Toward a Domain Ontology for Computer Projects Resolution: Project Memory Challenge

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Abstract: In recent years, the project management has been practiced in many special computer projects which took place in large companies. During the resolution of a project especially during the design phase, the project leaders have encountered many problems which are treated and solved in the already existing projects. The resolution of a similar new project forces project leaders to spend a lot of time accessing and reusing existing project knowledge. This is why the problem of capitalization of knowledge proves to be very important in order to solve the problem of time, of cost and of quality that a project manager can encounter during his resolution. The best solution is to propose a technique for memorizing and saving knowledge. This solution presents in a way the project memory. In literature, there are several approaches that are all about the capitalization of knowledge and the construction of project memory. All these approaches are generic models which are applied to any type of project such as the industrial and the technical project. In this paper, we present a model approach for a project memory. In practice, this challenge is addressed by proposing the domain ontology that characterizes the specification of computer project.

1 INTRODUCTION

According to the remarkable evolution of technological life, sharing information and experience between the actors of each organization has been developed rapidly. Indeed, designers have encountered problems during the design of their projects. So, they don't only use the shared information to solve problems but also to avoid past mistakes. Then, the proposition of a solution to memorize tasks, actions and results during a finished design project is proved to be fundamental.

In this context, we propose an approach for the capitalization of computer project memory knowledge.

This approach presents a decision support in the project management phase of the design on the previous plan, and this by proposing solutions and problems that are already encountered in the previous projects.

Our decision-making process will not only help structure formalize and capitalize knowledge about the resolution of a past project, but above all provide a dashboard which is in the form of indicators, information and a guide favoring the decision making by leader of computer design project.

In the case-based literature (Benoît Eynard, 2001)(Paula Potes Ruiz, 2012)several architectures are presented. Inspired by this work, we define the architecture of our system on two main processes: an off-line process and an on-line process.

In this paper, we focus on the first process "offline process". This process concerns the formalization of knowledge and the implementation of domain ontology through three models: project class model, project model and rational design model.

Indeed, ontology is defined in computer science, and the field of knowledge engineering (IC), as a particular artefact to represent knowledge. It is now classically accepted to distinguish the three levels of ontology which are: (Hernandez N. M., 2007)

- The top-ontology, the highest level structuring and the high-level knowledge '.
- The core or core ontology, provides the concepts structure of the domain and describes the relations between these concepts.
- The ontology of the domain, that is to say, the concepts of the field as they are handled by professionals.

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The paper is organized into three main sections. Section 1 presents "related work" the main works existing in the literature as well as a comparative study. In Section 2, we reveal our proposed approach by focusing on the offline process. The third and the last Section introduces the notion of ontology and the construction of the domain ontology that we proposed.

2 RELATED WORKS

Mining the state of the art, various works addressed the project memory models which aim at the capitalization of knowledge and the construction of project memory.

Zacklad and al (Zacklad, 2014), propose a groupware "MEMO-net" using the DIPA problem solving method for capitalization and knowledge management in design projects. This groupware makes it possible to manage the knowledge used in order to better capitalize and reuse them. This groupware is a tool that has two modules: (design and diagnostic) that allows a project group to solve problems encountered during the design (capitalization of the design logic) and to preserve the characteristics related to such a product. Ermine (Ermine, 2001) has described its knowledge management processes through the margerite model. These processes can be internal or external. What interests us is the internal process of capitalization and sharing of knowledge within the company.

Serrano in (Serrano, 2014), proposed a global system of capitalization of knowledge allowing the actors of the company to exploit the important mass of information. This system also makes it possible to capitalize events in the field of OSI (Open Source Intelligence) based on the Web Lab platform.

Other approach is proposed in (Harani, 1997) as a design assistance tool whose main objective is the capitalization of knowledge involved in the design of a product for reuse.

Bekhti(Bekhti, 2003) proposed a dynamic project definition and reuse process "DYPKM". This approach is based on a method that provides a structured trace of a project memory containing the context in which the design takes place and the logic resolution.

2.1 Comparative Study of the Studied Approaches

Several classifications of project memory models are available in literature. Inspired from these, we present our own classification in the following table (table 1) .This comparative study is based on a set of criteria, namely:

- **Simplicity of the Method:** This is a primary criterion because any method, as interesting as it is, loses much of its value if its use is complicated. Actors, who apply a knowledge capitalization method, during the realization of a design project, must not be obliged to acquire new specific skills to be able to use this method
- **Resource:** To represent all the knowledge forming the context of a design project, we need as resources all the project management data. It corresponds to the workspace, the data representing the constraints to be considered and the data of the project organization.
- **Application Domain:** This criterion gives a global vision on the field of application of each knowledge capitalization process or approach. we have to work on this criterion because we will focus, in our study, on computer projects.

