THE SACE-CSCW FRAMEWORK: AN INFRASTRUCTURE TO SUPPORT VIRTUAL ENTERPRISES AND CONCURRENT ENGINEERING PROCESSES

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This work presents the SACE-CSCW (Synchronous/Asynchronous Common Environment for Computer Supported Cooperative Work) framework. The goal of this framework is to design, and implement an integrated distributed multimedia/hypermedia environment to support virtual enterprises and concurrent engineering processes over the Internet. It contains the following systems: schedule; pre meeting; decision-making; videoconferencing; workflow control and project management; and rationale capture. They are being carried out in Java to run (synchronous and asynchronous) over a Web application. Actually only the decision making system module that allows to work with groups/subgroups of virtual enterprises and/or concurrent engineering processes and a cooperative editor have a working prototype.

1. INTRODUCTION

With information technology, the basic assumption of organization theory and practice such as the need to physically to group people together to provide for coordination or supervision, or the need to choose between centralized or decentralized structure, are being increasingly rejected. CSCW tools offer additional variables that, when combined with considerations of structure, people, and tasks, can help design more responsive organizations.

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As the market demands short response time and more flexible adaptation to customer needs, there has been a growing recognition of the need for new kinds of flexible cooperation towards the networked organization. The virtual organization allied to the Concurrent Engineering (CE) philosophy provides the means to meet these requirements.

Concurrent Engineering is the simultaneous development of product design functions, with open and interactive communication existing among all team members (McKnight,1989) to lower product cost, shorten production lead time, alleviate conflict during production, improve the quality of the product, and enhance the productivity and competitiveness of manufacturing enterprises (O'Grady,1988).

Our environment called SACE-CSCW (Synchronous/Asynchronous Common Environment for Computer Supported Cooperative Work) is concerned with the design, construction and implementation of a common environment of tools intending to support all the decision making tasks of organizations be it virtual or a traditional one by using the concurrent engineering approach. The environment contains the following systems: schedule; premeeting; decision making; videoconferencing; workflow control and project management; rationale capture and in the future should include the module "Conflicts Detection and Resolution". Figure 1 shows the environment architecture including the above "Collaborative Work Tools", "CE Tools", an information management module, data bases and STEP interfaces. More details concerned the architecture are presented elsewhere (Galina,1997).

In all CSCW tools, effective collaboration among team members are the key to success, whether they are a group of software engineers involved with tasks such as design, programming, debugging, testing and inspection (Dewan,1993) or a team of engineers designing an artifact that typically includes blue prints, CAD files, manufacturing plans, and other documents and tradeoffs by members of the cooperative teams (Klein,1993).

The work we are presenting addresses the decision making system and the videoconference system modules. They are being carried out in Java to run (synch and asynch) over the Web inside a Web application. The implementation is mostly using the Swing classes and the Java 2 Enterprise Edition specifications.

2. THE DECISION MAKING SYSTEM MODULE

Figure 2 shows a hierarchical structured diagram representing the stages a decision making process involves. They are the creation of: groups; meetings; sessions of brainstorming, organization and voting; and resources for writing an action plan.

These groups can form a super group of different organizations' individuals working together in a Virtual Organization or people organized in Concurrent Engineering teams to develop a product or service.

A group of people created to make decisions concerning organizations' problems or that get together to find out a problem solution have: a leader; at least two members with their social roles and a series of scheduled meetings to solve their problems.

Figure 1 – System Architecture

Each meeting can have: a set of Agenda/Topic issues, its final minutes and an action plan with its programs/strategies assigned to the members responsible for each program. An agenda/topic issue can have up to three sessions: brainstorming,

Figure 2 - SACE's Hierarchical Structured Diagram

organization and voting. All the groups members or some of them can be called to participate in these three sessions.

A brainstorming session can be public or closed. In a public session the user is aware of the actions of their colleagues, otherwise the session is closed and the user cannot see the ideas other users are writing in the environment. Although the interaction of the brainstorming session can be run as public its members can be either identified by their names/logins or identified as anonymous. A closed brainstorming session is also an anonymous session.

In a public brainstorming session, the members can share their ideas with other colleagues including hypermedia links to their own ideas. They also can make remarks concerning their colleagues ideas.

After a brainstorming session the members can run (scheduled by the group leader) a session of organization (ideas editing and compiling). This session is managed by the group leader or by an appointed facilitator.

In the voting session the members can vote assigning grades (ranking) to the chosen edited and compiled ideas they think solve the organization problems.

Following all (group/groups meetings) agenda/topic sessions comes the meeting minutes and the meeting action plan as was written before. This formal way of doing meetings somehow remember most of the meetings we are called to participate in.

3. OVERVIEW OF SYSTEM METAPHORS AND AWARENESS

So far the system implements an obvious security system using login and password data. A more secure system is scheduled to be done in future work. There are three types of users: 1) super user, 2) group leader, and 3) ordinary users.

