Darío Rodríguez, Ramón García Martínez

Proposal of design process of customizable virtual working spaces

Preimpresión entregado por los autores al Repositorio Digital, publicado con posterioridad en *Lecture Notes on Artificial Intelligence,* 8481: 450-459

Proposal of Design Process of Customizable Virtual Working Spaces

Darío Rodríguez & Ramón García-Martínez

Information Systems Research Group. National University of Lanus. Argentina.
PhD Program on Computer Science. National University of La Plata. Argentina.
rgarcia@unla.edu.ar

Abstract. The evolution of communications based on Internet technology allows considering the development of Virtual Workspaces. Recently, modeling formalisms have been proposed to specify the interactions among the various members of a workgroup interacting through a virtual space. Moreover, depending of the nature of the tasks developed by the workgroup, not all the communication resources based on internet are necessary. In this context, this paper introduces a design process of customizable virtual work spaces. The proposed process specifies the components of the virtual workspace architecture necessary to support the workgroup task. The process leads the specification based on the modeled interactions among members.

Keywords: virtual workspace, design process, modeling human interactions.

1. Introduction

Collaborative work is based on communication and exchange of information among individuals in order to develop a physical or conceptual object [1]. Systems within the paradigm Computer Supported Cooperative Work (CSCW) constitute an approach to facilitate group work processes oriented to developing conceptual objects. The interaction activities among group members related to development of object are mediated by communication resources based on Internet technology.

It has been proposed [2] that there are three types of conceptual frames for developing CSCW systems:

[a] Development ad-hoc, in which systems are built in a completely adapted way to the specific problem to which it is intended to support, this has been, until now, the usual trend in creating groupware systems.

[b] The use of programming toolkits, which provide a higher level of programming abstraction through functions and APIs (Application Programmer Interface).

[c] The development of CSCW systems based on components that allows the construction of CSCW systems using predefined building blocks that can be reused and combined in different ways.

This paper is related to first type of conceptual frames for developing CSCW systems, to which we call Customizable Virtual Working Spaces (CVWS).

In [3] is introduced a set of formalisms to deal with the modeling of aspects of group dynamics such as interactions among group members, and agreements over responsibilities of each member related to development of certain conceptual objects. The set of interaction modeling formalisms among group members within a virtual collaborative work space is briefly describe as follows:

- *Table Concept-Category-Definition*: Its function is to represent the factual knowledge of the conceptual model of group dynamics. This table introduces, in lexicographic order, the concepts that are going to be used in other formalisms specifying the category and giving the concept definition. There are three categories: actor (person), interaction and object.

- *Interaction Cases and Interaction Group Diagrams*: The modeling of the interactions among actors is made using two formalisms: [a] Interaction Cases and [b] Interaction Group Diagrams. An Interaction Case captures interactions between two actors. In particular, the reflection is a case of interaction of an actor with himself. An Interaction Group Diagram provides, in an integrated way, interactions among all actors considered in the modeling process.
- *Interaction Procedures*: The procedures describe the composition of interactions among the actors made for the development of an object. To express the procedures that actors can perform on the objects, is proposed to use predicates of order N.
- *Sequence Diagram of Group Dynamics*: It is used to express the group dynamics among the actors in the timeline imposed by the procedures of interaction. The formalism is called the Sequence Diagram of Group Dynamics.
- *Diagram of Conceptual Object Development*: Virtual spaces dedicated to collaborative work are intended to facilitate mediation inside teams whose members are not physically contiguous, and have to develop a conceptual object (for example: research, project development, software, thesis plan, technical articles, reports, among others). The modeling of interactions in virtual spaces dedicated to collaborative work should help to specify the interactions among group members, and the developing work stages of the conceptual object that the collaborative working team is carrying on. The virtual space for collaborative work must satisfy the requirement of keeping and documenting the different versions of the conceptual object that is being developed by the collaborative working team; leaving a record of the evolution from the agreement among the members of the working group since initial specifications of the conceptual object until its final stage development. These diagrams are digraphs with two types of nodes: the "conceptual objects" which will be denoted with circles and the "transformations" that will be denoted by rectangles. The "transformation" represents the action that must to be performed to make evolve the "conceptual object" from a level of development into another.