Table 1: comparative study of some knowledge Capitalization models.

Model	Simplicity of the method	Resource	Application domain	Using of (CBR)	Capitalization level
Ermine's model (Ermine, 2001)	Complex (marguerite model)	Corporate memory	Area of economy	No	Design
Zacklad ‘s mode(Zacklad, 2014)	Complex Collective Software (DIPA)	Diverse	For all design projects	No	Conception and context
(Serrano, 2014)	Global + wave (weblab platform)	Open source (blog, internet, site ...)	Field of defence	No	Event
Harrani Model (Harani, 1997)	Simple help tool	Company knowledge	Computer, mechanical, industrial	No	Design + Feature
Bekhti model (Bekhti, 2003)	Simple process	Project memory	Design project (all areas)	No	Context + design Rational

- **Using of CBR (Case Based Reasoning):** we have introduced this criterion to check whether the concept of case-based reasoning is used in the proposed model or not.
- **Capitalization Level:** this criterion allows us to define the part that a process or approach can capitalize.

2.2 Discussion

We have presented in this comparative study a set of models that help to capitalize knowledge. It is a clear and detailed study that allows us to note that:

- All the models proposed are almost all complex models which are based on other methods. The user of these models must have an additional skill to be able to use these processes of capitalization.
- For these models and others existing in the literature, the consideration of project memory as a knowledge resource is almost totally absent.
- Almost all the proposed models are applied for design projects and this has shown us the importance of these types of projects.
- Finally, we have noticed the absence of a model which guarantees the capitalization of all these concepts at the same time which are: project context, project characteristics and rational design.
- Based on this comparative study we will propose in the next section our approach to capitalize knowledge of project memory. This approach aims to provide decision support in project management from the design phase to the previous plan.

3 PROPOSED APPROACH

Our goal is to present an approach to help the leader to solve its new project by referring to the experiences and knowledge which are stored in a project memory. This section, introduces the architecture of our approach and in particular the modeling part which composed of three models: the project class model, the project model and the rational design model.

3.1 The General Architecture of the Proposed Approach

The architecture of our approach is, such that several approaches in the literature, composed of three main parts: an offline process, a base case and an online process (Fig. 1).

- **The Offline Process:** this process starts from modelisation (models + ontology) to the project excavation. This part identifies and classifies projects and the domain ontology.
- **The Knowledge Base:** it doesn't only contain instances of the ontology but also cases of projects, project classes and problems arising from the rational design.
- **The Online Process:** the online process is from the acquisition of new project until the project learning. the presents the CBR reasoning cycle: which Development, Remembering, Adaptation, enrichment, validation and storage.

