From the analysis of community activity to the appropriation of new tools. A methodological approach for the development of information technology solutions

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Abstract. More and more CoPs have chosen virtual environments and services to support their activities. However, recent research has underlined several problems: the lack of adequate scaffolding in terms of technical support and appropriate use of technology for communication and collaboration, the lack of tools and virtual environments to support real-life problem-solving and the reification of knowledge, the inadequacy of tools used by the communities in supporting individual and organizational learning processes as well as knowledge and identity building of CoPs. CoPs need new tools and services that are acceptable to them and capable of adapting to their existing virtual environment and evolving needs. Acceptability and adaptability of tools and services could be achieved through an iterative and participative process involving developers and CoPs' members in the co-development of scenarios of use. These scenarios can be considered as "boundary objects" facilitating the negotiation and collaboration between developers and CoPs' members. This process is experimented in the PALETTE project. In this contribution, we describe the characteristics of such scenarios of use and suggest a methodological approach to progressively design and represent these scenarios. In conclusion, we discuss questions and issues raised by the implementation of such an approach.

Keywords: community of practice, R&D methodology, participatory design

1 Introduction

For more than ten years, collaborative and networking processes have been recognised as an effective process for knowledge building and learning by professionals [7]. Wenger [12] has concretely described and analyzed the process by which adults enter in new communities of practice, learn and build their own identity. Wenger's social theory of

learning focuses on learning as social participation, as "a process of being active participants in the practices of social communities and constructing identities in relation to these communities" ([12] p. 4). Social participation, community building, development of identity, learning and knowing are deeply interconnected and are articulated around negotiation of meaning. For Wenger, negotiation of meaning is at the root of any individual and collective learning. Its goal is to ascribe meaning to our life experience. Wenger insists on the two interrelated processes of *participation* and *reification*, and on their duality which is fundamental to negotiation of meaning and to learning. On the one hand, participation describes "the social experience of living in the world in terms of membership in social communities and active involvement in social enterprises" ([12] p. 55). Participation thus means being an active participant in a social community and developing both the individual and the community identities. On the other hand, the reification process is one "of giving form to our experience by producing objects that congeal this experience into "thingness"" ([12] p. 58). Both participation and reification are supposed to lead to learning since they contribute to the development of identity. Wenger also stresses that three dimensions must be present for practice to be the source of community coherence: dense relationships of *mutual engagement* organized around what its participants have to do; negotiation of a *joint enterprise* defined by the participants in the very process of pursuing it; a *shared repertoire* that combines both reificative and participative aspects, reflecting a history of mutual engagement and being a source for the negotiation of meaning. Of course, in day to day practices, we may find that these processes are lived differently according to the CoPs, their domain of interests and their history [3] [4].

It has also been recognized that web-based technologies could support CoPs. More and more CoPs have chosen virtual environment and services to support their activities either totally or partially. However, recent research has underlined the lack of adequate scaffolding in terms of technical support and appropriate use of technology for communication and collaboration (including web-based platforms, wireless communications, mobile devices and extensive use of multimedia contents), the lack of tools and virtual community environments supporting real-life problem-solving, the lack of support to reify knowledge and make it accessible to community members and beyond, and finally the inadequacy of the tools (forum, discussion lists, web-based training environments) used by these communities in supporting the individual and organizational learning processes as well as knowledge and identity building of CoPs. CoPs encounter the need for new tools and services to support their specific activities. If these new tools must be usable and efficient, they also have to be acceptable by each CoP and capable of adapting to its existing virtual environment and evolving needs.

The acceptability of a system is a combination of social and practical acceptability. Social acceptability refers to "whether the product will be used in the real world". Practical acceptability includes usability, but also reliability, compatibility, utility [9]. Social acceptability is namely related to the degree of the activity transformation induced by the uses of the new tools and services. This activity transformation may be encountered at different levels: aims, actions and operations. In other words, the computer artefacts

interact with and change people's work and mind. In return people adapt the artefact to fit their work or transform the artefact and develop their schemata and competence to fit their work [10]. To support this acceptability and the adaptation of the services and tools, an iterative and participative process of co-development by developers and CoPs of scenarios of use is proposed. These scenarios can be considered to be "boundary objects"[1] facilitating the negotiation and collaboration between developers and CoPs. This process is experimented in the PALETTE project[2]. In this contribution, we describe the characteristics of such scenarios of use and suggest a methodological approach to progressively design and represent these scenarios. In conclusion, we discuss the questions and issues raised by the implementation of such an approach.

