

“Towards an Ontology for Knowledge Management in Communities of Practice”

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Abstract. The work presented in this paper is about learning in Communities of Practices (CoP). It is situated in the context of Knowledge Management (KM) services that we are developing in the Palette project dedicated to learning in CoPs. The approach is made on several models detailed in this paper. These models constitute the theoretical grounding upon which the KM services will be based; they are organized in order to constitute a generic meta-ontology, from which a CoP-dependent ontology can be built, so as to annotate the CoP knowledge resources.

Keywords: Knowledge Management, Communities of Practice, Learner Profile, Competence, Collaboration, Process/Activity, Lessons learnt.

1. Introduction

According to Wenger [25], CoPs are groups of people who share a passion for something that they know how to do, and who interact regularly in order to learn how to do it better. CoPs can be found within businesses, across business units or across company boundaries [21], still they differ from business or functional units, from teams and networks: people belong to CoPs at the same time as they belong to other organizational structures. An effective organization comprises a constellation of interconnected CoPs, as these are privileged nodes for the exchange and interpretation of information. CoPs preserve the tacit aspects of knowledge that formal systems cannot capture. CoPs can be considered as a mean by which knowledge is “owned” in practice. Indeed, such groups allow the functions of creation, accumulation and diffusion of knowledge in organizations.

Acknowledging CoPs emerging significance in KM services development, this paper presents a set of models enabling the formalization of core aspects related to CoPs every day work. More specifically, the work presented in this paper is carried out in the framework of the Palette IST project (<http://palette.ercim.org/>). Several CoPs on

three domains (management, engineering and learning) are involved and studied in the Palette project. Our work is situated in the context of KM services, our aim being to facilitate the efficient and effective management of the CoP knowledge resources. In order to reach this objective, we studied the theoretical grounding upon which the foreseen services will be based. This theoretical grounding is composed of models necessary for the service tools to exploit the knowledge properly. These models will be organized in order to constitute a generic meta-ontology, from which a CoP-dependent ontology can be built, so as to annotate the CoP knowledge resources. The CoP-dependent ontology could then be instantiated for the different CoPs involved in the Palette project. The ontology plays two roles: enabling to model a group in general and a CoP in particular, and enabling to annotate the CoP resources.

The paper is organized as follows: first, we present our approach based on several models. Then we detail successively each of the proposed models (community, actor and learner profile, competence, collaboration, process / activity, and lessons learnt) and do a comparison with related work. Last, we conclude by a summary of our contributions and the further work planned.

2. The Palette approach

Fig. 1 summarizes the models we identified as the most significant. They concern the following main concepts: community, actor, learner profile, competency, collaboration, process/activity and lessons learnt.

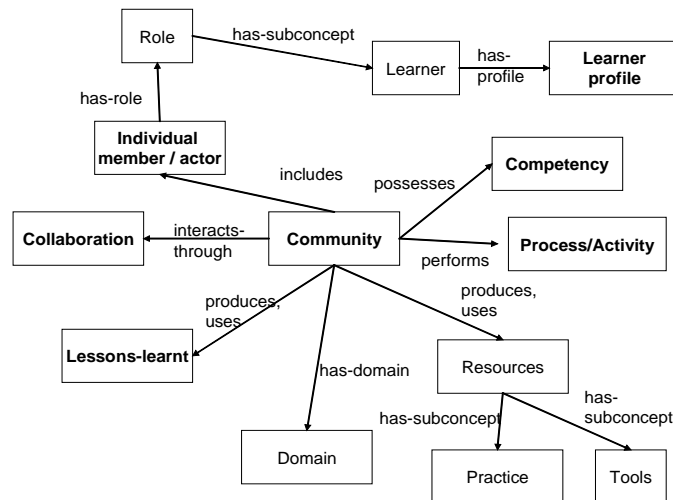


Fig. 1. Models linked to the concept of Community

Different actors can participate in a CoP as members: experts in a domain, students, or professionals. Actors can be characterized by their various roles in the CoP, and by their individual competency, linked to the domain of the CoP. According to their competency, actors can learn more or less about a practice and can participate more or

less actively in an activity. Therefore, competency is one of the major concepts useful to define KM services appropriate to CoPs.

