A TOOL FOR SUPPORTING THE COMMUNICATION IN DISTRIBUTED SOFTWARE DEVELOPMENT ENVIRONMENT

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ABSTRACT

In the Distributed Software Development (DSD) is fundamental the use of methodologies, techniques and tools to support the communication and help teams physically distributed in the activities accomplishment. The adequate communication in the cooperative work aids in the activities management, allows the identification of flaws and deviations in the planning accomplishment, it facilitates the conflicts solution, offers support to the decision making process and also contributes to maintain the cohesion of the team. This paper presents a tool that provides synchronous, explicit and formal communication, for a Distributed Software Development Environment. This tool, named VIMEE (Virtual Distributed Meeting), allows relate to CSCW (Computer Supported Cooperative Work) and DSD areas; it defines a common workspace to manage the virtual meeting, it supports the project management and the decision making in group.

1. INTRODUCTION

The search for costs reduction, increase the productivity and the improvement of processes and products quality have done many organizations to distribute their resources and investments geographically.

In Distributed Software Development (DSD) the teams are at different physical environments. The spatial and temporal distance bring some advantages to the organizations, but, they also bring some challenges to the cooperative work. They are related with to the communication, coordination and cooperation in the accomplishment of the tasks, and are regarded with the distance among the members, cultural differences, time zones, lack of standardization of processes and incompatibility of tools and infrastructure.

In DSD, the good communication among the members of the team can: accelerate the internal processes, facilitate the solution of problems and conflicts, allow the decision making to happen in a faster and efficient way and contribute to the union of the team members improving their performance. It has been a great concern in the software management to provide and facilitate the communication, the coordination and the cooperation among distributed teams.

So, this work presents a tool to support the communication and the team decision making in the projects management. The Virtual Distributed Meeting tool (VIMEE) allows the synchronous, explicit and formal communication, for a Distributed Software Development Environment (DSDE). The team decision making, in this work, refers to the effective participation of the team members in the rising of solutions and achieve relevant opportunities to the environment in which the group is inserted.

The team decision making, in this context, means to provide subsidies to the change of ideas and opinions prioritization (selected by voting) so that all participants can contribute equally.

This paper is organized as follow. On Section 2, is described the communication management aiming at emphasizing the communication importance to establish interaction among software development teams. Section 3 presents the concepts related with CSCW in order to identify important elements for communication, coordination and collaboration in the cooperative work. On the Section 4, are emphasized some important aspects for DSD. On the Section 5 are discussed the related research in the area. The Section 6 presents the VIMEE tool with its main characteristics, functionalities and architecture. Finally, on Section 7 the final considerations are described.

2. COMMUNICATION MANAGEMENT

The communication management is defined as the set of necessary processes to guarantee properly the generation, the collection, the spread, the storage and the discard of the project information [1]. It is fundamental to provide an effective interaction among the project teams, providing the change of information, the sharing of resources and the coordination of the work efforts.

The communication management involves the planning, the accomplishment and the control of the communication plan. The planning of the communication, according to

Martins [2], implies in determining what information will need to generate, for whom and how these information will be distributed. It is necessary to know well every stakeholder (involved or affected by the project or its results) and the function that each one performs in the project, its role in the production process, its responsibilities and mainly its decision making authority [3].

After the identification of the stakeholders it is necessary to define what are the relevant information for each one and also how and when they should be informed. It is very important that the obtained information is registered correctly and distributed to the interested parties.

The project information can be distributed by several methods, such as meetings, distribution of documents copies, shared access to the database, fax, e-mail, voice channel and videoconference [1].

In the context of the communication, an approach that has deserved a special highlight, is CSCW. It is due to its concern with work group, by identify relevant elements for the communication, coordination and cooperation in the cooperative work.

3. CSCW AND *GROUPWARE*

According to Nielsen [4], CSCW can be defined as the study of techniques, methodologies and technologies to support the work group. The resources offered by applications of this type have the purpose of minimizing the obstacles found during the development of the work group, allowing the raising of profits in the accomplishment of the tasks when compared with individual work.

Groupware is the term used to describe the technology developed by researches in CSCW [4] and can be seen as a computer tools collection, people and work processes operating in synchronized way in an organization. These tools facilitate the informal communication and the tasks automation, allowing the accomplishment of the team work in a more effective, efficient and creative way [5].

Groupware is built on three basic principles: communication, coordination and cooperation. For this reason it is mentioned as 3C cooperation model [6] [7]. According to this model people communicate among them in order to cooperate. During this communication, commitments are generated and negotiated. The commitments are the tasks that will be necessary for accomplishing the activities. These tasks are managed by the coordination, that organizes the group and guarantees that the tasks are accomplished at the correct sequence, in the right time and carrying out the restrictions and goals imposed.

