A Systematic Approach to Keep Track of Knowledge from Cooperative Working Tools Enriched by Semantic Data

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1 RESEARCH PROBLEM

Who took on this task? did they go on about doing it? What was the reason behind it? To whom this task was affected previously? It is hard to answer all these questions in context of an enterprise, which doesn`t give an interest to manage and keep track of knowledge over years.

Nowadays, with the digital and technological revolution, work processes, methods, tools, project design and organisation are involved by information systems, even the collaborative work is assisted by special tools, which gives the possibility to a set of workers to communicate, interact and exchange elements.

In fact, this research area has succeeded to tempt researchers into investigating and exploring it. Many researchers have wondered whether it is possible to extract, identify and share knowledge within collaborative working tools. (Nada Matta e. a., 2011) Consequently, a lot of interesting work has been realized to integrate knowledge management in collaborative working tools like Product Life cycle Management (Terzi, 2010).

But this way of doing things always demands a significant amount of intervening on our behalf, to do a routine update and maintain for these mechanisms, which represents an additional charge of work for the experts. As a result, the efficiency of the developed solution will be negatively impacted.

On the other hand, knowledge could be extracted from different sources: databases, electronic documents, employees, papers… (Segonds, 2011)

The process of injecting extracted knowledge into collaborative working tools should be applied with a high precision. Semantic data offers the ability to both analyse and select automatically the knowledge to put it than in the right context.

In my PhD, we are addressing the problem of integrating knowledge management within collaborative working tools like PLM, and how to keep track of knowledge systematically, which means, an automatic and regular work to manage and keep track of knowledge over time knowing that a semantic data models should be present in the proposed approach linking knowledge with it's right concept.

Our research works will be applied in a French public organism in the energy and environment sector. Cooperative work in this sector demands a high commitment of specialists from different fields (energy, hydrology, chemistry, geology, computer science…). Knowledge and memory projects represent a key value and a fundamental element to progress and make successful projects. The Main idea is to apply the proposed systematic Approach to capitalize, share and keep track of knowledge in this area.

2 OUTLINE OF OBJECTIVES

During my PhD research, our goal is to study how to design and build a systematic approach that's consists of:

- First: integrating knowledge management in collaborative working tools which will provide a real time interaction between working environment and various knowledge resources, aiming at identifying and extracting knowledge continually than applying a semantic filter To analyse and check extracted elements. to be able to inject them afterwards in structured way into collaborative working environments.;
- Secondly: keep track of knowledge circling in an enterprise through collaborative tools in a

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structured form which guarantees the possibility to exploit and reuse project memories and past experience.

3 STATE OF THE ART

3.1 Knowledge Management

Defining knowledge was a subject of several research works giving a various point of view. For example, Saussure defined the notion of semiotic which highlights the fact that the representation of knowledge embedded in an activity is related to a specific symbol. The semiotic triangle completed later the basic notions of semiotic by considering three triangle centres: Sense, Symbol and Referee. Focusing to these three dimensions a knowledge can be defined as a symbol having a sense based on a referee. (Nada Matta H. A., 2016)

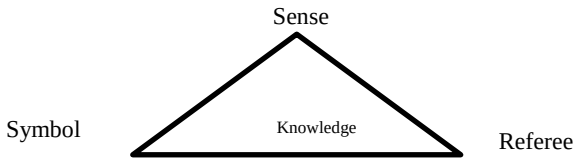

Figure 1: Semiotic triangle.

Since 1990's a new discipline was born, named "knowledge management " aiming at valorising the notion of knowledge. Knowledge management is defined as a global process in the enterprise. It includes all the processes that allow capitalization, sharing and evolution of the Knowledge Capital of the firm.Focusing in what happened in industry, there's a strong need in organisms to find a method to avoid past errors as well as to learn from past experience, which fixed the main goals of knowledge management adding to the valorisation of human resources in an enterprise. (Ermine, 2003)

(Nonaka, 1995) interested in how knowledge could be either created or conversed and defined the SECI model. Which is a model representing transformation steps of knowledge in an enterprise. Polyani in his researches concluded that knowledge could be classified into two contradicted types: tacit and explicit (Polanyi, 1961).

Tacit knowledge referees to a kind of knowledge not expressed and residing in human mind. Whereas, explicit knowledge is all knowledge expressed orally or written somewhere, formalized or represented somehow. (Polanyi, 1961).

The SECI model, represents four steps of transformation (Nonaka, 1995):

- Externalization: converting knowledge from tacit to explicit, this transformation could be given by writing, expressing or formalizing tacit knowledge;
- Combination: converting an explicit knowledge to a more complicated one. Training is one of methods providing this transformation;
- Internalization: the process of creating new tacit knowledge from explicit one. It could be provided by reading for example.
- Socialisation: A knowledge creation process based on physical rapprochement, tacit knowledge is shared by common activities.

