

PROJECT MEMORY : A formal approach of modeling and reuse

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Abstract

A project memory is a representation of the experience acquired during projects realization [Matta et al., 2000]. It can be gotten through a continuous capitalization of the enterprise activity, notably its design rationale. We present in this paper a representation structure of a project memory (Context and design rationale). Our aim is to demonstrate how a formalization of this structure can give a flexible representation as well as a dynamic knowledge access.

1 Introduction

Knowledge management is a process of explicitation, modeling, sharing and appropriation of knowledge [Dieng and al., 1998]. The majority of knowledge management methods aim at defining a corporate memory considered as a strategic asset of the organization. We can classify these methods in two main categories: knowledge capitalization methods and direct extraction methods (Figure 1).

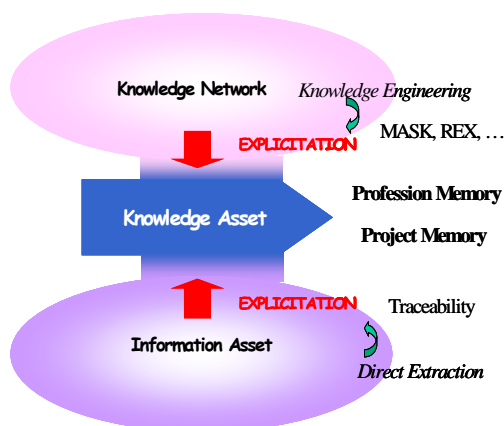


Figure 1 . Two techniques of explicitation of knowledge: capitalization and direct extraction

- The methods of knowledge capitalization use primarily techniques of knowledge engineering. These techniques consist mainly of knowledge extraction (experts interviews or collection from documents) and modelling. We can note for instance methods MASK, REX [Matta et al., 2000], etc.
- The direct extraction aims at extracting knowledge directly from the activity of the organization. We can distinguish several techniques as data mining (extracting knowledge using statistical analysis), text mining (extraction of knowledge based on linguistic analysis of texts [Bourigault and Lépine, 1996], techniques of traceability (e-mail, forum of discussion structuring) and design rationale representation).

We study in this paper, the traceability of the design rationale that aims at defining a project memory [Matta et al., 2000]. We demonstrate how the formalization of the project memory representation could be interesting and useful. This formalization has as goal obtaining a flexible representation structure as well as a dynamic knowledge access.

2 Building a Project memory

A project memory is generally defined as a representation of the experience acquired during projects realization [Matta et al., 2000]. This memory must contain elements of the experience coming from the context as well as from the problem solving. these elements have a strong mutual influence so that if the context is omitted, the restitution problems solving is insufficient.

2.1 Project context

We mean by project context the whole information witch could be used to characterize project situation in

each time. The project context must contain notably the description of the work environment (means and techniques, referential, instructions and constraints of the project) and the project organization (participants, their roles and tasks organization).

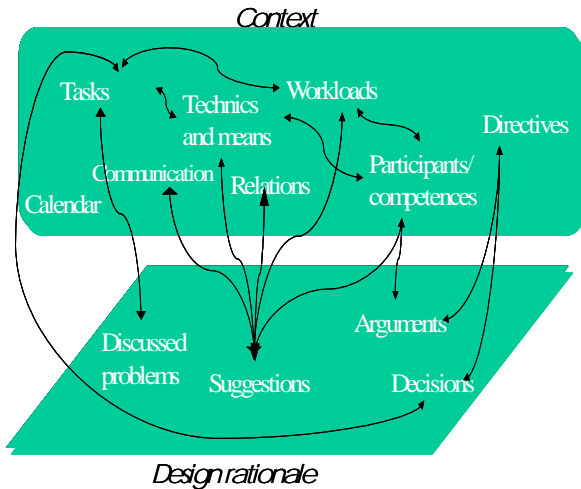


Figure 2 . Mutual influences between elements of the project

Except the system DRCS [Klein, 1993], some approaches (the reader can refer to [Matta et al., 2000] to have more details about these methods) provides techniques to represent design rationale but they omit representing the influence between the context and problems solving in a project. Even DRCS system can only allow representing a part of this context (the tasks organization and the projection of the decisions on the artifact). In the same way, we can observe some efforts in DIPA formalism [Lewkowicz and Zacklad, 1999] to represent the organization of work in a workflow (task/role). However, also other elements have to be identified like constraints, directives, resources and competences, modes of communication, etc. We consider in our approach representing a complete vision of the project context by emphasizing its influence on the problems solving (Figure 2).