The Groupware tools, allow the groups to work together on artifacts, manage their processes, send forms, share files and exchange messages. The use of Groupware solutions is not supported just in the use of technologies but also in the changes of organizational practices. Many times, it is necessary that the work process and the team attitude are changed to create an adequate environment to establish the cooperation[5].

3.1 Groupware Systems

In order to establish efficient mechanisms to control CSCW system it is necessary to define the objectives of communication firstly. It is necessary to make possible to define several access way and interactions among people.

According to Reis [8], the interactions supported by groupware tools can be: Implicit, Explicit, Formal e Informal. Table 01 shows a description of these interactions types.

Table 1. Interactions offered by groupware (REIS, 1998).

Interactions	Description
Implicit (indirect)	Users cooperate by sharing common objects. Example: multi-user edition systems.
Explicit (direct)	The communication between users occurs in a clear way and it is directed from sender to receiver. Examples: telephone, chat, video conferencing systems and e-mail.
Formal (structured)	It is based on formal procedures that guide the activities progress. Shows the control of "who can / should do what and when." Example: Process centered software development environment.
Informal (unstructured)	It establishes common sessions among partners (same level) that interact in a free way. It is necessary to store information about all the ideas raised by users. Example: brainstorming session.

4. DISTRIBUTED SOFTWARE DEVELOPMENT

Due to the dispersion of qualified human resources, many organizations find in DSD an alternative to work with teams geographically distant amongst themselves [9]. The flexibility and the adaptability of the organizations in the search of skilled labor, the reduction of the delivery time and the quality increase in the accomplishment of processes contributed to creation of environments of distributed work. In that, professionals meet one each other in different places accomplishing integrated tasks.

According to Carmel [10], DSD is causing a great impact in the way that software products have been modeled, built, tested and delivered to customers. The author emphasizes some factors that have contributed for the growing of DSD, among them: lower costs and availability of skilled labor; evolution and larger accessibility to telecommunication resources; evolution of the development tools; the need to possess global resources to use it at any time; the formation of virtual teams to explore the market opportunities, the pressure for the time-to-market development, using the

advantages provided by the different time zone in the continuous development.

There are several motivations to work with distributed teams, however there are also some challenges, which can make a project to be impracticable. Some of them are: language and culture diversities, time zones, tools and infrastructure incompatibility and lack of processes standardization. For supporting the cooperation in DSD some tools are used to allow the cooperative work in a more productive way, supporting the communication of ideas, the sharing of resources and the coordination of work efforts [7].

5. RELATED WORKS

DiSEN, environment in which this work is integrated, is an DSDE that combines techniques, methods and tools to support the inherent activities to the process of producing software products, such as management, development and quality control [11].

Pozza [12] presents a model for cooperation named SAC (Synchronization, Awareness and Communication), that proposes turn more flexible the characteristics that involve the cooperation among users of distributed workspaces, considering the distributed software development domain. Workspaces provide interaction environment and information storage. This model was defined for the workspace manager of DiSEN.

MILOS (Minimally Invasive Longterm Organizational Support) proposes support the accomplishment of processes and organizational learning for the distributed software development [13]. It supports the coordination of software engineering projects, it provides audio and video to the developers (using Microsoft NetMeeting) and it enables the sharing of codes lines among them.

CVW (Collaborative Virtual Workspace) is a cooperative environment developed to give support to teams geographically dispersed [14]. CVW provides a virtual space that consists of applications, documents, rooms, enclosures and buildings that allows the groups interaction. From the technical viewpoint, it is a framework that integrates several techniques of cooperation (video-conference, chat, etc.).

TeamSpace is an IBM project that supports distributed teams work, modeling them in a more holistical and integrated way [15]. It provides support to virtual meeting, taking into account the time factor. This way it enables its users to perform activities of their respective groups.

6. A TOOL FOR SUPPORTING THE COMMUNICATION IN DSDE

The tools presented on the section 5 (MILOS, CVW and TeamSpace) offer workspaces in which the developers can to work cooperatively and they have in common the fact that they do not belong to a specific domain. Those tools, with exception CVW, the cooperation among the developers is established using tools such as Microsoft NetMeeting. Therefore the communication occurs in an informal way, without session control and also without an explicit coordination. Other characteristics such as to offer the possibility to voting in case of impasses, to allow the documents formulation (minutes of a meeting) that records the information shared among the participants, are not considering by them. These characteristics were considered when VIMEE tool was developed and they constitute in important contributions.