This paper is structured as follows: the definition of the problem of customizable virtual working spaces is presented (section 2), a design process for this type of spaces is proposed (section 3), a concept proof to illustrate the application of the design process is given (section 4), and preliminary conclusions and future research work are presented (section 5).

2. Definition of the Problem

Several authors [4-8] have pointed out that the current state of conceptual modeling of work group is characterized by the following limitations:

- Lack of conceptual models that adequately specify the interactions related to the development of group activities supported by virtual workspaces.
- Lack of processes that allow deriving the architecture of the virtual space designed for the particular needs of a workgroup, from conceptual models which specify the interactions among its members.

With regard to the first limitation, since 2009, authors have been working on tools for interaction modeling among persons and analysis and design of virtual working spaces [3,9]. Regarding the second limitation, in this paper is proposed a preliminary solution to the problem of defining a design process for customizable virtual workspace, with emphasis on identifying the components of its architecture.

3. Proposal of Design Process

We propose a Design Process of Customizable Virtual Working Spaces (CVWS) defined by two phases: Conceptualization Phase of CVWS and Modelling Phase of CVWS.

The Conceptualization Phase of CVWS has the goal of transforming a description of the activities within workspace (emphasizing necessary interactions among the members to deal with the tasks), into the interaction modelling formalisms previously indicated (see section 1). Two activities are performed: "Conceptualization of interactions" and "Specification of CVWS functionalities". The activity of "Conceptualization of Interactions" has as input the description of the workspace and generates as output a conceptual description formalized through artefacts: Table Category-Concept-Definition, Interaction Cases and Interaction Group Diagrams, Interaction Procedures, Sequence Diagram of Group Dynamics, and Diagram of Development of Conceptual Object. The activity of "Specification of CVWS Functionalities" has as input the conceptual artefacts that give a formalized description of the workspace, and generates as output the list of functionalities that CVWS has to support.

The Modelling Phase of CVWS has the goal of deriving the architecture of CVWS from the modelling formalisms obtained in the first phase. Two activities are performed: "Component Selection of CVWS" and "Modelling the architecture of CVWS". The activity of "Component Selection of CVWS" takes as input the list of functionalities identified in the previous activity and generates as output a list of components of CVWS. The activity of "Modelling the Architecture of CVWS" takes as input the list of components of the artefacts of interaction modelling, and generates as output architectural model of CVWS.

The design process [10] of customizable virtual working spaces (CVWS) is summarized in Figure 1.