Knowledge creation and transformation processes are provided within a context introduced by Nonaka in 1996, this context so called BA, (an ideogram kanji) composed by two parts: left one means "water and earth "and right one means " enable" (Nikujiro Nonaka, 1998). On the other hand, BA is defined as the world where the individual realizes himself as part of the environment on which his life depends. Knowing that to every process of SECI models presented above, there's a special BA (interacting to externalization, originating to socialisation, cyber to combination and exercising to internalization). BA could be virtual, mental or physical platform. (Nikujiro Nonaka, 1998)

Knowledge management is provided by a variety of methods. Every method, is distinguished with it's own process, goals and finalities. Among them Two methods reflecting two different points of view are strongly discussed in literature: Gameth (Grundstein, 2007) and Mask (Ermine, 2003). In table below we present a comparison between Gameth method proposed by Grundstein and MASK method proposed by Jean louis Ermine.

Either MASK or Gameth are interested in identifying knowledge resources and characterize knowledge, but MASK allow us to go further the identification and provides a variety of models to represent knowledge. Which valorise human resources expertise. (Nada Matta J. L.-Y., 2001)

Criterion used to characterize knowledge in these methods may be seen complementary that's why we are studying the possibility to mix both of methods given criterion in knowledge identification to get more efficient results.

Table 1: Mask vs Gameth.

	MASK (Ermine, 2003)	Gameth (GRUNDSTEIN, 2007)
orientation	Domain	process
Goal	Formalize/codify knowledge	Identify knowledge resources
Final result	Operational Knowledge Management System	Report
Interview with expert	directly	Using quiz
Knowledge criterion	Factual and strategic	Strategic and vulnerability

3.2 Product Life Cycle Management

In industry, the objective of enterprises is always to increase as much as possible their gain, that's why, researchers and engineers are always looking for more developed solutions to improve production and manufacturing tools, which motivate the invention of many working tools like PLM. Product Life cycle management (PLM) is the activity of managing a company's products all the way across their lifecycles in the most effective way. (Stark, 2017) also, it can be defined as a strategic approach for creating and managing an organization's product-related intellectual capital from its conception to retirement. (Louis Rivest, 2012)

Since the end of 1990's (year of appearance of the concept) PLM is steeply integrating firms as a strategic business approach that applies a consistent set of business solutions that support the collaborative creation, management, dissemination, and use of product definition information, supporting the extended enterprise (customers, design and supply partners, etc.), spanning from concept to end of life of a product or plant, integrating people, processes, business systems, and information.

3.3 KM and PLM

Some research suggests to integrate knowledge management in PLM tools, The link between PLM and KM is interesting as it can help answering "on field" problems (Segonds, 2011)

For example, (Artur Felix, 2014) in his approach based on ontology, he proposed to deal with the problem of knowledge incompatibility in PLM processes. As a solution, he proposed an approach based on three layers: an ontology layer gathering a core ontology and domain ontology for every process, the second layer a process chain layer where the working processes are separated and the last layer a data layer to support every process with the concerning data. It's interesting to build an ontology and integrate it in PLM but maintaining and updating theses ontologies still poses a problem because, to an expert it's an additional charge of work in their daily tasks. Also separating data layers with a high restriction and privacy as presented in the discussed paper will impact intersected processes data access.

In 2013, an approach developed by (Sébastien Nila, 2013) integrating KM in PLM environment, this approach based on two phases.: extract knowledge and analyse it. This solution used agile iterations in particular, and is oriented code development.

Another approach presented by (Pham Cong Cuong, 2018) aiming at share knowledge through PLM tools using a reasoning Mechanism based on ontology and integrated in PLM tools. This approach focused only on knowledge sharing but we should also be in how knowledge was created or extracted or how can it be capitalized throw PLM.

3.4 PLM and Data Analysis

Nowadays we are facing a phenomenon named by experts as "data explosion ", (Zhu Y., 2009) making a sense to the huge volume of data generated by information systems. Believing in the Efficiency of analysing data to predict something or someone's behaviour, data analysis still involves a variety of domains and application which make it actually a trend.

One of application of data analysis is PLM tools, in (Jingran Li, 2015) the author aimed to integrate big data analytics in PLM, and he proposed a method that consists of first extracting and selecting data then putting it in beginning of life, middle of life or end of life of product in PLM.

Enriching PLM by knowledge extracted using big data tools is an important strategic method as it could achieve the desired results. In this paper, the author presented some challenges that his approach could face like data visualisation, PLM data security, data storage and collection. But another important challenge should applying big data in PLM deal with, is the semantic of generated results. As a power point Big data platform make analysing a huge volume of data having different types (structured, non-structured or semi structured) possible but as a weakness point result could be also huge and

semantic of generated data is not guaranteed. Which makes the semantic of big data results, a performance criterion to be considered.

4 METHODOLOGY

The research will be carried out in four main phases that each one is developed to solve one of the problems mentioned in section 1.

4.1 Capitalize the past Experience

An important existing past experience is not capitalized efficiently in the enterprise. After studying different knowledge management methods, we decided to choose and to follow MASK method in order to capitalize knowledge and past experience as a first working step. Applying MASK method in KM project means following some important steps (Nada Matta J. L.-Y., 2001):

1. Identifying services and domains;
2. Referencing documents and interviews with experts;
3. Modelling with MASK;
4. Characterizing knowledge.