Collaboration is an important concept since the objective of a CoP is to deepen members' knowledge and expertise in the CoP's domain by interacting on an ongoing basis [23]. Participation is one of the two fundamental principles of negotiation of meaning in a CoP [22], the other one being reification. Participation implies action, even if, according to Wenger, it is "broader than mere engagement in practice".

Activities are central to the life of a CoP. They are the place and moment where and when interaction is made visible and fruitful. Specifically, activities are organized in order to exchange experience about a practice but also to enlarge knowledge of different members.

Learning is one of the key reasons why CoPs are being created and cultivated [23]. Every member of a CoP is at one moment or another involved in a learning process. Being able to define and characterize learners' profiles is an important aspect of KM within CoPs. Indeed, it is important to know how learners react, exposed to a piece of knowledge in order to provide services personalized to their cognitive profile.

One of the key activities of a CoP is to share and exchange about the CoP' practice. This sharing of knowledge can lead to the definition of best practices, this is considered as lessons learnt. Lessons learnt allow us to determine the behavior that is appropriate to a given situation. They lead to identification and qualification of best practices.

Let us detail each of these models.

3 Community and Actor model

3.1 Presentation of the Palette Community and Actor model

Wenger [21] distinguishes three dimensions along which a CoP defines itself. Firstly, its *joint enterprise* that indicates what the CoP is about, as understood and continuously renegotiated by its members. The second dimension concerns the *mutual engagement* that indicates how the CoP functions and binds members together into a social entity, while the third, so called the *shared repertory of common resources* (routines, artifacts, vocabulary, styles...) indicates what capability the CoP has produced is developed by the CoP members over time.

As stressed in [25], a CoP can be characterized by its domain, meaning the area of knowledge that brings the community together gives it its identity and defines the key issues that the CoP members need to address. Furthermore, the community is another characteristic of CoPs. A CoP involves people who interact and who develop relationships that enable them to address problems and share knowledge. Community builds relationships that enable collective learning. Another aspect characterizing a CoP is its practice. A CoP brings together practitioners who are involved in doing something. Practice anchors the learning in what people do.

The community is thus composed of members: these actors can play different roles, according to the activities of the CoP and to the CoP stage of development. They interact, collaborate and learn by doing. They may also interact with the CoP's

external environment. As far as the activity of knowledge sharing is concerned, we can distinguish the roles of knowledge provider and of knowledge recipient. On the other hand, for the social structure of the CoP, we can distinguish different roles of leaders, as suggested in [21]: inspirational leadership by thought leaders and recognized experts, day-to-day leadership by those who organize activities; classificatory leadership; interpersonal leadership; boundary leadership by those who connect the community to other communities; institutional leadership by those who maintain links with other organizational constituencies (in particular the official hierarchy); cutting-edge leadership.

Taking all the above into account, in the proposed model, a community is characterized by: (1) its domain; (2) its practice; (3) its members: these individual actors will be characterized by their individual competence, their social relationships in the CoP, their modes of participation in the CoP and of collaboration, their roles, their learning profile, their activities inside and outside the CoP; (4) its external environment that can be constituted by other actors (e.g. stakeholders in the organization that play a role of support to the CoPs, other CoPs, etc.); (5) its resources: we can distinguish on the one hand the resources or outcomes developed by the CoP (artifacts, stories, routines, documents) and that constitute the practice of the CoP, and on the other hand, the resources used by the CoP (e.g. the CoP tools that, according to [24], we classify into publishing tools, tools ensuring individual participation, tools ensuring community cultivation, tools for asynchronous interaction and tools for synchronous interactions); (6) its history and its life: in particular, its life status corresponds to its current stage of development (potential, coalescing, active, disperse or memorable according to [21]).

