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Towards a knowledge repository for collaborative design process: focus on conflict management

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Abstract

The increasing competition and complexity of products and processes require new organizational concepts for product development. Collaborative design deals with the sharing of various interests and resources among various actors with the aim of reaching a common purpose. This purpose relies on the development of products using knowledge sharing and interactions with some coordination between these varied activities. The research objective is to provide a collaborative design environment which allows inter-skill collaboration to be coordinated by defining a common repository for knowledge management in a collaborative design situation. This paper will focus on the particular situation of conflict management. From a domain analysis of conflict management process, the first elements of a repository are given by identifying involved knowledge (static view) and formalizing protocols driven by actors to resolve conflicts (dynamic view).

Keywords: Collaborative design; Knowledge repository; Conflict management

1. Introduction

Numerous studies have recently reinforced the importance of collaboration in concurrent engineering. Collaborative design refers to various interests and people put together to achieve a common purpose which means developing a product via interaction and knowledge sharing, with a certain degree of coordination of the various implemented activities. This collaboration occurs among actors provided with various expertises, coming from different skill areas in a multi-geographic and sometimes multi-firm environment. The term ''skill'' refers to knowledge and competence required to successfully perform work-related functions. This paper focuses on the knowledge component, seen as a set of information which is contextualized according to the skill.

Various resources set up around design actors describe a real network around the design project [1]. As in any collective work, it is nevertheless important that various actors taking part in the design activity synchronize their representation. Interactions between designers are guided by two complementary objectives: to be synchronized in time and action and to be

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synchronized at cognitive level [2]. Through coordination activities, temporal-operating synchronization fulfils one operating function (task allocation) and one temporal function (articulation and coordination of tasks). Cognitive synchronization aims at establishing a mutual knowledge context and at building a common operating repository. In [3], this cognitive synchronization allows ensuring that each actor possesses sufficient knowledge on relevant facts in correlation with the purpose to be reached, in order to assess a global understanding of the situation. De Terssac and Chabaud [4] show that actors of a work group have to agree on gaps implicitly left by management and on procedures to be set up in order to fill these gaps. They are supposed to gather their skills and finally establish a common understanding, a shared context [5]. These operations constitute a common repository essentially based on verbal and deliberate communication.

Following the example of the DMMS project (Design Management and Manufacturing System) [6], intra-skills relations are regulated by a stable and precisely defined repository. The latter can even be normalized (for example, BASE-PTA, French standard AFNOR for automation specialists) and do not raise any problems. What is actually missing in this collaborative engineering situation is that no common repository formalizing inter-skill relations exists. As Zarifian [7] called it, this ''space of inter-subjectivity'', inside which identity strategies should fit in the direction of a common knowledge project, does not exist today in a multi-field context.

Indeed, collaborative tools currently existing on the market, such as CSCW (Computer Supported Collaborative Work) tools, are organized according to three dimensions of a collaborative activity [8]: *communication* dimension which allows direct exchange of knowledge between collaborating actors, *coordination* dimension which defines rules of interaction between actors themselves and in a shared work space and *production* dimension which allows production of shared objects (such as common documents) and management of access to these shared objects.

Most of collaborative tools focus on communication (messaging) and coordination features (approval forms, workflow tools, video-conference tools) but few of them deal with collaboration amongst actors. Regarding this feature, besides shared documentary bases, market tools propose forums to facilitate exchange among actors. Such spaces do not formalize inter-skills relationships and do not guide actors towards setting up a common knowledge project.

As for research works, they have focused on the development of strong collaborative tools, such as the CORVETTE project [9] which extended the concept of workflow to take into account new classes of applications (collaborative work, crisis management, etc.) by proposing innovative transactions models. Other works focused on objects sharing in distributed applications, such as David et al. [10], who proposed a concept of capillary CSCW by integrating the notion of ''nomadism'' (capacity of accessing particular knowledge from a mobile post, on any platform, which can connect and disconnect to different information sources). Finally, some research works deal with integrating the concepts of malleability and flexibility in collaborative systems, such as the DARE system proposed by Bourguin et al. [11] and the AMF-C system [12] based on a multi-facets approach thanks to patterns which formalize typical collaborative behavior.

Then, current research projects mainly focus on problems of coordination and access to shared data, problems which are sensitive in collaborative tools development. They quasi-total raise problems of temporal-operating synchronization but poorly tackle the cognitive synchronization aspect. Indeed, they do not formalize inter-skill relationships and do not guide actors towards the setting up of a common knowledge project. In fact, as an increasing number of actors is involved in an integrated design process, more and more knowledge are then shared and taken into account when developing products [13]. The information system is supposed to collect and capitalize this knowledge by collecting the various involved information. This can mean a selection of the most useful ones [14].

Focusing on the latter aspect, this research has therefore consisted in supplying a collaborative design environment which formalizes inter-skill collaboration. The purpose is to define a repository for information and knowledge management in collaborative design. For that purpose, two research experiments within the CRAN laboratory are considered:

- The CAMDers (Computer Aided Mechanical Designers) game whose aim is to analyze the