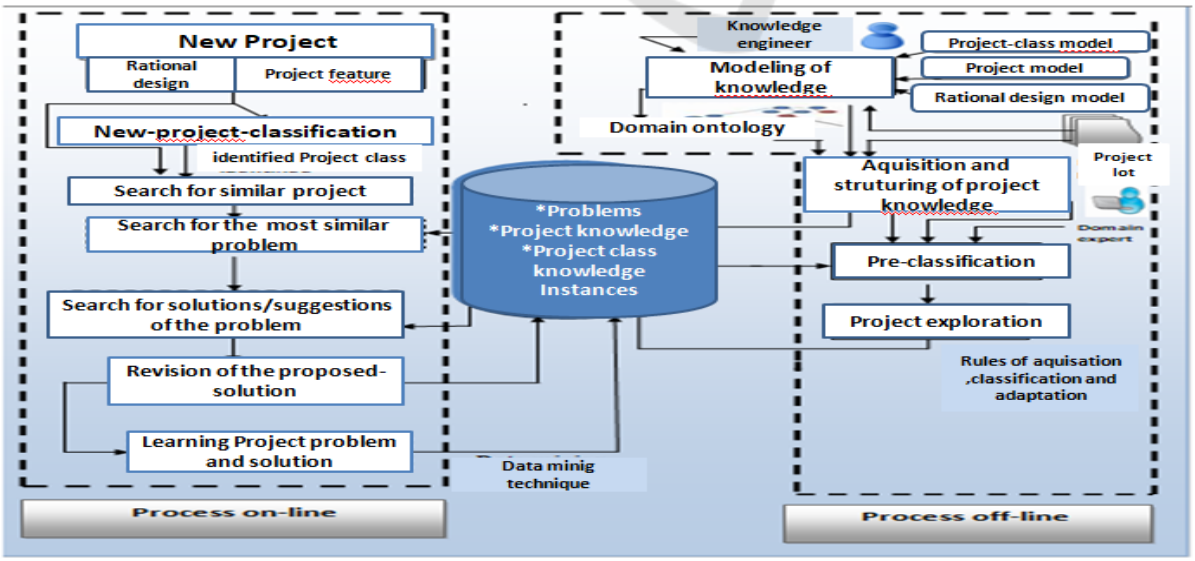

Figure 1: Architecture of the proposed approach.

In this article, we will concentrate on the modeling part of this approach in which we will describe the three suggested models and the proposal of domain ontology.

3.2 The Project Class Model

During the resolution of a computer project, we can distinguish different classes in the same organisation. Such as security, software engineering, imaging, data base, artificial intelligence…

It is in this context, that we propose this model to allow the leader to classify, from the beginning, the project. This process can be done by specifying their knowledge, its resolution method (scrum (Alain Collignon, 2016), pert(Mahfouf, 2014)…), its reasoning rule and its architecture. This model (Fig 2) is composed of three elements:

- **Project Class:** this element is composed of an enumerative project list that belongs to this class as well as a list of common denominators (rules + keywords).
- **Project Class Knowledge:** All the knowledge related to the project class in question are associated to all the rules used in the reasoning phase for this type of project class.
- **Point of View:** This component presents the methods of conducting project class and the type of used architecture.

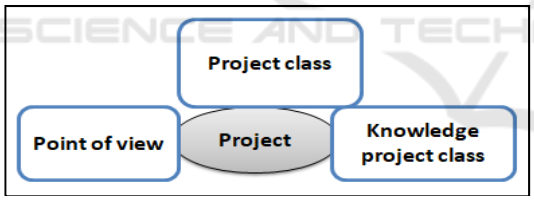

Figure 2: The project class model.

3.3 The Project Model

The proposed project model (fig. 3) has three-dimension. The choice of components of this model is inspired from the composition of the project memory. For this reason, in the following section we will present a brief study of the notion of project memory.

3.3.1 The Memory Project: Definition and Structure

According to (Nada Matta, 2014) a "project memory" is a very limited part of a capitalization exercise of a whole range of diverse experiences in the business. This memory aims at facilitating the traceability and the re-use of similar projects. It consists essentially of two components which are the problem-solving context and the method of resolution.

In (André, 2004) the "project memory" was considered as a technique that approximates the meeting often done at the end of the project because it seeks to determine the same knowledge and lessons learned during the project.

3.3.2 The Description of Proposed Model

The project model is composed of three elements:

- **Project:** This pillar gives general information about the project. It includes the following attributes.
  - Project Name: gives the name, title or project subject.
  - Abstract: contains the objective, the principle and the result of each project.
  - Keywords**:** are essential words of a subject or a project which allows them to be identified.
  - Project Team: This is the name of the person in charge of running a project and managing its progress (project manager, project-director, supervisor, user, provider, project-actor ...)
- **Project Features:** This component reflects all the characteristics that a project can have during its realization. Among these characteristics we can quote the size, scope, cost, time, complexity, type…
- **Deliverable:** this class is composed of two sub-classes:
  - Rational Design: This concept gives an idea about the list of problems associated with the solutions and suggestions given by the leader of a project. In order to better explain this component, we have proposed a model which will be described in the following subsection.
  - Nature: The deliverable nature given by such a project can be either: a service, document or a product.

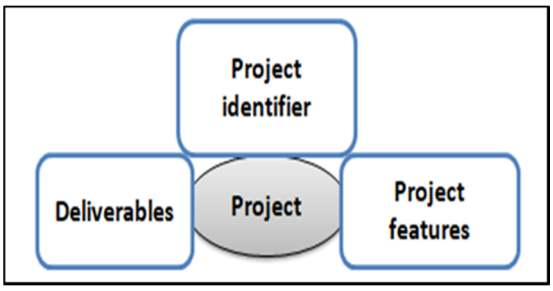

Figure 3: The project model.

3.4 Rational Design Model

This model (Fig 4) is presented using three essential components:

- Problem list: each problem is described by its name, its textual description and its attributes.
- Suggestion list: before reaching the final solution the designers have proposed a set of suggestion.
- Solution list: for each problem there is one or more solutions that are defined (text) and argued (arguements).