2   Characteristics of the scenarios of use

In regard to the purpose of the PALETTE project, which is both to improve and facilitate the functioning of the CoPs and to develop online services, the scenarios of use should have some specific characteristics:

- They should speak both to the CoPs and to the partners of the PALETTE project in charge of the development of the services. Both parties' information needs must be met.
- They should depict the aims of the CoPs' activities as well as the chain of actions and operations which constitute these activities.
- They should integrate the use of one or more instruments, possibly as part of a system of instruments.
- Following the participatory design approach, the scenarios should be enhanced and detailed all along the development process up to the description of the operations.

According to the classification of scenarios proposed by Rolland et al. [11], a scenario can be described in terms of form, contents, purpose and lifecycle. The figure 1 summarizes the choices made within the PALETTE project regarding the purpose of the scenarios:

- The form of the scenarios will be text-based, illustrated by graphical representations. Different software will be used, notably MOT+ which allows the graphical

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[1] The term "boundary objects" was created by Leigh Star, in sociology of sciences, in order to describe the objects that coordinate, according to a given intention, diverse perspectives. Objects that belong to many communities and serve as links between diverse perspectives have the potential of becoming "boundaries" if these perspectives have to be harmonized.
[2] PALETTE is an integrated European project aiming at facilitating and augmenting individual and organisational learning in Communities of Practice (CoPs). More information can be found at http://palette.ercim.org/

representations to be exported in different standard formats (XML, IMS-LD, OWL) suited to the varied needs of the developers[3].

- The contents of the scenarios are descriptions of the activities of the CoPs (collaboration, information use, production of documents, knowledge management...) and their use of tools within a specific context (history, actors, roles…).
- The purpose of the scenarios is to meet the developers' information needs, to present a structured view of their own functioning to the CoPs and to build "boundary objects" useful for the negotiation, between the developers and the CoPs, of the scenarios themselves and the experimentation modalities.
- The lifecycle of the scenarios depends on the different negotiation stages within the participatory activities involving both the developers and the CoPs.
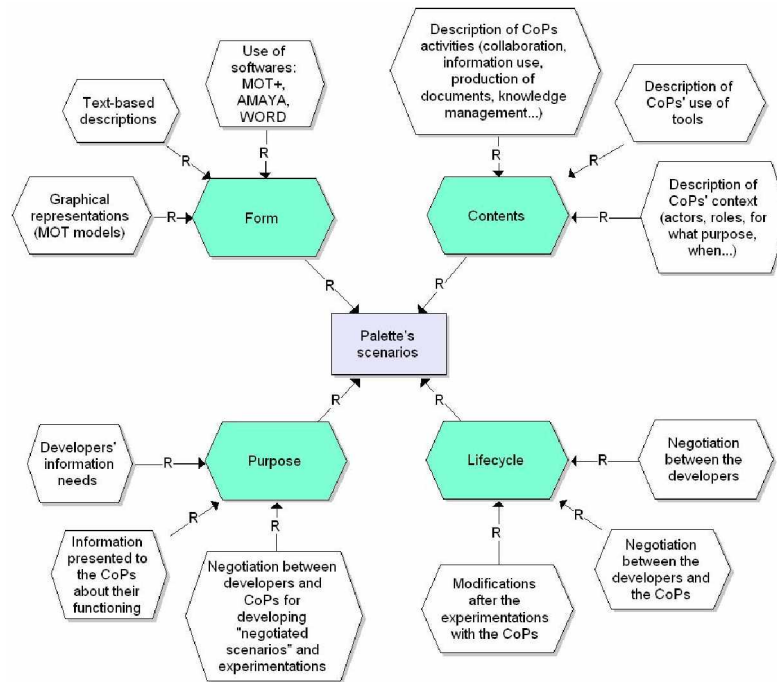

Fig. 1. Graphical model of the PALETTE's scenario of use

"R" means "Regulates" (or "has an effect on")	⬡ = Principles, objectives
	▭ = Object

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[3] More information about Typed-Objects Modelling Methodology as well as the MOT+ software can be found at http://www.licef.teluq.uquebec.ca/eng/index.htm.