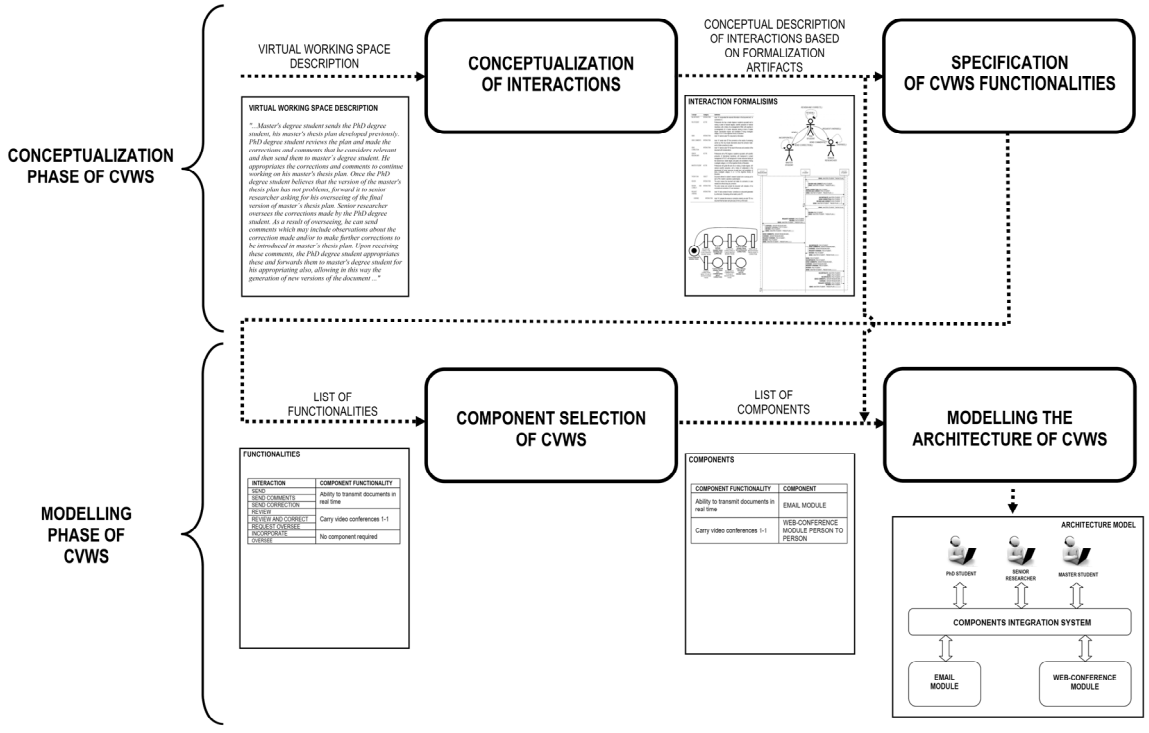

Fig. 1. Design Process of Customizable Virtual Working Spaces

4. Concept Proof

To illustrate the proposed Design Process is provided a proof of concept based on a case brought in [7]. The situation described in the case is based on developed interactions within a virtual space during the thesis plan review of a master´s degree student made by a PhD degree student (co-

director of the master's thesis) under supervision of a senior researcher (director of the master's thesis and doctoral´s thesis). The case "Review of Master's Thesis Plan" is described in the following bit of text:

> *"...Master's degree student sends the PhD degree student, his master's thesis plan developed previously. PhD degree student reviews the plan and made the corrections and comments that he considers relevant and then send them to master´s degree student. He appropriates the corrections and comments to continue working on his master's thesis plan. Once the PhD degree student believes that the version of the master's thesis plan has not problems, forward it to senior researcher asking for his overseeing of the final version of master´s thesis plan. Senior researcher oversees the corrections made by the PhD degree student. As a result of overseeing, he can send comments which may include observations about the correction made and/or to make further corrections to be introduced in master´s thesis plan. Upon receiving these comments, the PhD degree student appropriates these and forwards them to master's degree student for his appropriating also, allowing in this way the generation of new versions of the document ..."*

5.1. Conceptualization phase of CVWS

In this section is presented the results of activity “Conceptualization of interactions” (section 5.1.1) and activity “Specification of CVWS functionalities” (section 5.1.2) for case "Review of Master's Thesis Plan".

5.1.1. Activity: Conceptualization of interactions

In the proposed case are identified: three actors, an object, eight interactions. These are shown in Table Category-Concept-Definition illustrated in Table 1.

Table 1. Table Concept-Category-Definition of case "Review of Master's Thesis Plan"

Concept	Category	Definition
INCORPORATE	INTERACTION	Actor "A" incorporates the received information in the document and / or comments in it.
PhD STUDENT	ACTOR	Professional who has a master degree or academic equivalent and is making a career of doctoral degrees, scientific production of national importance, with a history of co-management of R&D, with expertise in co-management of in human resources training at level of master degree, specialization degree, and accreditation of being investigator category III or IV of the Argentine Ministry of Education.
SEND	INTERACTION	Actor "A" sends to actor "B" a document or information.
SEND COMMENTS	INTERACTION	Actor "A" sends Actor "B" the comments on the results of overseeing carried out, this may include observations about the correction made and/or further corrections to make.
SEND CORRECTION	INTERACTION	Actor" A" sends to actor "B" the result of the review and correction of the document with its observations.
SENIOR RESEARCHER	ACTOR	Professional with a PhD degree or academic equivalent, with scientific production of international importance, with background in project management of R & D, with background in human resources training at the doctoral level, master degree, and grade, and accreditation of being investigator category I or II of the Argentine Ministry of Education.
MASTER STUDENT	ACTOR	Professional with grade title and who is making a master degree, with national scientific production, with a history of collaboration in the development of human resources at grade level, and accreditation of being investigator category IV or V of the Argentine Ministry of Education.
THESIS PLAN	OBJECT	Document referred to student´s research project who is carrying out to earn a PhD, master's, specialty or grade degree.
REVIEW	INTERACTION	The actor reviews the document and states his comments (in case needed) but without doing any correction.
REVIEW AND CORRECT	INTERACTION	The actor revises and corrects the document with indication of his comments and corrections (if it was necessary).
REQUEST OVERSEE	INTERACTION	Actor "A" asks oversee of review / corrections on a document generated by a third actor. Overseeing will be made by actor "B".
OVERSEE	INTERACTION	Actor "A" oversees the reviews or corrections made by an actor "B" on a document that has been sent previously to him by a third actor.