2.2 design rationale

Representing the design rationale [Buckinham, 1997] in the project memory consists of modeling the process of decision-making through all the elements characterizing it. These elements are essentially (figure 3):

- **Problem objects:** The global problem discussed during the meetings is composed of sub-problems or elements of problem. The idea is to break up the whole discussion into basic elements. The structure thus permits to represent these elements of discussion with their contents, to bind between them and

to represent the evolution of each of them during the negotiations.

- **Arguments:** One of the most significant elements of any negotiation is the argumentation. In our approach the argumentation is an essential element of the representative structure because it is the origin and the cause of the evolution of the discussion of the problem and consequently of the decision-making.
- **Suggestions:** The arguments advanced by the speakers during meetings often lead them to make their own suggestions concerning such or such part of the discussed problem, we envisaged in the model a space for the suggestions of the participants. The suggestions are related to the arguments and the participants who proposed them.
- **Participants:** The representation of the participants in the structure is important, it permits to bind the arguments and suggestions to their transmitters. Each participant is characterized, primarily, by his competences and his role in the project (see context). It permits to really understand the logic and the reasoning of the participants and the motives of their interventions.

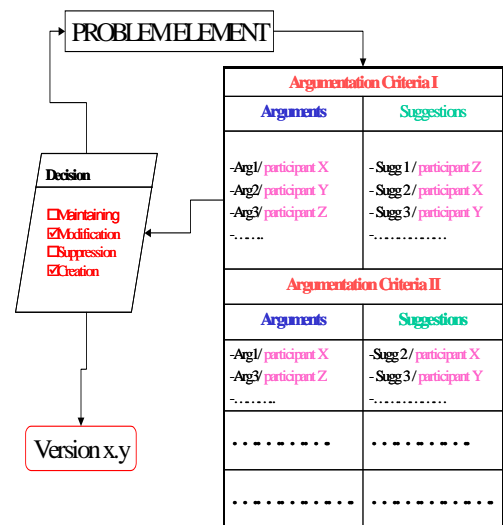


Figure 3 . Problem discussion structured form [Bekhti and Matta, 2001]

2.3 Relational model (context/design rationale)

We studied different models representing the cooperative work and containing the same elements as in a project. We can find this kind of model in CSCW studies and notably in the group awareness representations. We suggest in figure4, a relational model representing different connections existing between the elements of

design rationale and those of the project context. The idea is to make a global model representing both of the context and the design rationale and showing the existing influences of the elements of each part on the other one.

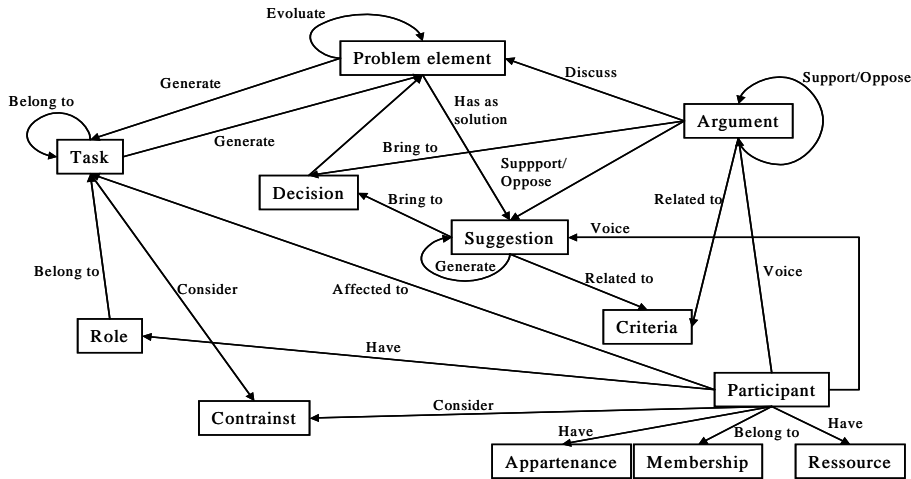


Figure 4 . Problem discussion structured form [Bekhti and Matta, 2001]

3. Using the formal representation

As we noticed before, our first motivation is to construct a global and flexible model. This model must represent all project memory components and their relations. The formal system is very adapted to model this kind of memories. In fact, we can represent the project memory elements, relations by using the formal logic language.