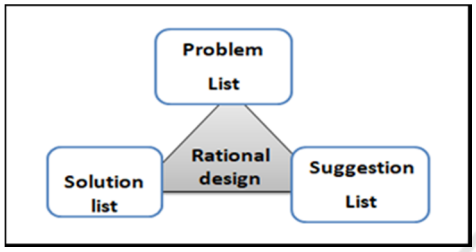

Figure 4: The rational design model.

After the presentation of these models we noticed that there are a very large number of different concepts which define the field of computer projects such as types, characteristic, deliverable...

4 DEVELOPING DOMAIN ONTOLOGY

4.1 The Components of Ontology

Ontology can be defined as representative model which presents the domain knowledge with explicit specifications that feature interoperability between human and machine,(Chun-che, 2015) it is composed essentially of: classes, proprieties, axioms instances and relation (Ahmed Maalel, 2011)

- **Concepts:** A concept can represent an object, an idea or an abstract concept. They are also called ontology classes in some works. A concept can be divided into three parts: a term (or several), a concept and a set of objects. (Mejri Lassad, 2009).
- **Relationships:** Relationships reflect the (relevant) associations between the concepts presented in the analyzed segment of reality. These relationships include the following associations: (Subclasses of (generalization-specialization) Part of (aggregation or composition), Associates with, Instance of, etc. (Chun-che, 2015).
- Properties: May include subproperties (and superproperties). Ontologies define a set of properties to be used in a specific knowledge domain. There are many types of typologies of properties such as the Inverse properties.
- Axioms of the ontology used to define the semantics of terms (classes, relationships), their properties and any constraints on their interpretation. They are defined using well-formed formulas of first order logic using the predicates of ontology.
- Individuals: Instances constituting the extensional definition of ontology; these objects convey knowledge (static, factual) about the domain of the problem (Ahmed Maalel, 2011).

4.2 The Methodology of Ontology Construction

The construction of ontology is a difficult task requiring the implementation of elaborate processes to extract the knowledge of a domain, manipulated by computer systems and interpreted by human being.

In literature there are many methods of ontological construction. We present here our choices of each step in the construction of domain ontology for computer projects (Hernandez N. M., 2007).

- The Text-To-Onto methodology is an application for extracting ontologies from corpora or web documents and it also allows the reuse of existing ontologies (Marie-Noelle, 2009).
- The Onto Builder methodology, which allows building ontology from web resources (Ahmed Maalel, 2011).
- The METHONTOLOGY and KACTUS (Hernandez N. M., 2007)which are designed to be applied in more general settings. In KACTUS, the methodology aims to reuse existing ontologies and propose mechanisms for this reuse. For METHONTOLOGY, it is applied to clarify the various stages of construction by respecting:
  - Project management activities: planning, quality assurance.
  - Development activities: specification, conceptualization, formalization, implementation, maintenance.

- Support activities (integration, evaluation, documentation).

For this reason we have proposed a method based on this methodology in order to construct our domain ontology of the computer project domain.

4.3 Steps of Construction of the Ontology

This methodology is offered through a set of steps, a cycle of development of ontology that can be adopted during the construction of a new ontology (McGuinness, 2007)

a. **Specification:** The purpose of this step is to provide a clear description of the problem being studied and how to solve it. It clarifies the purpose, scope and degree of granularity of the ontology that will be constructed.

b. **Conceptualization:** During this stage, it is a question of transforming the terms obtained following the linguistic study of the corpus: terms will be transformed into concepts and the lexical relations in semantic relations. At the end of this step, a conceptual model is obtained. We distinguish in this phase the two following tasks:

- The definition of concepts: it identifies the concepts from the resources that were originally specified in the specification phase.
- The hierarchy of concepts: it organizes the concepts in a hierarchy that expresses the subsumption relationship between concepts.

c. **Formalization:** The objective of this step is to express, by means of a formal language, the conceptual model obtained at the end of the previous step (Ahmed Maalel, 2011). This step makes it possible to add properties to concepts, axioms, constrain the areas of a relationship.