Based on the cooperative work models, the communication management approaches and also on DDS it was developed the Distributed Virtual Meeting tool (VIMEE) which provides support to the synchronous, explicit and formal communication, aiming at supporting the DSD. The VIMEE tool makes possible a more productive meeting and offers support to the group decision making. It defines a common work area to manage the distributed virtual meetings, in which the participants can act and visualize the performance of the other ones. The communication among the participants occurs in a clear and explicit way and it is based on the formal procedures (who is able to do or must do something, what and when) which guides the course of the activities.

The VIMEE main characteristics are the following:

- To allow the synchronous (meeting process) and asynchronous (scheduling and meeting notification) communication;
- To allow the scheduling and automatic notification to the participants;
- No there is limit for the number of participants;
- To provide formal control of the process;
- To support differentiation of profiles;
- To allow the visualization of project artifacts;
- To allow the sharing of documents and images;
- To allow the voting for the decision making;
- To allow the cooperative edition of the minutes of meeting;
- To allow the storage of the document generated throughout the meeting, and corrective actions for the projects are defined.

The functional specification of the tool was defined considering characteristics of the 3C cooperation model [7] and of the SAC model [12] which involve concepts related to the communication, coordination, cooperation, synchronization and awareness. The organizational levels considered were the ones presented by the Project Management Model (DiSEN-PMM) [16]. DiSEN-PMM considers the following organizational levels: strategic, tactical and operational connecting them to the managerial and operational levels established for the DiSEN environment. A detailed view of these organizational levels is presented in Trindade et.al.[17].

At the strategic level, the general manager will carry out the proposed activities related to the strategic planning. At the tactical level are the local managers who take care of the distributed units and the project managers who take care of the projects under his/her responsibility and, at the operational level are the software engineers that will be responsible for tasks accomplishment. The participants who are able to act in the process of the meeting are as defined at DiSEN-PMM. The Figure 2 shows the established roles to the participants and their respective functions in the process of a meeting.

Table 2- Roles of VIMEE users.

Role / Responsible	Functions
Requestor: General Manager Managers Places Project Managers	- Schedule meeting
	- Define participants
	- Define ruling items
	- Define mediator
	- Define secretary
	- Provide artifacts
Secretary: Any users invited to meeting	- Prepare minutes of meeting
	- Send the minutes of meeting for appreciation
Mediator: Requestor or a users chosen by the requestor	- Start / Finish meeting
	- Start / Finish session
	- Manage list of participants for speech
	- Block participants
	- Manage the voting
	- Calling attention to ruling items
Participant: All the users invited to meeting	- View participants
	- Request to speech
	- Speech
	- Vote in case of conflicts
	- Visualize project artifacts
	- Provide documents / images
	- Assess the minutes of meeting

The participant has the perception of every member present in a meeting, to speech he/she should make his registration and wait for the right moment to express himself/herself.

The participant can make available documents and/or images and project artifacts stored in the DSDE repository.

Some subjects discussed in the meeting may need voting, therefore, the tool provides mechanisms for the selection of alternatives by vote. After the discussion of all ruling items, the participant should appreciate the minutes of meeting and he/she may gives his/her contribution. So the minutes of meeting can be approved and finally the meeting can be closed.

6.1 VIMEE ARCHITECTURE

The VIMEE tool is based on the Client-Server architecture and it was developed using the J2SE java technology.

The VIME architecture presents a logical layers division (as shown in Figure 1) to distribute their functionalities among the system layers in different abstraction levels, and also, in order to facilitate the maintenance process, besides being adherent to the infrastructure of DiSEN. They are: *Application Layer*, *Business Layer* and *Infra structure Layer*.

The *Application Layer* presents the user interface graphic for the interaction with user, which are: *Agenda Meeting*, for register of meetings, *Presence Receiver / Confirmer*, so that participants can confirm or justify their absence at meetings that were called and *Virtual Meeting Room*, for implementation of meetings.

In the *Business Layer* are the *Business Objects* (entities) consisted of the data model, used in the application layer. *Meeting Handler* is responsible for controlling the virtual meetings accomplished at the *Virtual Meeting Room*. On his/her turn, the *Notifier Meeting* is responsible for controlling the notifications of the meeting invitations as well as the confirmation of them.

The *Infrastructure Layer* seeks to supply infrastructure to the business layer. In that there are: the *Persistence Service*, and the *Communication Service*. The former is responsible for the persistence of the *Business Objects* of the data model. The *Communication Service* is responsible for supplying support to the communication for the meetings notifications and also the cooperation in *Meeting Handler*.