An example of a specific scenario is presented in Figure 2. It is a graphical representation (form), describing a specific CoP activity – the decision making process concerning students' projects – (contents), which is used by the PALETTE's developers as a use case and presented to CoP's members in order for them to better understand their own functioning (purpose), and which will be negotiated and probably modified according to the vision of the CoP's members (lifecycle).
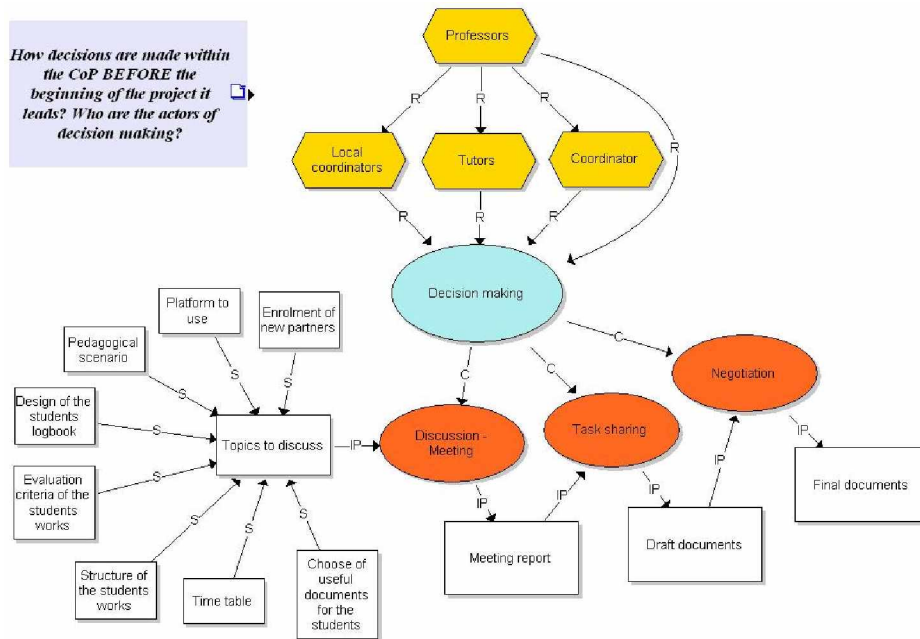
Fig. 2. Graphical model of a specific scenario of use

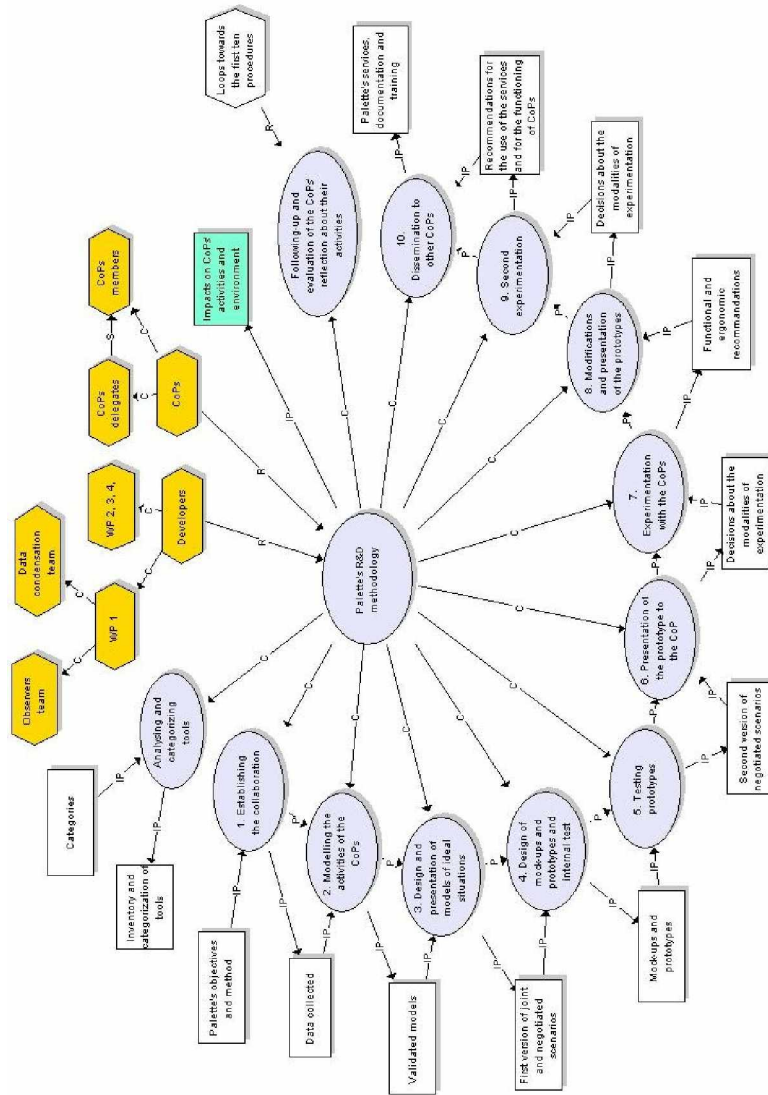| "R" means "Regulates" (or "has an effect on") | ◯ = Processes, actions |
"C" means "is Composed of"	⬡ = Actors
"IP" means "Input/Product-Output"	▭ = Objects, products
"S" means "is a Sort of"	

