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Dynamic data sharing and security in a collaborative product definition management system

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Abstract

Product definition management (PDM) is a system that supports management of both engineering data and the product development process during the total product life cycle. The formation of a virtual enterprise is becoming a growing trend, and vendors of PDM systems have recently developed a new generation of PDM systems called collaborative product definition management (cPDM). This paper presents the concept of a virtual engineering community (VEC) to support concurrent product development within geographically distributed partners. A previous case study has shown that collaborative engineering design may be modelled from a parameter perspective [1]. Effective implementation of the parameter approach raises the following problems: how to support data sharing and secure that span the partner borders. This paper describes the system architecture, deployed security mechanisms, the prototype developed within cPDM, and the system demonstration using a real test. The implementation of this architecture extends a common commercial PDM system (Axalan™) and utilizes standard software to create a security framework for the involved resources. Collaboration infrastructure, shared team spaces and shared resources are essential to enable virtual teams to work together. Various organizational and technical challenges are implied. The outlined architecture features a federated data approach. These issues are discussed and potential perspectives in the area of collaboration engineering are identified.

Keywords: Parameter-based collaboration; Concurrent engineering; PDM; CPDM; Virtual engineering community; Common workspace; Web-based application; Virtual engineering community

1. Introduction

Complex product development is characterized by an enormous quantity of engineering data, process uncertainty, frequent engineering changes and disturbances [1]. Many iterations are due because of its iterative nature and multiple levels of data maturity. Efficient management of product engineering data is critical to the enhancement of corporate effectiveness [2]. Accordingly, companies are seeking techniques and tools that will allow them to control design, engineering and measuring through collaboration technologies [3]. Product data management (PDM) technology is increasingly becoming a necessity to manage complex engineering data. PDM is a system that supports management of both engineering data (such as drawings, project plans and part files) and the product development process during the total product life cycle. There are several benefits of PDM systems that have been discussed previously [4,5]. These include interdisciplinary collaboration, reduction of product development cycle time as well as reduction of complexity of accessing the information, improvement of project management, and improvement of collaboration in the supply chain [6].

Since its establishment during the 1980s, the concept of PDM has evolved [7]. In the mid-1990s, extended enterprises have been adopted as a manufacturing strategy where OEMs are working closely with their partners, supplier and customers. As a consequence the PDM concept was broadened to include the full product definition life cycle. As such, new tools started to emerge to support collaboration product development among the geographically distributed partners. With the Internet being used in new product development and its benefits

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widely recognized [8], the PDM concept was expanded to encompass new names such as collaborative product definition management (cPDM), collaborative product commerce (CPC) and product lifecycle management (PLM) [7]. All these concepts emphasize world collaboration using Internet technologies. A PDM system may include several functions[1] [9]: document management, product structure management, workflow management, product classification, configuration management, process modelling, visualization and collaboration, web integration, security and interoperability. Such capabilities vary among suppliers of such systems and several problems exist while adopting and implementing PDM in organizations. In general, IT support for distributed virtual enterprise has been an extensive research area over a decade [10]. Dynamic data sharing and security within a virtual engineering community (VEC) are the central focus of this paper because experts of consulting PDM companies [3] require that for effective collaboration between partners (manufacturers, suppliers, engineering) product data must be accessible and comprehensible to people with varying skills and expertise and product data must also remain secure, yet be readily accessible.

This paper defines a VEC as a dynamic network created by at least two independent organizations in order to jointly design a new product (or enhance an existing one), or deliver a service without establishing a legal body on its own. The VEC has no common processes and procedures (e.g. approval and change procedures) and has no common IT-platforms for communication and exchange of information. Moreover, each VEC is built on a project-by-project basis with different partners, privileges, and duties.

For collaboration purposes, engineering data need to be shared at several points in time to ensure data consistency. In an ideal case, specifications for a product component would be mature right from the beginning and design delivered by each partner fits perfectly into the final product. However, practice shows that such a case never occurs and design is accompanied by many engineering changes [11]. Papers dealing with it are lacking in the case of cross-company collaboration [12][13]. Engineering changes are required for several reasons including change in customer demands or design errors due to involvement of several designers with different interests. Management of engineering changes raises the need to create and share a common view of product data that are relevant to all partners in the VEC in order to minimize their number and their impact.

Since design is performed in parallel, concurrent engineering principles force partners to ease the collaboration through the following requirements:

(a) extensively share data needed for design cooperation and hosted by different partners;
(b) provide location transparency, i.e. system supplying a user of the VEC with request data, and users do not need to know at which site those data are located;
(c) provide easy access to product data of the business partners if granted;
(d) require a notification service to inform users of the VEC about design progress and its problems; and
(e) monitor the progress being made towards the design objectives.

To tackle the issues "collaboration in a distributed environment" and "dynamic data sharing and security", this paper describes the concept of *common workspace* and its implementation within a cPDM to support a VEC as described in the SIMNET project.

This paper is structured as follows: Section 2 discusses the background of the research. Section 3 introduces the framework including the collaborative *distributed workspace* concept and its requirements. Section 4 discusses the proposed architecture. Section 5 describes the prototype. Finally, the paper concludes by pointing out the limitations of the system and discusses future directions for research.

2. Background and literature review

2.1. Simnet framework

This research is a part of the Esprit Project SIMNET (EP 26780). This project aims to create an IT infrastructure for a VEC that is based on the parameter-based-collaboration approach (PBC), and to support cross-company engineering processes management. The solution investigated by SIMNET includes the four following elements:

1. An engineering workflow (*ewf*) approach to support parameters upgrading.
2. An engineering change management (ECM) procedure that links product structure to workflow management and support parameter change propagation.
3. Extensions of the PDM Axalant^{TM} system to support collaboration and dynamic data sharing within a community of partners.
4. A provision of a secured communication infrastructure to secure the exchange of product data within the VEC.

SIMNET approach (*ewf* and ECM) is represented in Fig. 1. The PBC addresses the need for better communication within a VEC. This approach emerged from a previous case study conducted within two European companies [1]. The case study has shown that engineers tend not to view their work in terms of creating documents, nor in terms of processes, but in terms of assigning values to parameters as well as affecting relationships among parameters. The *ewf* approach has been developed to structure the collaboration from the parameter perspective, for more details see Rouibah and Caskey [14]. *Ewf* links engineering activities

[1]These functions have been referenced in a large number of scientific PDM papers. This classification is based on their consulting engagement with PDM users and vendors.