The final result is to capitalize and structure what exists already in term of knowledge and past experience.

Studying and analysing the technological environment and detailing used software to share documents, or to facilitate communication and work organisation represent the second part of this phase.

4.2 Defining Techniques to Keep Track of Knowledge

In this phase, our work will focus on defining techniques to make capitalization and keep track of knowledge a systematic task. Which mean a regular work, done automatically through collaborative working tools.

In this process expert implication should be reduced to the maximum and we will try to design an architecture enabling system reasoning to apply semantic filter and analysis.

4.3 Integrate Defined Techniques into Collaborative Working Tools

Defined keep tracking knowledge techniques will be integrated into working environment. In our context PLM is used as one of collaborative working tools supporting project from beginning to its end of life, so in this phase, we will work in how to integrate our approach in PLM.

Evaluation and check of given results will be done at the end of this phase.

4.4 Evaluation

To check efficiency of our approach, we should evaluate some axes:

- Interoperability: we will check the ability of our system to detect either various and heterogenous knowledge resources and to connect with them to extract knowledge;
- Credibility: it concerns the quality of extracted knowledge and how much it is linked to the right concept;
- Visualisation: all the extracted and capitalised elements should be visualized through collaborative working tools with structured form;
- Accessibility: capitalized and stored knowledge and track of knowledge should be accessible for any request by experts;
- Velocity: another point that should be measured in our system is time responding to requests and it's capacity to identify analyse and store knowledge in reasonable period of time.

In evaluation phase, there are some special tools that exist to check the detailed points, we will try to use them to guarantee the performance of our solution.

5 EXPECTED OUTCOME

The outcome of our project is a system based on collaborative working tools and their environment. Experts use PLM daily to do their tasks, our proposed system will extract knowledge gradually from all the used supports (mails, papers, electronic documents, data bases) and analyse it with the semantic filter, after that store knowledge and capitalize it to be accessible and to enrich PLM. Work decisions, project organisation, planification, logistics all of these elements will be also identified, extracted and capitalized to provide a visualisation of realized projects which may helps to avoid past errors. A preliminary imagination of the approach is presented in figure 1.

Being composed by potentially four layers:

- PLM: represents the core of the architecture, allowing collaboration between experts ;
- Semantic filter: semantic phase to select knowledge based on predefined models, it

represents a phase of analysis and clustering of extracted knowledge to inject it into PLM with a high level of signification provided;

- Knowledge resources: being various and heterogenous, we will propose a component providing communication and exchange with them, it main goal wil be to identify resource knowledge , linking it with the system to extract knowledge;
- Traceability component: a component to manage traceability and capitalize continually past experience. It will be responsible for first identifying project organisation, work decision and every kind of knowledge related to logistics or tools used in building projects , store it and make it accessible throw PLM to have a detailed idea about past experience and realized projects.

After building this approach , it will be important to investigate to make this contribution extensible as well as open to innovation and future upcoming technologies.

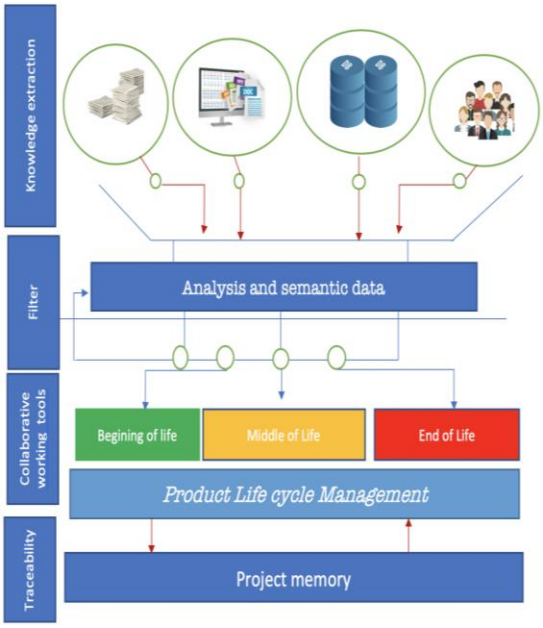

Figure 2: Preliminary conceptualization of the proposed approach.

6 STAGE OF THE RESEARCH

First, I concentrated my researches in studying knowledge management methods, this phase allowed me to have a deep idea about MASK methodology to adopt it in our work. How to integrate it into PLM tools, was the main subject of the second working step. Then, we focused our researches in how to get benefit from data analysis to extract knowledge from heterogenous knowledge resources (electronic documents, employees, papers, mails...) and use it into collaborative working tools (like PLM).
Next, we studied the challenges of applying analysis methods to enrich PLM tools and the requirement of a semantic filter.

In parallel, we started capitalizing and collecting knowledge using MASK interviews with experts, also we started modelling tasks using MASK models in order to prepare a book of knowledge.

In the current step of research, and after clarifying the problematic, we started building an evident image of the final contribution. As a future work, we will investigate in making the presented theoretical approach a real functional project and test it. Finally apply it in the enterprise, and evaluate the results basing on fixed goals.

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