From persons and interactions introduced in Table Category-Concept-Definition, interaction cases that are part of the group interaction diagram which is shown in Figure 2 are identified.

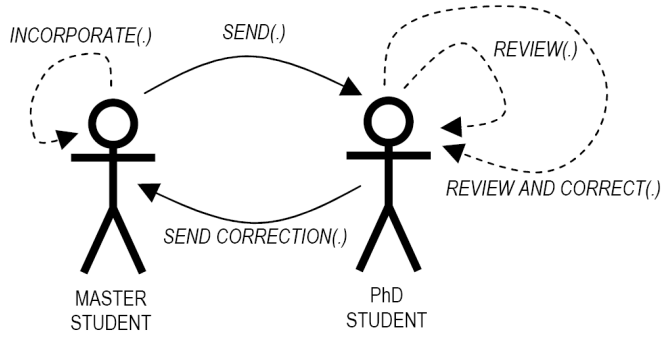

Fig. 2.a. Interaction case between Master Student and PhD Student

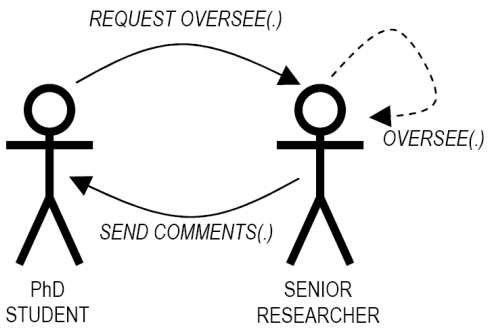

Fig. 2.b. Interaction case between PhD Student and Senior Researcher

From persons and interactions introduced in Table Category-Concept-Definition, interaction cases that are part of the group interaction diagram which is shown in Figure 3 are identified.

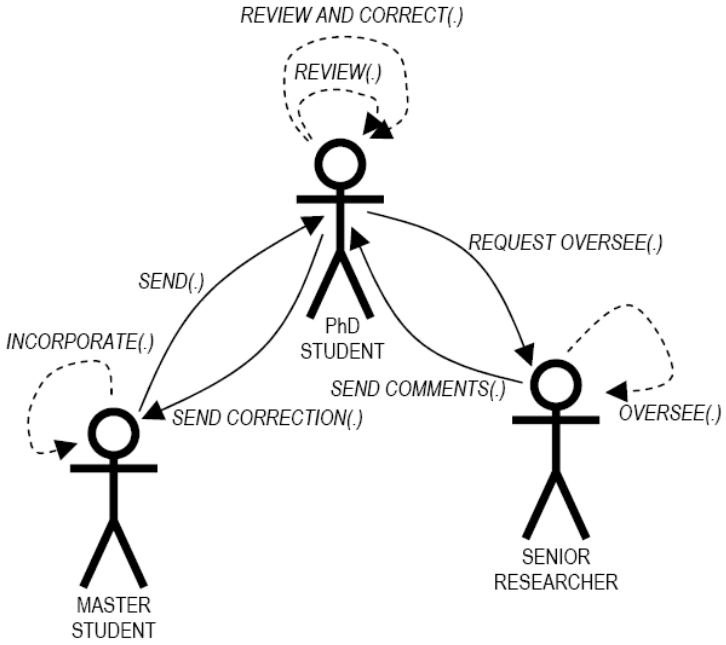

Fig. 3. Group interaction diagram among Master Student, PhD Student and Senior Researcher

The group dynamics developed among actors through the timeline, expressed through the interactions identified in the case of concept proof, is shown in the Sequence Diagram of Group Dynamics in Figure 4. The conceptual object identified is "Master Thesis Plan" and the Diagram of Conceptual Object Development is shown in Figure 5.

5.1.2. Activity: Specification of CVWS functionalities

Based on the information contained in the Table Concept-Category-Definition the subset of interactions may be built and the functionalities that serve to each interaction are identified. It may happen that several interactions may be satisfied by the same functionality. For the case study, the relation interaction-functionality is presented in Table 2.