We can thus represent the situations defined in the project memory using terms and formulas.

3.1 Formal logic and the project memory

In Figure4 below, we propose a global graphical model representing both of context and design rationale in the same time. In order to get the formalization level, we define our appropriate syntax based on the first order logic.

We thus define our vocabulary containing variables, constants and relations to represent information in the project memory (figure5).

- Variables: represent the objects composing our domain (project memory) like role, constraint and resource (nodes of the graphic model – figure4).
- Constants: represent the defined values of the domain object.
- Relations (predicates): represent the relations between the domain objects.
- Logical brackets and connectors.

To represent the situations set, we consider two steps:

3.2 Conceptual representation

This step corresponds to the modeling. It allows representing the information existing in the project memory. In this case we use only variables and connections.

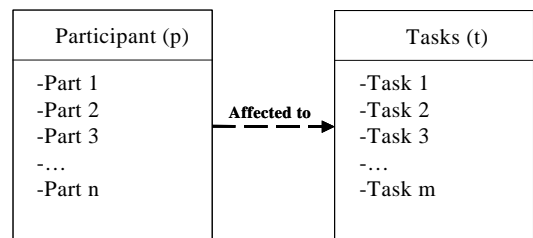


Figure 5 . The relation Participant - Task

Example: to represent the connection "participant affected to task" (figure5) we need:

- A variable symbol *par* for participants set.
- A variable symbol *task* for tasks set.
- the relation *Affected_To* for "affected to" .

"Participant affected to task" become thus:

Affected_To(part,task).

We, thus, represent the model part in figure6 by the expressions in figure7.

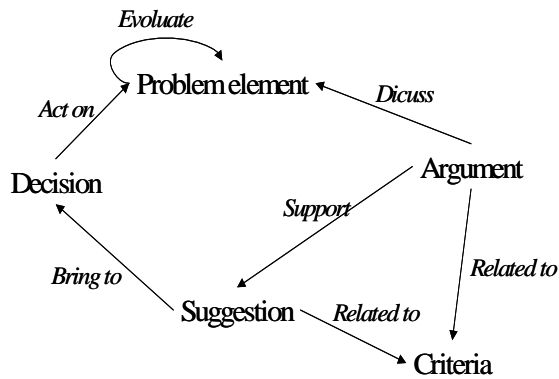


Figure 6 . Project memory model part

We obtain:

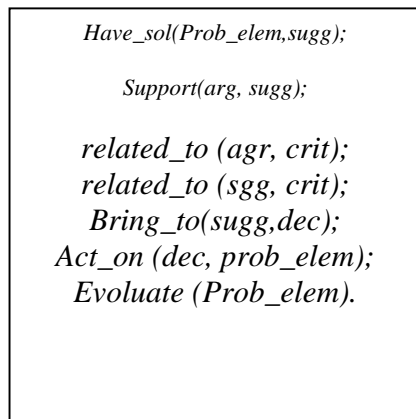


Figure 7 . Formal representation of figure6

We represent in the same way the other situations and we, thus, obtain a formal representing of different parts of the model “context / Design rationale”.

3.3 Generated representation

A project memory is defined in order to keep track of experience and, thus, provides guidelines to solve problems in an organization. We are, then, interested in the way to reuse knowledge memorized. In fact the interest of make a track of a project is to be able to understand information which it contains and especially the “why” of the decisions. To meet this need we propose many access to the project memory according to different points of view [Bekhiti and Matta, 2001] like: problem solving, argumentation criteria, evolution of the problem solving, participants competences and chronological point of view. These points of view permit to understand the decision-making procedures and their contexts.