In other words, it is a question of defining concepts according to a formal and extensional semantics. It is also used formalize the relations that exist between the concepts by defining their varieties and the sets of extensions of concepts that they connect (Hernandez N. M., 2007).

d. **Implementation:** This phase aims to move the conceptual model to a model implemented in one of the languages (OWL, OWL Lite). For the implementation phase we work with the "PROTEGE" tool (Ferdinand Dhombres, 2010)

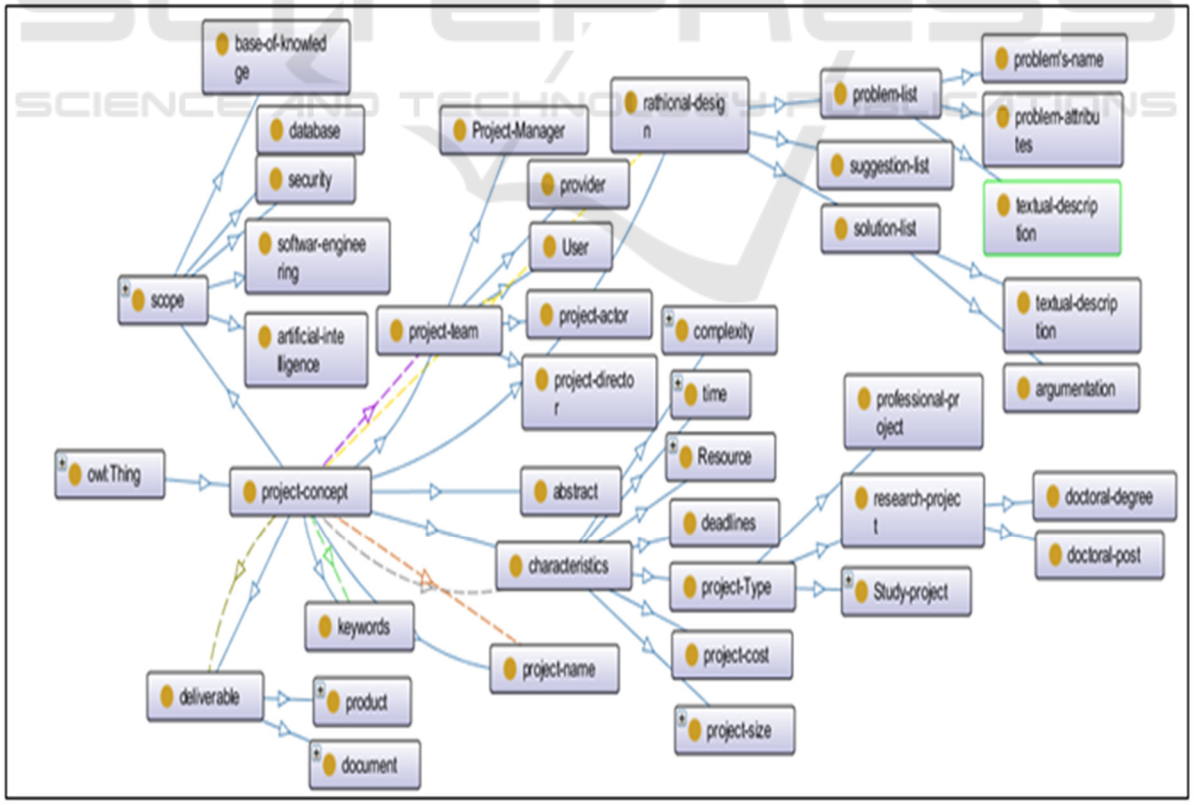

Figure 5: Proposed domain ontology.

This tool is the most popular and widely used tool for ontology development (Naveen Malviya, 2011) It is a stand-alone open source platform that provides a graphical environment for ontology editing, visualization and control (constraint checking) .It is the most popular ontology publisher at the moment, serving as a reference for a large community of users.

e. **Maintenance:** This phase can update the ontology developed by adding, modifying, or deleting concepts or other elements of the ontology. The Maintenance of ontology is very important because it allows it to stay up to date.

4.4 Main Classes of the Proposed Domain Ontology (Fig 4)

The field of the "computer project" includes a large number of concepts related to the project concept), such as the identifiers of a project, the characteristics and the types of deliverables...

In the next section we will describe the main concepts of our project, proposed ontology**.**

- **Project:** This is the main class of our domain ontology. A project is defined by a set of attributes that are the project name, summary, keywords, project manager, and project team.
- **Characteristic:** a project has a set of characteristics that can be differentiated from one project to another: Scope, complexity, size, delay and cost, resource. Each of them can have subclasses (complexity: complex, simple, innovation .., size: small, large ...,).
  The concept «scope feature, can be either a professional project (business project), a research project (web, security, data base, imaging, networks ...) or a study project (license, master's degree or thesis.)
- **Deliverables:** each project is characterized by a return value, this value can be of three types:
- **Product:** A product can be hardware or software
- **Service:** service offered online or offline.
- **Document:** It can be a site or a text. This text can be a report (design report, usage report or technical report).