3.2 Presentation of the Palette Learner Profile Model

Given the fact that learning is a major part of CoP's activities, one of the most significant roles undertaken by almost all CoPs' members is the role of a learner. Acknowledging the importance of enhancing learning within an organization, in our approach we focus on learners, i.e. actors whose main objective is learning. More specifically, we present a generic Learner Profile model that aims at exposing the learners' cognitive characteristics when exposed to a piece of knowledge. The proposed model has derived after the common consideration of existing approaches on learners' profile models, learning activities and learners *per se* [11], [4]. The selection of the specific notions and relations used in the proposed model was driven by our aim to design a learner profile that could serve the developing ontologies for both individual and group learners. Furthermore, in developing the proposed model, our aim was to provide a model for representing static as well as dynamic aspects of a learner's profile.

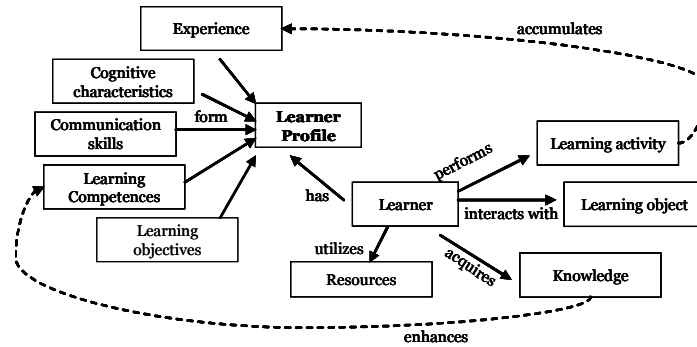


Fig. 2. The Palette Learner profile model

Figure 2 presents the proposed Palette Learner Profile model. In this model, the notion of Experience refers to the knowledge of or skill in or observation of some thing or some event gained through involvement in or exposure to that thing or event. Cognitive characteristics comprise intelligence, perception, memory capabilities, creativity, organizing skills. Communication skills refer to the individuals' abilities in interacting with their environment. A Learning objective is a statement establishing a measurable behavioral outcome. The statement must include how the measurement is accomplished. Learning competences refer to academic background, education, training, working experience etc. Learner is the person who learns or takes up knowledge or beliefs. A learner is an actor's role that can be undertaken by an individual or a group of actors. Learning activity is every activity performed that intentionally or non-intentionally resides to knowledge acquisition. Learning object is every piece of knowledge. Knowledge refers to a fluid fix of verbal and/or manual skills brought about through training, instruction or practice that denote familiarity with facts, truths, concepts or principles. The Resources notion refers to every means a learner utilizes to perform a learning activity. All arrow connections appearing between the Palette Learner Profile model concepts express the relations occurring between them. For instance, the relation between learner and knowledge is the topic acquired. It should be noted that the interactions among notions are not exhaustively defined, these are indicative and further relations or amendments to the proposed ones may occur according to findings of our future work.

3.3 Related work

Related research findings about learners' modeling prove that due to the complexity of human actors and the diversity regarding the learning context, it is a thorny task to develop a commonly accepted learner profile [4]. For instance, the learner model in [1] depicts a learner as a concept hierarchy but it does not refer to issues such as the learning object, or the learners' interactions with their environment and other people. However, it provides interesting information about a learner's cognitive characteristics and is furnished with the representation of knowledge assessment issues. Another

related approach, the “PAPI Learner” conceptual model comprises preference, performance, portfolio, and, possibly, other types of information [19]. Yet, this model includes only the minimum information necessary to satisfy the functional requirements and to be maximally portable, and it does not provide any information about a learner’s profile dynamic aspects. The IMS Learner Information Package specification is a useful collection of information that addresses the interoperability of internet-based Learner Information systems with other systems that support the Internet learning environment [9]. Still, this, like all the above, cannot be employed for the representation of a community as a learning entity.

