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Abstract

Nowadays, lots of knowledge is lost or hidden because it is in people’s heads and not conserved in digital archives. Especially for enterprises, this means a pecuniary advantage is lost every day. In this paper, we propose a Semantic Knowledge Management System that allows us to save knowledge in a semantic way and motivates employees to conserve their knowledge. To motivate people we intend to use concepts from the uprisin field of Gamification and tailor them to enterprise needs mixed with concepts adapted from the Social Web. We also present ideas on how to use Linked Open Data as a source to enrich and enhance conserved knowledge. While many existing Knowledge Systems concentrate on the management and automatic creation process, our system strikes a new path to involve people in the knowledge creation process. Our goal is to produce semantified and more accurate results than existing solutions. This semantic knowledge is searchable, reusable and well structured and thus a great base for further usage.

1 Introduction

Knowledge is one of the most important resources in an enterprise and every day, enterprises create and archive a large amount of data in hopes of conserving knowledge. We think data becomes more valuable if also the knowledge of the employee who created the data is archived. To achieve this, we need a new generation of digital archives where not only data but also knowledge is conserved.

To give an example of how failed knowledge management negatively affects an enterprise and how the situation can be improved using a semantic knowledge management system, we would like to present the following scenario: An enterprise successfully acquired a solar energy plant project. As the company has not much expertise in this field, they have selected one of their employees as the project leader and asked him to familiarize himself with the topic. In the course of the project he and his team produced many documents like project plans and reports, articles in selected journals and information material for trade fairs. Thus, they gained a lot of expertise in the field of solar energy during the project. Three years later, the company got a follow-up project to build a much larger solar energy plant because of the expertise shown in the previous project. This confronted the management with some problems as the old project leader left the company a year ago. As the management wanted to make the project, decisions had to be made which of the other team members had enough expertise to become the leader of this project. The management wanted to select that former team member who contributed the most to the first project. To determine that, the old documents should be reviewed and based on this analysis, the new team leader should be named. But, most of the material produced during the first project was saved somewhere with meaningless names and therefore hard to find. In the end, the management could not really figure out who was responsible for what and thus the decision who should become the next project leader was not easy. That the knowledge was not fully archived was not due to the fact that the previous team was lazy or wanted to keep their knowledge, but rather that the process of archiving was to time consuming and not really supported by the management. So, again the management had to choose one of the former team members without a proper knowledge foundation. After the management has determined a team and a leader that might fit the requirements, again several documents have to be created for the new project. Thus, the problems of lost knowledge might come up a second time by running the risk of creating redundant documents, as the old documents could not be found. This is only one simplified example for lost knowledge because of failed knowledge management but it outlines some factors why it is an advantage to archive all possible information. If the information ‘who worked on what document’, and more specific on what part to what extent, had been archived during the first project, decisions processes like the succession for the project lead would be less complicated.

In this paper, we propose a new Semantic Knowledge Management System (SKMS) that helps conserving knowledge by using semantic concepts to associate meaningful information to the data. Semantic means for us to annotate documents, pictures or parts of them with unique concepts describing its meaning through a strong structured formalization. Such concepts can be persons, events, locations, other contextual information, etc. With this semantically annotated data, it is easier to find relationships between data about the same person or topic based on the concepts instead of comparing words and dealing with problems like synonymy and ambiguity. Moreover, semantic data from other sources, e.g. the Linked Data [Berners-Lee, 2006] or Linked Open Data initiative, can be used to enrich the enterprise’s knowledge base by linking external knowledge to the enterprise knowledge.

The main problem for achieving our goal of conserving knowledge is how to create the semantic data. Creating this semantically annotated, strongly structured and thus linkable data is time expensive and until now it is not possible.
doing it without human help [Rusu et al., 2011]. Thus, an SKMS has to involve employees in the creation process and motivate them to contribute, which will not happen if they cannot see a personal benefit. In the following sections we present our idea on how to integrate and motivate people to help creating knowledge. We also give some insights on the proposed architecture of the SKMS and discuss future steps. This general idea leads to the following research questions that we want to address with SKMS:

- **Creating Knowledge**: The main goal of this work is to enable an enterprise to create, store and manage knowledge. To reach this goal several sub-goals have to be fulfilled. On the one hand, data has to be preprocessed and annotated using state of the art technology like named entity disambiguation [Ploch, 2011] or semantic annotation approaches like [Rusu et al., 2011]. But on the other hand, this automatic process is only a first supporting step as the quality of such automatic methods is still not on a level where the full semantics are recognized. Thus, human input is still the most important source for such a knowledge creation. To support this human driven knowledge creation, several open research quests have to be solved.