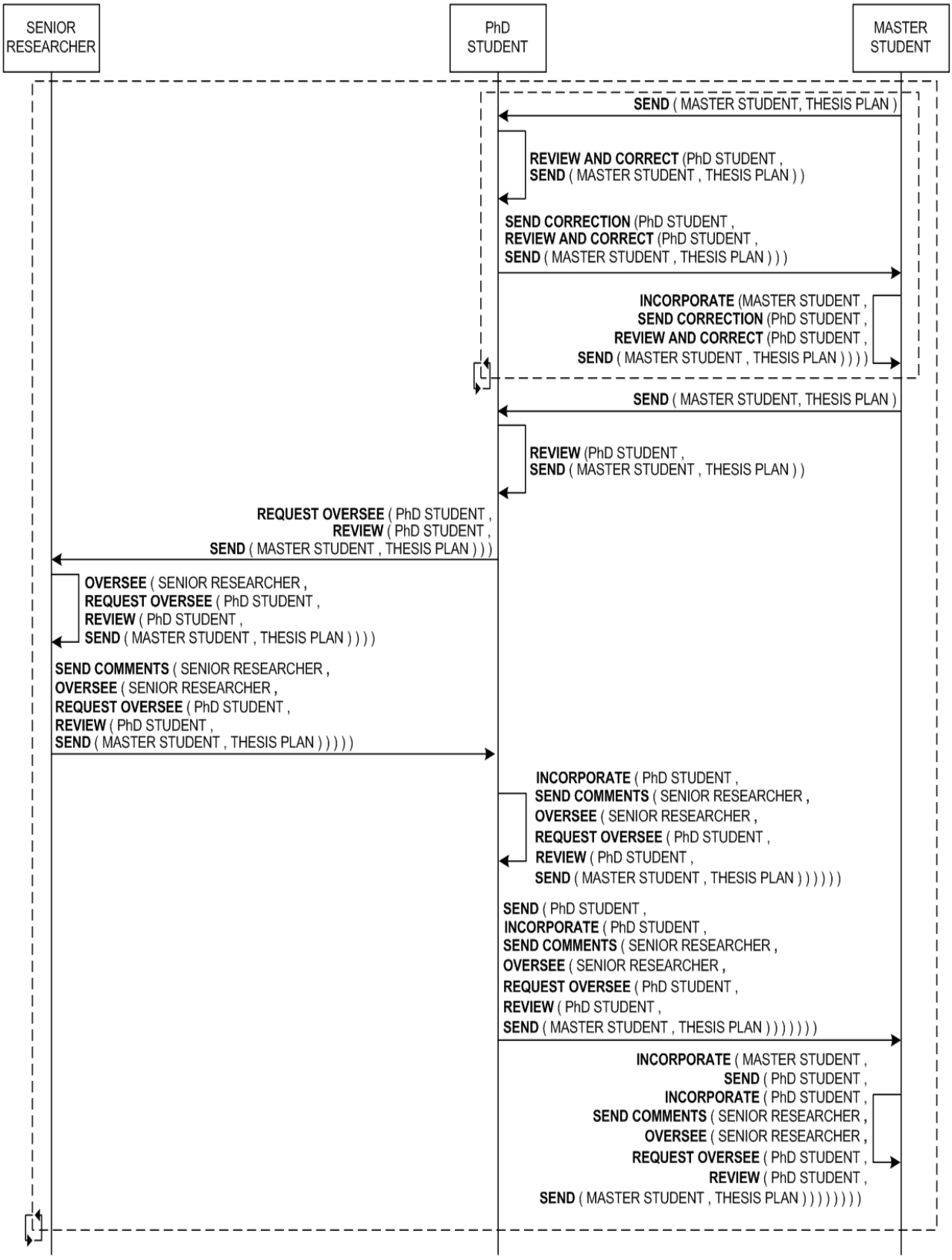

Fig. 4. Sequence Diagram of Group Dynamics of case "Review of Master's Thesis Plan

