Supporting Collaborative Processes in Virtual Organizations

Ricardo Mejía
Ecole Supérieure des Technologies Industrielles Avancées, France

Nicolás Peñaranda
Centro de Innovación en Diseño y Tecnología Tecnológico de Monterrey, Mexico

Arturo Molina
Centro de Innovación en Diseño y Tecnología Tecnológico de Monterrey, Mexico

Godfried Augenbroe
Georgia Institute of Technology, USA

INTRODUCTION

The expansion of Internet-based tools has opened new opportunities to improve collaborative work through the development of a new generation of tools designed to support e-work and e-collaboration. The concepts of e-work and e-collaboration have been evolved through the increasing demand of collaborative environments to support distributed networked activities. This trend has triggered the development of new Information Technologies in order to enable the collaboration and interaction of product development teams in distributed environments.

The objective of this article is to describe a technology classification that supports successful collaborative engineering environments (CEE) of virtual organizations (VO). A CEE is then a platform that supports rapid respond to customers, and improves the interaction among members of Virtual Organizations to successful carried out activities of integrated product and process development.

To develop CEE is imperative to integrate the right methodologies and technologies to achieve e-collaboration between VO's members. For this reason an e-collaboration technology classification is proposed to improve and facilitate the understanding, selection and implementation of collaboration technologies in VO.

BACKGROUND

The notion of VO has its origins on the extended enterprise concept (Gott, 1996) where organizations, together with customers and suppliers, are engaged collaboratively in the design, development, production and delivery of their products. Under this approach, the VO concept has evolved as temporary alliances of organizations that come together to share skills or core competencies and resources in order to better respond to business opportunities and produce value-added services and products, and whose cooperation is supported by computer networks (Camarinha-Matos & Afsarmanesh, 2004). Extended enterprises and VOs can be defined in terms of business processes, this article will focused on the "integrated product development" process in order to set the context to define a collaborative engineering environment.

Networked activities demand a huge amount of collaboration and it is here where collaborative environments play a key role when distributed partners exist. A collaborative environment is needed to facilitate team work and, in particular, to enable a group of persons to manipulate shared information objects, and modify them in a coherent manner (Suleiman, Cart, & Ferrié, 1997). Consequently, the concept of e-collaboration is defined by the concept of integrate internal and inter-

organizational processes supported by Internet-based tools (Gerst, 2003). This is a key concept to accomplish an implementation of collaboration technologies in a VO to, achieve e-work and e-collaboration (Nof, Morel, Monostori, Molina, & Filip, 2005).

CLASSIFICATION OF E-COLLABORATION TECHNOLOGIES FOR PRODUCT DEVELOPMENT

The product development process in VO presents four key phases (Mejía & Molina, 2002): (1) market requirement definition, (2) project planning preparation, (3) project execution, and (4) customer follow-up. The project execution phase is composed of four main activities: (a) ideation, (b) basic development, (c) advanced development, and (d) launching. All these phases and activities use specific tools or applications to assist engineers, designers, marketing people and all the people involved in product life cycle activities to be more effective and efficient. However, successful collaboration environment requires identifying, selecting and implementing ad-hoc technologies in a company. Therefore, it is useful to classify the technologies in a taxonomy to provide a guide to the project team about which technologies and tools are required to launch a collaborative project (Mejía, Canché, Rodríguez, Ahuett, Molina, & Augenbroe, 2004). These e-collaboration technologies are classified as (1) functional tools, (2) information and knowledge management tools, (3) coordination tools, and (4) communication tools.

E-collaboration between VO's members can be accomplished when information/knowledge, coordination and communication tools are integrated on Web platforms. These Web platforms supports access in real time to all the project information and documentation to the product development team; coordinates who, how and when specific tasks have to be undertaken and finally communicates the final objective of the project to all the participants in the team.

The following sections describe in detail the taxonomy of technologies and present a methodology to organize the integration of coordination, collaboration and information/knowledge tools among VO's members.

Functional Tools

These tools support specific execution of a task or a group of tasks allowing the fulfillment of specific objectives within different stages of product development. These kinds of applications are frequently automated or semi-automated engineering methodologies or techniques. Usually a well defined sequential and logical activity performed to accomplish precise objectives, is able to be automated. In addition, such activity can be executed with a computer to support decision making. Two types of functional tools have been identified: functional tools based on information and functional tools based on models.

Functional Tools Based on Information

In this category, the most common tools are the ones used in concurrent engineering. These tools have been commercially developed to generate computational applications facilitating the use of automated methodologies. Some examples can be the QFD (quality function deployment) (Revelle, 1998) which enables the transformation of customers' requirements into actions and design, allowing engineers to focus in content and activities within the QFD instead of documentation issues. For FMEA (failure modes and effect analysis) (Palady, 1995), there are computational tools to process automation, detecting potential failure identification in a product or process design before that these occur. FMEA can be considered as a standardized analytical method to detect and eliminate problems in a systematical and total manner. Finally, IDEF-0 (ICAM definition method zero) (NIST, 1993) is other example, which presents software applications that automate hierarchical deployment, enabling systems definition at any number of detail levels, through the necessary level for required analysis.

These tools can be developed on Web applications, which improve the team coordination and the project performance, using specific functional tools for each activity.

Functional Tools Based on Models

These are engineering software applications based on mathematical, simulation and knowledge based models which support the product development cycle. Applications such as CAD/CAM/CAE are example of these