. For enterprise, continuous improvement means lower costs and higher profits. This solution offers a comprehensive solution for turning customer complaints into an opportunity for success. The final verdict on the success of a company's efforts at meeting customer-demanded quality is long-term market acceptance of the resulting product. The *portal* are extending the business, because is including an organizational model for making sense of large amounts of information, and provide access to services. A *web site* provides some organized information, but a *portal* provides the integration and organization of many more types of content and services, including linkages to other sites.

In the PREMINV platform, we are creating an hardware-software environment for implementing the above-presented concepts, imposed by global collaborative manufacturing and Internet technologies.

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