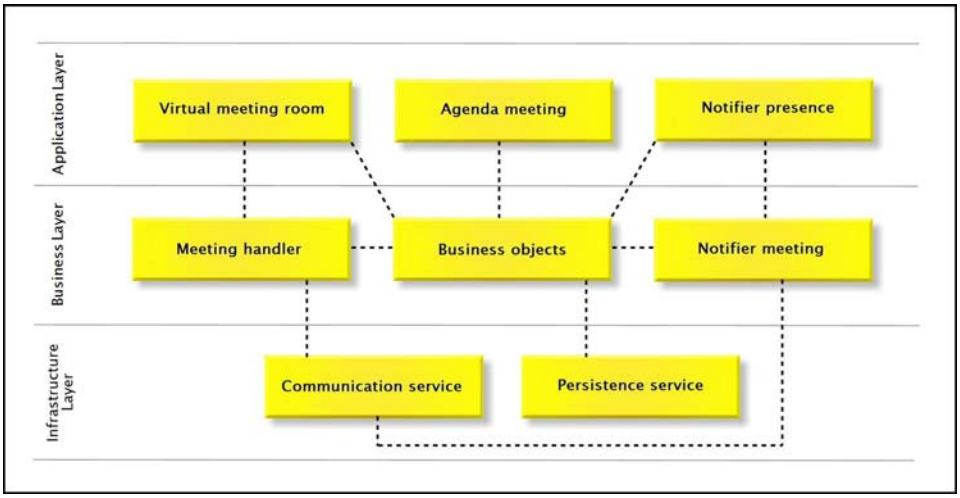

Figure 1 –VIMEE Architecture

The user interface graphic of the Meetings Schedule allows to schedule and define the necessary elements to conduce a meeting (participants, mediator and ruling items). The activities related to the meetings scheduling are shown on Figure 2.

The Presence Receiver/Confirmer user graphic interface allows the members, called to participate of meeting and notified by e-mail, to confirm their presence or justify their absence in that.

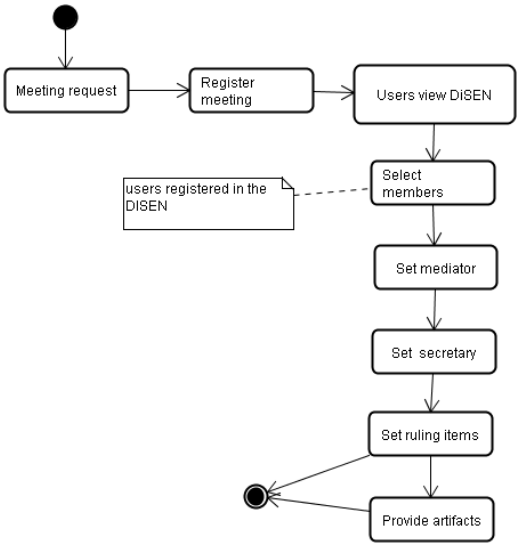

Figure 2. Activity Diagram – Agenda Meeting

Finally, the Virtual Meeting Room user interface graphic supplies access to the meeting cooperative area. The Virtual Meeting Room presents 3 visions: Participant, Secretary and Mediator, according to the respective profile.

In order to implement the different functions, for the defined roles for the VIMEE in the meetings, the tool presents a main interface for the access to the meetings scheduled, and other three interfaces for the access to Sections (corresponding to the ruling items), Voting Management and Meeting Record Management, according to the displayed by Figure 3.

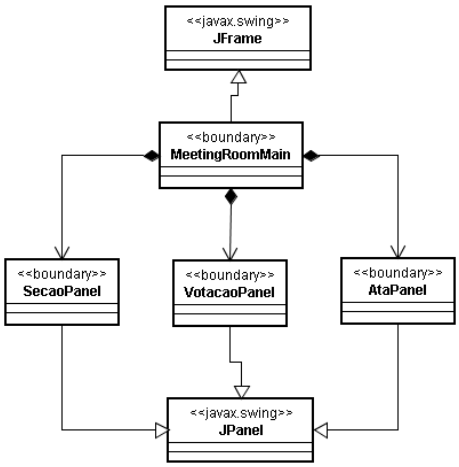

Figure 3 – Class Diagram – Interface Meeting

The Mediator's Vision, as shown in Figure 4, presents some resources, differently from the other visions, necessary to the coordination of a meeting, such as: to control the beginning and the closing of the meeting, to control the beginning and closing of the ruling items, to manage the speech, to block participants and to manage voting.