4 The competency model

4.1 Presentation of the Palette Competency model

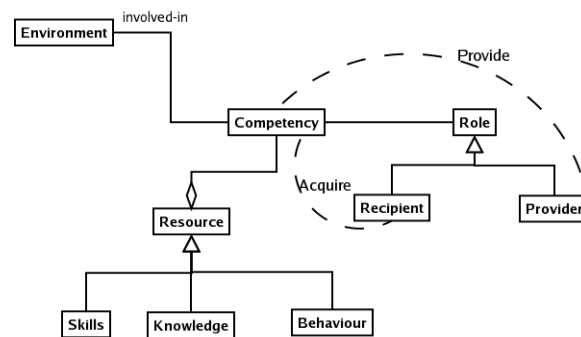


Fig. 3. The Palette Competency model

The goal of our competency model is to represent the competency in the context of CoPs, specially the acquisition/exchange of competencies. We take it into account through the distinction of different roles that actors can play in their relation with competency. We also need to define the competency, and we chose to make the distinction between three types of resources that characterize the competency. The last aspect that this model allows us to represent is the link between a competency and its context of use that is represented by the environment in which it is involved.

The competency model we propose involves the following concepts: Environment, that describes the situation in which the Competency is involved: solving a problem, achieving an objective or a task; Competency which is defined as a set of Resources provided or to be acquired by an Actor that plays a particular Role in the Environment to perform an Activity; Role that is used to link Competency to the actors. An actor can be Provider or Recipient of a Competency; Resource which is the set of items that compose a Competency. It can be of three types: Knowledge (theoretical knowledge (declarative or procedural)), Skills (capabilities of an actor to do some thing), Behaviour (the way of behaving of the actor in a group or in a given situation).

4.2 Related work

Many models of competency were proposed in the literature, they give different points of view of competency. Our work can be compared to two main approaches : on the one hand, an internal point of view that characterizes or defines the competency - this is the case of the [18] and the [10] that make an interesting distinction between objective kinds of knowledge involved in a competency and subjective ones that provide important information on how people use their competencies; on the other hand, an external point of view that considers the competency in its context of use and acquisition is provided for example in [8] and [13]. The KmP model [13] makes it possible to deal with both individual and collective competency and allows us to search the space of existing competencies. Since these two points of view are complementary and we need both of them to represent competency in the context of CoPs, our model try to unify them.

5 The Collaboration Model

5.1 Presentation of the Palette Collaboration Model

Collaboration is represented as a relation between four main concepts: the actors involved, the linked activities, the objective(s) of the collaboration and finally the resources it needs or produces.

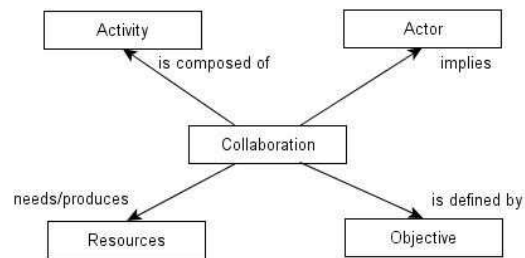


Fig. 4. The Palette collaboration model

Actor is a member participating in the collaboration, whatever its level of commitment or its knowledge. He may have several roles during collaboration, as he inherently possesses various competences that allow a participation in several activities. Activity is the mean to achieve the aim of collaboration. It can be planned (such as a meeting) or impromptu (such as chats or mail exchanges). Its observation and analysis can lead to best practices definitions, a decision, the creation of a document, etc. Collaboration arises from a goal that is common to each actor: the realization of a particular Objective. Each actor can have personal aims he wants to reach during collaboration. Finally, Resources represent anything that is used or produced by collaboration. There can be documents, theories, software, and instruments...

5.2 Related work

In order to build our model of collaboration, we studied the theories of Engeström [6], Laferrière [12] and Montiel [16]. In his theory, Engeström presents the activity as a relation between the subject, the object and an artifact that could be an instrument, a tool, or a product from another activity. In the same way, Laferrière's model of collaborative learning shows that the objective of collaboration is important in order to have a precise vision of collaboration. In [16], several definitions of collaboration are presented. They all rely on the same main concepts, i.e. actor, activity, artifacts and objective.