The role of the super user is to insert ordinary members and their groups' leaders in the system. The group leader creates his/her Virtual Organization groups or Concurrent Engineering teams, defines meetings, agenda, etc. accordingly to the hierarchy depicted in figure 2.

The system covers three specific activities: production (the main concern is to generate ideas); coordination (to set agenda, to organize ideas, etc); and communication (chat and videoconference system).

Sharing and privacy are defined by the group leader or by decision of the groups' members but this is a group leader task. Sharing means a public type of meeting where the user can (using the collaborative editor): 1) read, write and send ideas and remarks; 2) help the process of organizing ideas and write remarks; and 3) see the votes of other mates.

Fully privacy is possible when the interaction (type of meeting) of a session is set as closed (there is not any kind of awareness). The privacy can be partial when the interaction /identification of a session is set as public/anonymous (we do not know who the people we are working with are, but we see their ideas, remarks, etc).

The use of the chat system is possible when the interaction (type of meeting) is set as public independently of the user identification and the time dispersion. The videoconferencing system can be used when the interaction/identification is set as public/nominated in some sessions.

Figure 3 shows the system's main interface. This is the window the group leader and the ordinary users will see after the system's checking of the user login/password data. It depicts some interesting metaphors and awareness

information concerning statuses of the groups these users belong (their meetings, the topics being discussed, the users who joined the meetings, etc).

Figure 3 - SACE-CSCW's Main Interface

(a) Button to call the Group Manager function; (b) Button to call the Meeting Manager function; (c) Button to call the Group's Memory Interface function; (d) Button to call the Group/Meeting Minutes Interface function; (e) Shows the User's Groups; (f) Shows the name of the running Meeting; (g) Shows the list of the Scheduled Meetings; (h) Shows the list of the Finished Meetings; (i) Button to exit of this window; (j) Button to call the help function; (k) Shows the list of the members of the selected Group; (l) Shows the list of Sessions of each Topic of the selected Meeting (table 1 depicts these icons awareness); (m) Shows the *in context* status bar; (n) Shows the icons of other functions of the system: chat, diary, printer and the engine to present multimedia objects).

The system interfaces are very rich, but because of lack of space they cannot be depicted in this paper. A very important interface is the Group Memory window. It shows for each Virtual Organization group or Concurrent Engineering team information of the following types: (a) User's groups' list; (b) Meetings of a selected Group; (c) Topics of a selected Meeting; (d) Swing panel to show results of the Brainstorming/Organization/Voting sessions and each user ideas; (e) Ideas generated in the brainstorming session; (f) Remarks of each generated Idea; (g) User list (it can change when we choose a group or a topic; and (h) Minutes for each selected meeting. Another very important interface not showed is the videoconferencing/chat interface. It introduces some facilities that leverage the fully integration of the

groups and teams through the available multimedia functions: sound, video and links.

Table 1 : Meaning of the Group's Sessions Icons

Icon	Session
Brainstorming session has been already started
Organization session has been already started
Voting session has been already started
All sessions of the selected Topic are finished
None	None of the sessions have been started yet

4. CONCLUSION

This version of SACE-CSCW is evolving from other simpler implementations (Santos,1997). Although SACE-CSCW offer a highly suitable basis for support virtual organizations and concurrent engineering processes' teams it has an underlying software architecture which properly supports the cooperation of independently developed software units and their evolution over time.

Part of the decision making tool resembles Nunamaker's Group System (Nunamaker,1991), but only in part of its functionality.

Several other systems have similarities to aspects of SACE-CSCW. The Diva Virtual office environment (Sohlenkamp,1994) provides support for communication, cooperation, and awareness in both temporal modes. The Montage prototype (Tang,1994) provides lightweight audio/video glances among distributed collaborators and integrates other applications for coordinating future contact. Majic (Okada,1994) is a project that implements a multi-party videoconferencing system comparable to face-to- face meetings.

A strong contribution of SACE's framework is related to the decision making process.

The environment allows several companies cooperating to produce a product. The "Workflow Control and Project Management" module where the users specify the business processes and all the detailed information about resources, tasks, activities, time schedule, etc eases the integration via computer networking.

We think that the research did for this paper can ease the discussion of the use of this environment to Virtual Organizations, and can also serve as a foundation for further research on this topic and be a contribution to the conference's talks and discussions.

Changes in technologies and market structures have shifted competition from a single organization to a network scope, resulting in a need for new organizational strategies and structures. Traditional organizational designs are generally not appropriate for these new strategies. New organizational structures, like those which

is the main topic of this conference - infrastructures for virtual enterprises - need to achieve both flexibility and coordination among partner organizations and their respective diverse business activities in new international markets.

Our further research concerns to try the prototype tool in a real and comprehensive Virtual Organization structure. The computer based tool will be available to the partners to design cooperatively the meta-structure and to later refine each organization's contributing part in an integrated distributed multimedia/hypermedia environment.

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