- **Gamification**: The main research question is how to motivate employees to help creating semantic knowledge. We therefore focus on the uprising field of Gamification [Cheng et al., 2011; Nikkila et al., 2011] and want to adopt those concepts to the enterprise. The application of motivational methods like ranking of users or digital awards has a long tradition on computer games and has also driven social games like Farmville.

- **Social Web**: How to involve people is another research aspect strongly tied to the Social Web. Social Web has gotten a lot of people engaged in content creation and quality management. We want to leverage Social Web approaches (Wikis, Social Networks) and integrate them into our SKMS.

- **Semantic Data Management**: An important part of the SKMS has to be a dedicated data management component. We not only want to store the created knowledge but also to benefit from the Linked Data research. The data management component should be able to provide the created knowledge as linked data but also to tap into the available linked open data and integrate it into our system as an external source of knowledge.

2 Semantic Knowledge Management System

Knowledge Management Systems (KMS) are designed to collect and organize knowledge of an enterprise by continuously analyzing documents and employees’ expertise. During the last two decades many systems were proposed, some based on relational database systems some of them even based on ontologies [Ribino et al., 2009]. All of those systems are capable of storing and finding knowledge. With our Semantic Knowledge Management System (SKMS) [Davies et al., 2009] we want to exploit semantics to annotate resources such as documents [Uren et al., 2006] with concepts. We also want to link knowledge to the ever growing Linked Open Data network to benefit from this external knowledge source by enriching internal enterprise facts with external knowledge. Beyond this, we want to focus on the necessity [Uren et al., 2006] of motivating employees to participate on the annotation and therefore knowledge creation process. Some Semantic Wiki approaches already tried to adapt Social Web ideas, such as the ‘Semantic Wiki developed through the Knowledge in a Wiki (KiWi)’ project. KiWi offers known wiki functionalities extended with a component to annotate words in texts with concepts to help users adding semantics during the text writing. While the wiki idea works, the missing of a motivational component prevents users to put extra effort in the semantification process as no direct benefit is seen in KiWi.

Our proposed SKMS consists of three main parts, see Fig. 1. The Gamification/Social Web component is responsible for the motivation of employees to add annotated data, the Linked Open Data component adds external knowledge to the system that is used to support the human annotation process and the Knowledge Management component stores and manages the created knowledge.

2.1 Gamification and Social Web

The motivation component is the core of our proposed SKMS and will be based on Gamification and Social Web concepts. As said, our SKMS aims to annotate data with semantics. Unfortunately, the annotation process has to be run semi-automatically, e.g. by manually choosing best fitting concepts from multiple automatic suggestions. The motivation component should motivate employees to participate in those processes.

Gamification is an upcoming research field on how to motivate people to get tasks done, e.g. to motivate and engage students in schools [Lee and Hammer, 2011]. Gamification aims to apply dynamics and concepts of games on non-game contexts like enterprise knowledge management to make it more engaging and fun [Deterding et al., 2011]. The main idea is to have goals, rules and rewards to create interesting new challenges. E.g. in golf, without having any rules, it would be easy to put the ball into the hole, only the rules make it an interesting challenge. Further important concepts learned from games are the visualization of goals and rules and providing attractive feedback, e.g. rising balloons and sound effects on the screen if a goal was reached. To keep people motivated also rewards like digital awards or real world benefits like coupons have to be considered.

Social Web concepts can help us to create the right environment for such an enterprise Gamification approach. Many people are already using Social Web applications like social networking (Facebook), creating social media (Wikipedia), tagging (Delicious). Handle tasks in a group with friends or even strangers and getting approval or expressing one self, motivates people to participate with contribution on those applications. To adopt its concepts helps us to ease the acceptance as the concepts are already known. Beside the social aspect the most promising concepts for us are tagging, authoring and linking.

Moreover, there are already some efforts on motivating people for the Semantic Web. For example, a proposed collection of schemas by Bing, Google and Yahoo! can be applied to markup web pages, blog articles or contributions on social networks to improve the display of search results. 

1http://www.kiwi-project.eu/
2http://www.ribbonhero.com/ Ribbon Hero 2 is a game for learning Office.
3http://www.schema.org
As a result authors become familiar with semantic annotation and its benefits. Tools like Zemanta \(^4\) supporting them through the annotation process already exists.