6 The Process/Activity model

The Process model within the Palette context aims at describing sequences, roles, objectives, inputs and outputs of transformations, be they knowledge transformations within the CoP or transformations being part of the CoP's objective or core processes.

6.1 Presentation of the Palette Process/activity model

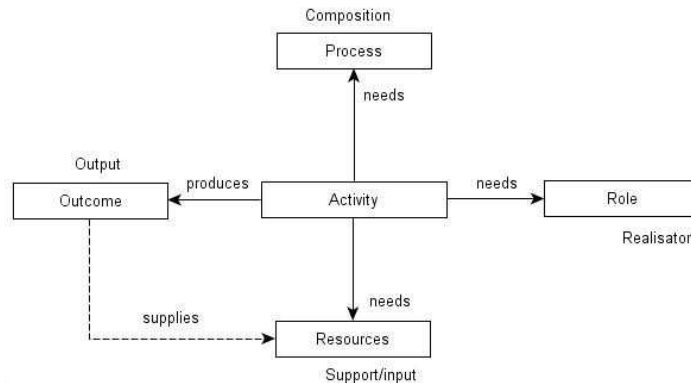


Fig. 5. The Palette process/activity model

A Process is a set of activities that need roles and resources in order to transform input objects into output objects, called outcome. An Activity is considered as a transformation of an input resource by a role during a process. An activity is seen as a ternary relation: a role, resource and a process. It needs the three following elements in order to be performed. In a process, the activities are planned. A Role represents the responsibilities ensured by a function. It refers to a specific level of competency and to specialized skills. A Resource enables or helps the realization of an activity. A resource can be a tool or a product: software, a document, a competency, a practice, a method. The Outcome is the output of the activity. It can be part of resources needed to perform another activity.

6.2 Related work

In their Coordination theory [3], Crowston and Osborn describe “processes as sequences of activities performed by organizational actors that produce and consume resources”. The Palette Process/Activity model is inspired from this theory [3]. After having defining the main elements describing a process and an activity, the terms have been adapted to be understandable and sufficiently explicit. The Activity System Model (ASM) of Engeström [6] refers to the activity theory, and allows to define activity in a context of community. In the ASM, an activity is a systemic whole. Each element has a relationship to others, each relation is also mediated. This model is complex and presents a lot of relations between the elements. However it can be used in various contexts and enables to see the relations with the other models.

7 Lessons Learnt model

7.1 Presentation of the Palette Lessons Learnt model

Since one of the main objectives of a CoP is to enable and foster collective learning, this last model was a crucial one to build. In the model, a *Lesson Learnt* is considered as the result of a process, collectively performed by the CoP members, of analyzing ones’ practices in given situations, and of drawing useful recommendations from this analysis that the CoP members can refer to when encountering similar situations of practice.