3   PALETTE's methodology

The scenarios of use and prototypes are conceived in stages with the participation of both developers and community members. This is fundamental to our methodology in which the representation of the CoPs' practice is elaborated in an iterative process which leads to the creation of the scenario and eventually to the specification of tools. The use of graphical representations such as the ones used in this article facilitates the exchange about the scenarios. They may be seen as a kind of boundary object between the two parties and must be understandable by both.

In this section we briefly describe the PALETTE's methodology represented in Figure 3 using three kinds of objects:

- The actors (oblate hexagons): the developers (the PALETTE's partners), which consist of the different Work Packages (WP) and sub-teams within the Work Package 1 responsible for the design of the methodology, and the CoPs with their delegates and members.
- The twelve processes of the methodology: the ones numbered from 1 to 10 happen one after the other while the first and last ones are recurrent. Indeed, throughout the ten stages, developers evaluate and follow-up the community's reflexive process on the transformation of its activity.
- The objects: the inputs/outputs in/from each process.

3.1   Analysing and categorizing tools (ongoing process)

This process intervenes at different times into the methodology and aims to provide an inventory and a categorization of tools developed by PALETTE's partners, used by the CoPs or existing on the market. Categories of tools are worked out according to different sources. The inventory produced is reused in different processes of the methodology: the modelling of the CoPs' activities, the design of prototypes and the dissemination to other CoPs.

Fig. 3. Stages and on-going processes of PALETTE's methodology (with actors and inputs/outputs)

"R" means "Regulates" (or "has an effect on") "C" means "is Composed of" "IP" means "Input/Product-Output" "P" means "Precedes"	◯ = Processes, actions ⬡ = Actors ▭ = Objects, products

3.2   Establishing the collaboration with a CoP (Stage 1)

At the end of this stage, an agreement is reached between the CoP and the developers or the project is abandoned. To reach a collaboration agreement, the CoP – in its entity if it is small, or through chosen delegates if it is large – needs to understand:
- the intended stages of the methodology and the project's requirements;
- that ethical principles such as confidentiality will be respected;
- that it is in the community's interest to engage in the process and that it is free to retreat at any moment.

At this stage, negotiation allows to adapt the collaboration modalities to each CoP without modifying the purpose of the project.

After PALETTE's objectives and method have been presented and a negotiated agreement about the collaboration has been reached, the first participatory activity takes place. An initial set of data on the community activity is collected by the "Observers team" following an interviews' guide it has developed.

The interviews' guide provides the observers with a document which helps them to follow the methodological principles of the PALETTE project. It contains a description of the objectives and ethical issues of the interview process, the list of questions to ask as well as some tips.