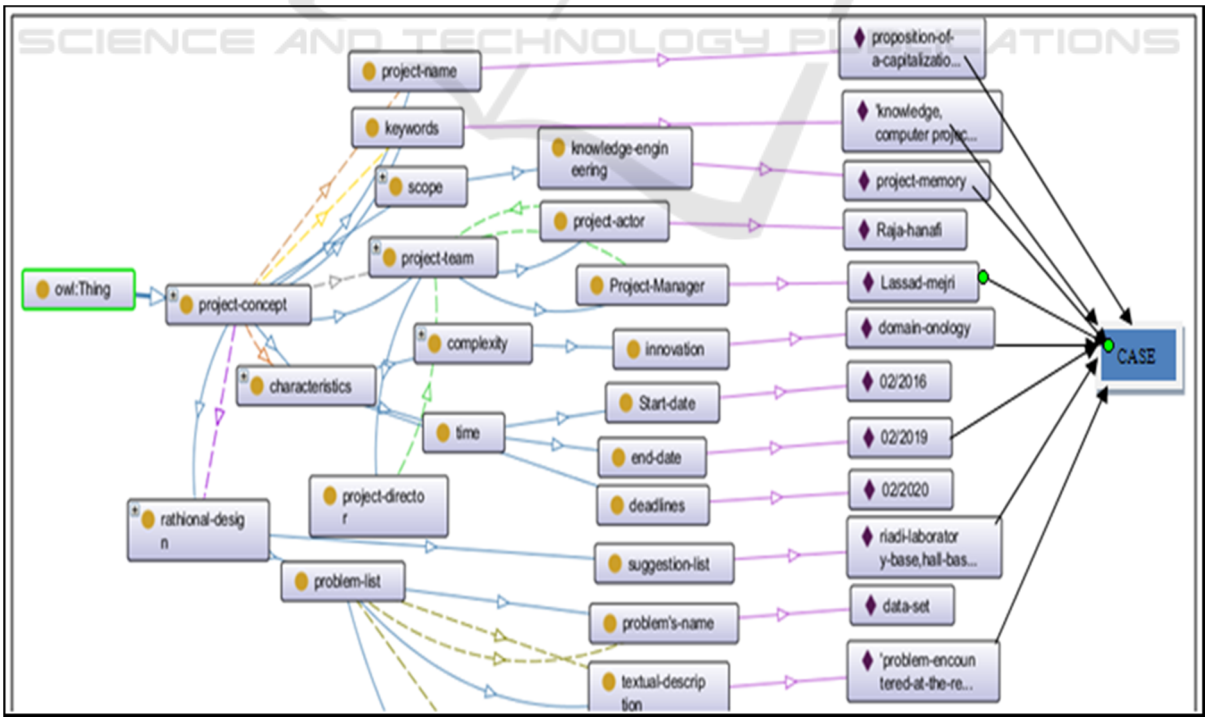

Figure 6: Creation of an individual and instantiation of ontology.

4.5 Creation of an Individual

We have suggested this ontology in the hope of creating a strong relation between this notion and the case-Based reasoning system (CBR) and this can be done by different factors:

- Ontologies play an crucial role in CBR systems because they can reduce the effort to acquire
- Knowledge in the different stages of reasoning (Chun-che, 2015).
- Ontologies are effective ways to formalize structure, store and used knowledge.

The final instantiation of this ontology (individuals + instances) is actually the new case on which our reasoning is based (fig 6). They help to establish a common vocabulary to describe the case, or the model knowledge needed to index and organize the event.

We have advanced our thesis research topic to instantiate our proposed ontology.

5 CONCLUSIONS

Through what we have presented in this paper, it turns out that the notion of ontology represents a very effective approach to introduce knowledge.

Throughout this paper, we have tried to clarify the notion of ontology by presenting certain definitions from their types and their components.

In addition, we have described several methodologies in the construction of ontology and we have finished this section by proposing a method of construction of a domain ontology based on METHONTOLOGY methodology.

The domain ontology explains the concepts and relationships that can be found in the field of computer projects, this one can be extended with task ontology.

In the near future works we will focus on interrogate our ontology either by using the SPARQL-QUERY (“Protégé’s tool) or by proposing a short algorithm. Then we will tackle the producing of our knowledge base which will be built from the data set existing in the “Hall”.

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