First ideas how to use Gamification in the enterprise is to give employees the opportunity to self-determine their future work areas and project involvements. This can be done by analyzing interests and skills of employees based on their contributed semantic knowledge. If somebody adds many documents semantically annotated with solar energy tech information, this person will probably be involved in the next solar energy project. Thus, employees get rewarded for commitment and knowledge contribution. In this example the Gamification goal is getting tasks or leader of a project one is interested in. The challenge is to create and conserve more knowledge about specific topics than most others in the same enterprise do, to become the expert. The rules could be that one has to produce meaningful and novel knowledge underlined by references, and of course semantically annotate it much as possible.

Finally, the reward would be to become the next leader or if leadership abilities missed just a team member of a project which is about the employees actual expertise. As a result the enterprise benefits twice. First from the created knowledge and second because employees involved in projects are actually interested in the topic and thus motivated.

While the general idea of using Gamification in enterprises is straight forward, the realization contains some pitfalls that have to be considered. Giving rewards can motivate one employee whilst demotivate others. Therefore the kind of achievement has to be carefully thought of. A good Gamification approach also has to consider socio-cultural [Khaled, 2011] and technological challenges, otherwise one may run the risk of encouraging unintended behavior. The size of an enterprise also affects the Gamification concepts, one concept that makes sense in a big company may not work in a start-up. A lot of research has to be done here, and the resulting SKMS has to be capable to adapt the Gamification concepts to the individual needs of an enterprise and their employees.

### 2.2 Linked Data

Linked Data (LD) is a fast growing network of knowledge in different domains. The idea of LD is adapted from the World Wide Web architecture in order to globally share structured data based on predefined principles [Heath and Bizer, 2011]. LD uses URIs[Sauermann et al., 2008] as unique identifiers for things described by ontologies which define concepts or a schema of things in the world. LD can be seen as a big distributed knowledge base created by many and easy to integrate through URIs. For our SKMS and Linked Enterprise Data we want to examine the following questions:[Berners-Lee, 2006]

- **How can LD help us during the process of semantification[Adrian et al., 2009]?** One possibility is to automatically suggest LD concepts or things (URIs) during the annotation process or use the LD knowledge to disambiguate data.
- **Can knowledge evolution be supported with LD?** Knowledge in LD can be used to extend or enrich existing data [Bizer and Schultz, 2010]. A conceivable solution could be to find similar LD concepts through ‘sameAs’ relations\(^5\) and to add that information to the enterprise’s knowledge.

### 2.3 Semantic Knowledge

So far, we have talked about new ideas to motivate employees and to use emerging semantic knowledge, but one integral component of a SKMS is the storage and management of the created semantic knowledge. Following the LD idea and to guarantee reusability and searchability, the knowledge in our SKMS will be archived using the Resource Description Framework (RDF) [Berners-Lee, 2006; Heath, 2008]. Therefore, we want to examine the necessity of developing a base ontology fitting to the special needs of enterprises for knowledge conservation. An enterprise ontology, and the according management component, has high standards regarding reliability and security. While we intend to use common standards for reliability and security, one big open challenge is to identify and split the Linked Enterprise Data in an open and internal part to

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\(^4\)http://www.zemanta.com

\(^5\)OWL sameAs definition: http://www.w3.org/TR/owl-ref/#sameAs-def
secure confidential information on the one hand, but to enable knowledge sharing and evolution on the other. This is important as many examples have shown that open data motivates even external people, not employees, to use and enhance data which in reverse helps the enterprise [Hausenblas, 2009; Böhm et al., 2010; Steiner et al., 2010].

3 Conclusion
The efficient utilization of knowledge is a key factor for the success of enterprise ambitions. Several Knowledge Management Systems were proposed aiming to archive enterprise expertise. In this paper, we outlined an approach for a Semantic Knowledge Management System, which annotates data with semantic concepts to add meaning to data. Moreover, we suggested using the Linked Open Data network to access further knowledge. We discussed arising problems of such an approach and ideas to solve them with the main focus on the question how to motivate employees to participate in the knowledge conservation process. We introduced Gamification and Social Web concepts as a promising approach and provided examples on how the application of concepts used in games (Gamification) and the Social Web could result in more contributions by employees of an enterprise. By creating incentives for the employees, e.g. giving them the opportunity to influence the assignment for future projects and task in return of created knowledge, both the enterprise and the employees benefit: The enterprise because of the created knowledge and the employees because they have the opportunity to work on projects they are really interested in. In conclusion, knowledge creation is a task that cannot be done automatically; a human contribution is still needed. Therefore, we have to find ways to motivate people to create knowledge. This can be done by pointing out the benefits of digital archived semantic knowledge and by giving them incentives.

References