The formal representation of the memory helps to generate different representations according to the need. In fact, using an inference system, based on the relations between the concepts, we can obtain several views on the memory. This generation gives a dynamic access corresponding to the need of the user. The views can be represented as graphs witch show the influence some memory’s elements. These influences can be shown according to the user need in a given situation and not predefined as usually recommended in design rationale approaches. For instance, user can need to get all argumentation criteria characterizing the discussion of a given problem or he want to see the problem according to the participants competences as in Example 1 and 2 respectively:

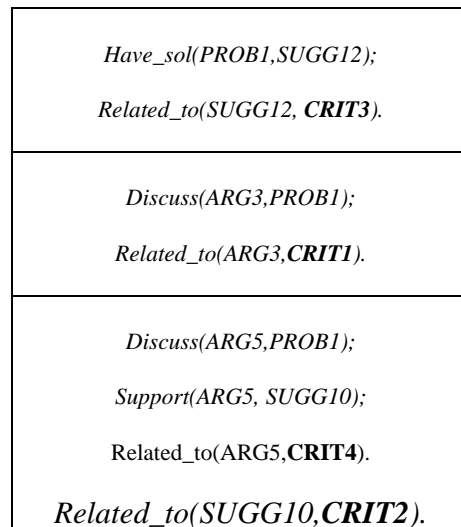


Figure 8 . An example of a generated situation focused on criteria

Example 1: Figure8 is an example showing three possible ways to get the argumentation criteria regarding the problem PROB1. In fact its shows that the problem element PROB1 has as solution the suggestion SUGG12 witch is related to criteria CRIT3. We also notice that argument ARG3, witch is related to criteria CRIT1, discuss the problem element PROB1 and finally that the argument ARG5, witch is related to the criteria CRIT4 discuss the problem element PROB1, ARG5 is support the suggestion SUGG10 witch is related to the criteria CRIT2.

From these instances we can generate a graphical representation (figure9) of point of view of argumentation regarding the problem element PROB1.

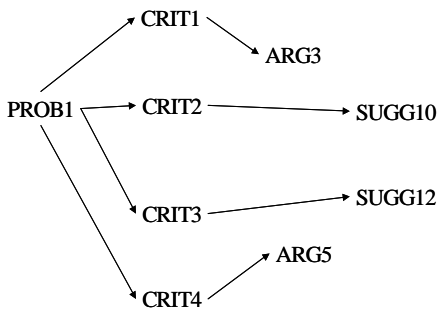


Figure 9. Graphical representation of figure8

Example 2: In figure10 there is an example of two project situations focused on participants' competences. A graphical representation of the point of view of participants' competences could be generated as in Figure11.

<p><i>Discuss(ARG9,PROB2);</i></p> <p><i>Voice(ARG9, PART6);</i></p> <p><i>Have(PART6,COMP3).</i></p>
<p><i>Generate(PROB2, TASK6);</i></p> <p><i>Affected_to(PART2,TASK6);</i></p> <p><i>Have(PART2, COMP1).</i></p>

Figure 10. An example of a generated situation focused on participants competences

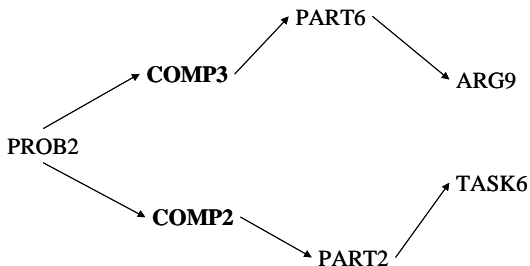


Figure 11. Graphical representation of figure10

The procedure is similar to generate other point of views representation.

4. Conclusion

A project memory reflects an acquired experience it must represent all elements of information related to the project, the context as well as the design rationale. We described in this paper an approach that permit a global representation of these elements. It puts forward the elements and the mutual relations that influence the

problem solving in a project and that through views representing the different faces of the project progress. We also presented a formal representation of the memory. This representation emphasizes influence between different elements of the memory. We thus obtain a flexible structure which can be easily augmented corresponding to the specificity of domains.

Otherwise, this formal representation can be used as an inference system in order to generate dynamically views on the collective problem solving. In fact depending on the needs of the user, he can ask to know about a given element has influence on some decision-making. It thus can rely these elements with its context and learn from the adequate decision making experience.

We also showed in this paper how a formal representation can give flexibility not only in knowledge representation but also in knowledge structuring and search. We develop a tool to support our approach offering, on one hand, a flexible structure of representation and on the other hand an adaptive user interface.

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