3.3   Modelling the activities of the CoP (Stage 2)

This stage consists of a first analysis and modelling of the data collected. Five main steps conduct to the elaboration of "Validated models":
- Proposing grids for the data condensation/extraction process. This step mainly aims at choosing a representation mode useful both for the developers and for the CoP. The advices provided by Miles and Huberman [8] in the design of matrices have been useful. It has been chosen to present the data with short texts and graphical models.
- Processing the raw data in order to obtain the transcripts and the minutes of the interviews.
- Analysing the data following a method of category-specific analysis [1] [6].
- Presenting the functioning of the CoP based on the analyzed data using two different formats: text-based descriptions of and graphical models.
- Validating and enhancing descriptions and graphical models presented by the developers through discussions with the CoP.

This last step is important for the collaboration with the CoP because it could allow the CoP to develop a better understand its actual functioning. It also could arouse its interest in imagining new situations and solutions.

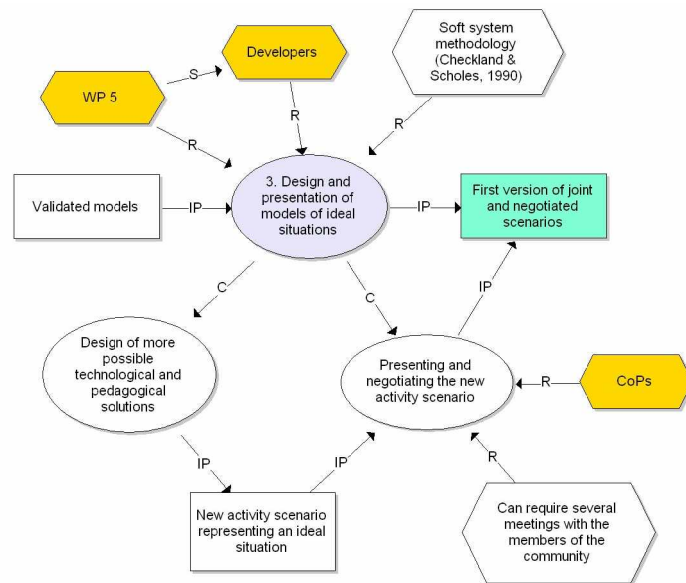### 3.4   Design and presentation of models of ideal situations (Stage 3)

This stage (see Figure 4) is adapted from Checkland's Soft System Methodology [2]. At this point, the developers elaborate one or more possible technological and pedagogical solutions in order to model a new activity scenario representing an 'ideal' situation. This new scenario can then be compared to the actual situation by way of discussions with the CoP's members, structuring the negotiation process between the developers and the CoP. This aims to stimulate a reflexive process about the community's activity and to engage its members in the design of the new tools, in the definition of their use and in the identification of a strategy to support the appropriation process. Several meetings may be required in order to achieve a joint and negotiated scenario acceptable by the developers and the CoP and feasible in its particular context. At this stage, an acceptable solution is defined as one which does not bear too heavy a charge on the members of the CoP. Together, developers and members of the CoP thus try to optimize the workload induced by the use of new tools and new processes.

3.5   Design of mock-ups and prototypes and internal tests (Stage 4)

At this stage, the developers design and test a first version of the prototypes. It is a first internal diagnosis of the tools. These internal tests should confirm that the tools or services being developed actually correspond to the solutions previously negotiated. In addition, the developers try to establish a first measurement of the degree of acceptability by evaluating the instrumental distance [10] and the users' competencies necessary to implement the solution. Thus the developers among themselves develop a common vision of the solution.

3.6   Testing the prototypes (Stage 5)

The aim of this stage is to test the prototypes with delegates of the CoP. The test is designed to simulate authentic actions performed by the community. The delegates of the CoP and the developers strive to perform a second measurement of the degree of acceptability of the solution, and, if needed, negotiate a more acceptable solution. If this is the case, Stage 4 is repeated. Thus the developers and the delegates develop a common vision of the new solution.

Fig. 4. Design and presentation of models of ideal situations (Stage 3)
 "R" means "Regulates" (or "has an effect on")   ◯ = Processes, actions
"C" means "is Composed of"   ⬡ = Actors, principles
"IP" means "Input/Product-Output"   ▭ = Objects, products
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3.7   Presentation of the prototypes to the CoP (Stage 6)

This stage aims to define modalities for the experimentation of the prototypes with CoP's members. These modalities could be different for each CoP. However two steps are required: the presentation of the prototypes or mock-ups to the CoP and a discussion about the modalities of the experimentation.