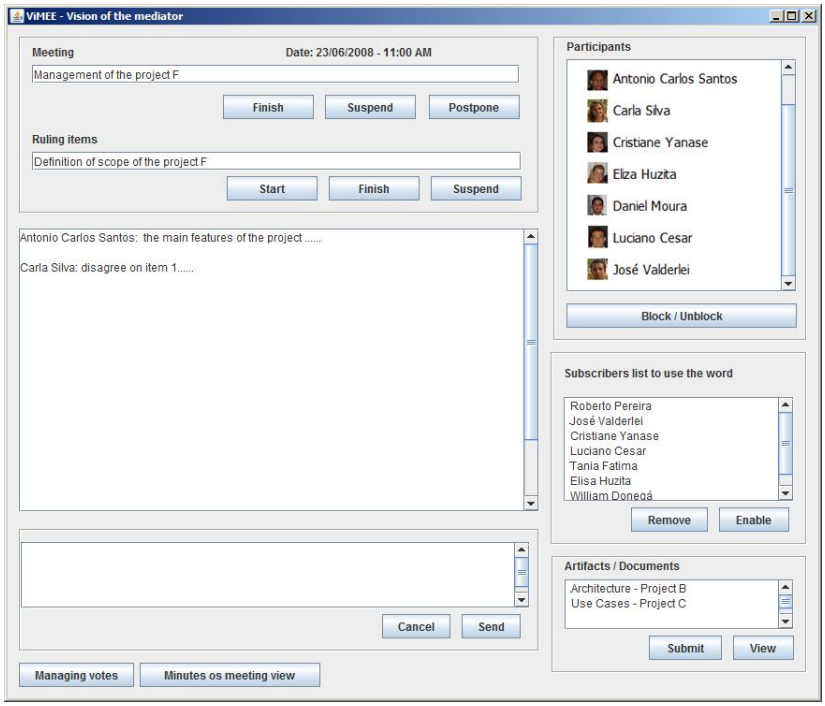

Figure 4 – Meeting room - the Mediator viewpoint.

The Mediator is a fundamental part in the process, because he/she has great influence on productivity, efficiency and effectiveness of the meetings. He/she should take the control, when it is necessary, attracting attention to the subject under discussion and so maintain the participants focused on the subject. He/she should also, when there is no consensus or when it is necessary, raise purposes and manage the voting. The mediator has access at any moment to the mail area, so he/she can use his/her speech to guide and steering the participants into the discussion.

The Participant's Vision has the controls those are necessary to communication, interaction and decision making. It allows the participants to communicate, to visualize project artifacts, to make available documents to support the discussions and to accomplish voting for the solution of impasses.

In the Secretary's Vision there are two additional resources, for the management of the minutes of meeting, allowing the secretary to elaborate the document and to submit it to appreciation of all the participants, until its approval.

A crucial factor is to recognize that communication creates new commitments and actions to be executed and these could bring influence on the continuity of the projects, as for instance, the procedures definition, the team and material resources reallocation and the conflicts solution. In this context, the VIMEE allows to storage the document generated throughout the meeting and the feedback received from the participants make possible to perform corrective actions on the projects. All those actions treated in the communication process should be disseminated into the DSDE.

7. CONCLUSION

Aspects related to the communication management, the DSD and CSCW were fundamental for the elaboration of the VIMEE tool presented in this work. The study of the types of meetings was also based on the criteria established for the formalization of the meeting process in this tool.

The defined model for the tool presents a group of characteristics that is not found in a single tool, among the analyzed ones and it considers some new characteristics. This group of characteristics covers some important aspects which are: it is based on formal procedures that guide the course of the activities, presenting the control of "who can / should do something, what and when"; it manages the scheduling, notification and reception of the confirmation of the meetings participants; it supports the profiles differentiation; it does not limit the number of participants, because it does not use video and sound resources; it allows the elaboration of the minutes of meeting in a cooperative way; it allows the sharing of documents and images; it allows the voting accomplishment for decision making; it allows the visualization of projects workmanships during a meeting, presenting, therefore, integration with the DSDE.

The VIMEE tool evaluation was accomplished taking into account two aspects: the DiSEN project research group viewpoint and also by software project manager viewpoint, who works in private companies. The result was satisfactory, because the great majority of the participants agreed totally or partially with the model process of the meeting defined for VIMEE. The evaluation participants informed that the tool presents usefulness for the teams geographically dispersed and also for local teams. It is due the fact of the support offered to call and confirm the participants when a meeting is scheduled.

Nowadays the actions formalized in a meeting and registered in the minutes of meeting, are treated in a non automatic way. So, as a future work, it is intended to provide the integration with a project management tool. With this the corrective actions identified in the meeting will be disseminated in DiSEN automatically.

ACKNOWLEDGEMENTS

For CNPQ for financial support. Process nº.506511/2004-9

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