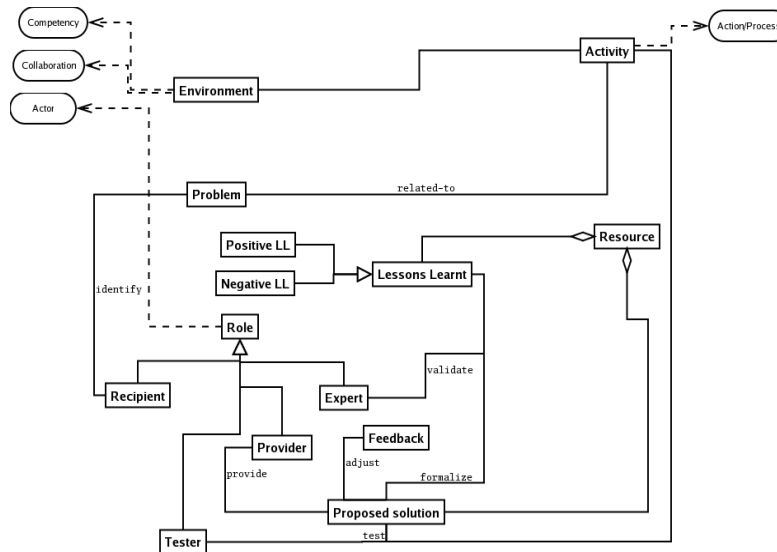


Fig. 6. The Palette Lessons learnt model

The Lessons learnt model that we propose, in the context of the Palette project, includes the following concepts: Environment which represents the context or situation in which Lessons learnt are used or produced, it relates to the concepts of Competency and Collaboration; Activity which relates to the individual objectives of the actors, that is to say the tasks they have to accomplish in the organizations they belong to, the activity requires the use of Lessons learnt in order to be performed; Problem is one of the main concepts linked to Lessons learnt, it describes, in the context of an activity or practice, a point at issue whose related solutions are analyzed so as to determine the best way to figure it out; Proposed solution: represents the proposal of a solution to the Problem, or a clue to solve it; Role is the status of each Actor involved in the processes related to the Lessons learnt, four main dynamic roles have been identified: Recipient is an actor who submits a Problem to be solved; Provider is an actor who provides a solution or a clue to the Problem; Tester is an actor who makes experimentation on the Proposed solutions and gives his/her feedback; and Expert is an actor who is able to assess the Proposed solutions, using his expertise on the domain and, at the same time, taking into account the feedback of the Testers; Resource: includes the different types of knowledge resources used to produce Lessons learnt (knowledge, know-how, etc.) and which form a competency; and finally Lesson learnt: represents the knowledge gained and produced as a result to the Activities of sharing, exchanging and analyzing knowledge. It is the synthesis and formalization of the Proposed solutions to the Problem. A typology of Lessons learnt can rely on their nature; for example, we distinguish: the positive Lessons learnt which consist of the activities recommended in the problem solving, they relate to the good practices of the CoP; and the negative Lessons learnt which describe the activities that are unadvised or to avoid, they relate to the bad practices of the CoP.

7.2 Related work

A survey of the works related to Lessons learnt and experience capitalization modeling enabled us to deal with aspects particular to Lessons learnt, such as the definition of the different operations to achieve (through the diverse roles we identify) and the description of the context in which lessons are learnt. Weber's model [20] describes the life-cycle of Planning Lessons learnt within an organization. Weber's work has been used by [15] as a basis for the identification and representation of use cases in the framework of Lessons learnt systems. Considering experience capitalization, the REX¹ method [14]; [5] consists of constituting "experience cards" stemming from any activity, and containing information about the context, comments and recommendations, and to store these knowledge elements in a corporate memory in order to be retrieved and reused by members of the company. MEREX² method [2]; [7] as well, deals with experience capitalization, and aims to make explicit Good Practices to be stored in a project memory, through the use of "knowledge forms" that contain the same kind of information as in REX method, but deals much more explicitly with the actor's aspect.

¹ REX: Retour d'Expérience

² MEREX: Mise en Règle de l'Expérience

8 Conclusions

This paper proposed several models useful for describing a CoP: community, actor, learner profile, competency, collaboration, process/activity, and lessons-learned. These models were built by adaptation of some existing models; they propose a unified view of some common models. We illustrated our models through an actual example of a CoP studied in Palette: the Telecom-INT UX11 (<http://www.inria.fr/acacia/2006/palette/example>). The proposed models are structured in an ontology that will be later on extended and specialized according to the analysis of the other CoPs involved in Palette.

The link between CoPs and ontologies was studied in some recent work. In [17], the authors present a method based on analysis of the relationships between instances of a given ontology in order to identify potential CoPs in an organization. But this role of ontology is quite different from our ontology that aims at both modeling the notion of CoP, and at annotating CoP resources.

As a further work, we will analyze several other CoPs involved in the Palette IST project, in order to extend the ontology. We will then develop several KM services based on this ontology.

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