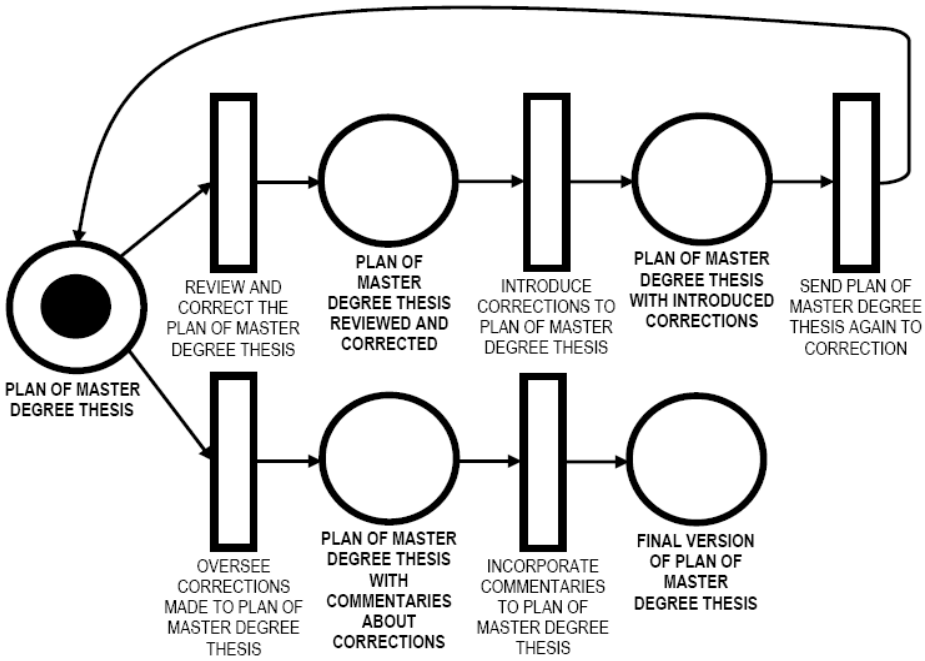

Fig. 5. Diagram of Conceptual Object Development for case "Review of Master's Thesis Plan

5.2. Modelling phase of CVWS

In this section is presented the results of activity “Component Selection of CVWS” (section 5.2.1) and activity “Modelling the architecture of CVWS” (section 5.2.2) for case "Review of Master's Thesis Plan".

5.2.1. Activity: Component Selection of CVWS

Based on the results in Table 2, components that give satisfaction to each functionality, are identified. For the concept proof, the relation Functionality-Component is presented in Table 3.

Table 2. Relation Interaction-Functionality

INTERACTION	FUNCTIONALITY
INCORPORATE	No component required
REVIEW AND CORRECT	
REVIEW	
SEND	Ability to transmit documents in real time
SEND COMMENTS	
SEND CORRECTION	
REQUEST OVERSEE	Carry video conferences 1-1
OVERSEE	

Table 3. Relation Functionality-Component

COMPONENT FUNCTIONALITY	COMPONENT
Ability to transmit documents in real time	EMAIL MODULE
Carry video conferences 1-1	WEB-CONFERENCE MODULE PERSON TO PERSON

5.2.2. Activity: Modelling the architecture of CVWS

The Architecture of Virtual Working Space is modelled based on the results in Table Relation Component-Functionality, Interaction Group Diagrams, Sequence Diagram of Group Dynamics, and Diagram of Development of Conceptual Objects.

The description of the case shows that it is not necessary that the "Master Thesis Plan" object needs to be in the virtual working space. This object may be shared through e-mail module and web-conference module. The selected modules are integrated through the "components integration system". For the concept proof, the model architecture of customized virtual working space is presented in Figure 6.

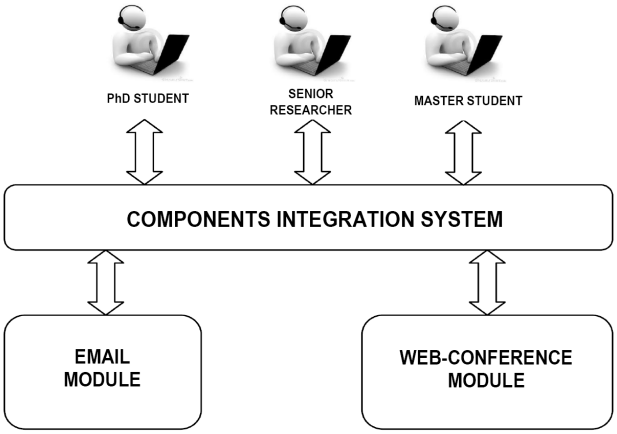

Fig. 6. Model architecture of customized virtual working space of the concept proof

5. Conclusions

Work in groups is one of the usual labour strategies that may be mediated by Internet technology. Virtual workspaces arise as a possibility to establish working groups in which persons are not physically contiguous or have difficulty to share the same real space.