3.8   Experimentation with the CoP (Stage 7)

The seventh stage aims to experiment the prototypes by observing the instrumentation and instrumentalisation processes [10] as well as the individual and collective learning being carried out. To be reliable and valid, experimentation has to be led over a significant period of time.
- For the instrumentation process, observation focuses on the appropriation of the constituent functions of the tools (functions conceived by the developers).

- For the instrumentalisation process, observation focuses on functions created by the CoP's members (not conceived by the developers).
- For the individual and collective learning being carried out, observation focuses on the various types of mediation processes which lead to it: praxeologic, sociocognitive and reflexive mediation processes.

  Based on these three observations, functional and ergonomic recommendations are made to improve the tools.

3.9   Modifications and presentation of the prototypes (Stage 8)

The developers modify the prototypes according to the results of the experimentations. Again, internal testing precedes the presentation of the new prototypes to the CoP and the negotiation about the modalities of a second experimentation. The prototypes could be then named "PALETTE's services, version 1".

3.10   Second (and further) experimentations (Stage 9)

Following the decisions about the modalities of the second experimentation, observations are conducted in the same way that was described in Stage 7. The product of this stage consists in providing recommendations for the use of the services and for the functioning of the CoP.

3.11   Dissemination to other CoPs (Stage 10)

This last stage aims at providing other CoPs and scientific communities with the project's products: the PALETTE's services, the documentation about these services and training.

3.12   Following-up and evaluation of the CoP's reflection about its activities (ongoing process)

The follow-up process influences the previous stages by accompanying the CoP through the reification of its activities and the production of knowledge. This reification is continually used and reused within the other processes through the different participative activities: interviews, validation of the scenarios of use, negotiation of the modalities of experimentation, etc. These activities, like in the CoP itself, provide a framework for the negotiation of meaning, reification of knowledge and reflection about the CoP's functioning and learning.

4   Conclusion: questions and issues raised by the implementation of the method

Conducting participative projects with CoPs raises specific challenges due to the nature of CoPs. These communities are not always stable bodies with a structured organisation. They use communication channels that are sometimes closed to outsiders. The interest of CoPs lies in their domain of practice, and the development, testing and appropriation of new tools is not a priority nor on every CoP's agenda.

The challenges lye in a) the appropriate choice of a communication channel, b) the choice of partners inside large CoP with whom the project can work, c) the management of the decision making process in general, d) the choice of criteria to identify CoP's members able to participate in the development of information technology solutions, e) the reliability of decisions, f) the transferability of experiences by one part of the CoP to the rest of the CoP or other communities.

a) The choice of a communication channel affects the policy of confidentiality. Shall the developers and the CoP's members use the existing CoP's channels such as forum, chat, mailing lists or the developers' channels which require separate logins?

b) Choosing the right partners inside the CoP is not easy. If the CoP's structure is somehow formalised, delegates might then provide data pertaining to Stage 1. The validation and testing of the solutions may be carried out by a special active subgroup willing to do so, or there may be a call to volunteers – both may bias the project.

c) There are many decisions to make internally and with the CoP. They concern the interpretation of the CoPs' functioning by the developers, the choice of the solutions, the length of testing and so on. However the decisional structure and procedure of a CoP are not often clear. In addition, the CoP's can discontinue involvement at any moment.

d) In special projects such as the development of information technology solutions to support CoPs' activity, one of the criteria for participation concerns the installation of software on one's computer. Not all CoP's members have the right to do so in corporate environments. Others don't want to install beta-versions of software that may destabilize their system. Finally, in non-corporate environments, CoPs may lack the technical ability to install and control server-based services.

e) Decisions are taken by some members of a CoP at a certain time, e.g. the use of a certain scenario to work with. There is a risk that new CoP's members or members that could not participate in the decision making process reject these scenarios. There is always a doubt about the reliability of the decision.

f) The transferability of experiences made with a motivated and willing group of CoP's members to the whole CoP, including the less active outer circle is important if a CoP adopts new ways of working and new tools. If the favourable experiences are not transferable because the "until now" silent majority boycotts the new culture, the CoP may be in danger.

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