In this context, this paper presents a design process for customizable virtual working spaces that require to be strictly adjusted to the needs defined by the nature of task developed by the work group.

The proposed design process, which falls within the type of production processes by project, allows the design of the virtual space architecture in which the virtual work will take place. This design is based on the formalization of the interactions among the members of the working group.

To consolidate the results presented in this paper, the following research works have been started up [11]:

[a] The refinement of the specification of the procedure steps of derivation to obtain the model architecture of CVWS from the modelling formalisms of group members interactions and tasks.

[b] The development of a prototype configuration of CVWS component-based and a prototype tool to support the process of formalizing interactions.

[c] The development a working environment that integrates the developed prototypes.

[d] Explore the validity of the Design Process of Customizable Virtual Working Spaces proposed in this paper in the following cases: (i) CVWS for Arquitects team working in building design, and (ii) CVWS for Software Engineers team working in software development.

6. Acknowledgments

The research reported in this paper was partially funded by Project UNLa-33A166 of the Secretary of Science and Technology of National University of Lanus (Argentina), and sponsored by the Department of Research and Development of Staffing IT Software & Services.

6. References

1. Grudin, J. 1994. *Computer-Supported Cooperative Work: History and Focus*. IEEE Computer, 27(5): 19-26.

2. Molina, A., Redondo, M.and Ortega. M. 2009. *A Review of Notations for Conceptual Modeling of Groupware Systems*. In New Trends on Human-Computer Interaction (Eds. J. Macías, A. Granollers, P. Latorre). Pp. 1-12. ISBN 978-1-84882-351-8.

3. Rodriguez, D., Ramon Garcia-Martinez, R. 2014. *A Proposal of Interaction Modelling Formalisms in Virtual Collaborative Work Spaces*. Lecture Notes on Software Engineering, 2(1): 76-80. ISSN 2301-3559.

4. Giraldo, W., Molina. A., Collazos, C. Ortega, M., Redondo, M. 2008. *Taxonomy for Integrating Models in the Development of Interactive Groupware Systems*. Journal of Universal Computer Science, 14(19): 3142-3159. ISSN 0948-695X.

5. Molina, A., Redondo. M., Ortega, M. 2004. *Evolution of an E-Learning Environment Based on Desktop Computer to Ubiquitous Computing*. Proceedings 34th ASEE/IEEE Frontiers in Education Conference.

6. Molina, A., Redondo. M., Ortega, M. 2005. *A System to Support Asynchronous Collaborative Learning Tasks Using PDAs*. Journal of Universal Computer Science, 11(9): 1543-1554. ISSN 0948-695X.

7. Molina, A., Redondo, M., Ortega. M., Hoppe, U. 2008. *CIAM: A Methodology for the Development of Groupware User Interfaces*. Journal of Universal Computer Science, 14(9): 1435-1446. ISSN 0948-695X.

8. Molina, A., Redondo, M., Ortega. M. 2009. *A Review of Notations for Conceptual Modeling of Groupware Systems*. En New Trends on Human-Computer Interaction (Eds. J. Macías, A. Granollers, P. Latorre). Pág. 1-12. ISBN 978-1-84882-351-8.

9. Rodríguez, D., Bertone, R., García-Martínez, R. 2010. *Collaborative Research Training Based on Virtual Spaces*. En Key Competencies in the Knowledge Society (Eds. Reynolds, N. & Turcsányi-Szabó, M.). IFIP Advances in Information and Communication Technology, 324: 344-353. ISBN 978-3-642-15377-8.

10. Curtis, B., Kellner, M., Over, J. 1992. *Process Modelling*. Communications of the ACM, 35(9): 75-90.

11. Fields, B., Merrian, N., Dearden, A. 1997. *DMVIS: Design, Modelling and Validation of Interactive Systems*. In Design, Specification and Verification of Interactive Systems. Springer-Verlag.