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Laszlo Szathmary
LORIA -- UMR 7503
BP 239, 54506 Vandoeuvre-lès-Nancy Cedex, France
Email : Laszlo.Szathmary@loria.fr

Abstract. This paper presents an ongoing research work on knowledge management. The problem is to be able to design a "multidimensional portfolio", in order to organize and to index the different aspects of knowledge in an enterprise. We have chosen an object-oriented view for such a representation. Every piece of knowledge is represented within classes in an object-based representation system. The multidimensional organization is supported by a number of tangled hierarchies of classes, one hierarchy giving a particular point of view on the enterprise knowledge.

1. Introduction

The primary goal of knowledge management is to improve organizational performance of an enterprise by enabling individuals to memorize, share and apply their collective knowledge to make optimal decisions. About 80% of the world's biggest companies have knowledge management efforts under way [1]. In the knowledge-powered enterprise – which is still an "idealistic enterprise", not a real one – the knowledge management happens in the background. It is done by everyone as part of the day-to-day job, embedded in the workflow. People are easily able to obtain the data, information and knowledge they need to do their jobs. They interact effectively with their colleagues – anywhere, anytime and by any means. The company is able to connect people with the knowledge to people who need it. In the knowledge-powered enterprise, knowledge sharing and application are standard. As a result, the enterprise can improve its performance and reduce its costs.

We have made a multidimensional view of the enterprise, which has three dimensions: one for knowledge, one for people, and one for documents. The principle of this view relies on the Semantic Web principles: the idea of having data on the Web defined and linked in a way that it can be used by machines not just for display purposes, but for automation, integration and reuse of data across various applications, and reasoning on documents [2]. The Semantic Web is still a vision, and to make this vision a reality for the Web, supporting standards, technologies and policies must be designed to enable machines to make more sense of the Web, with the result of making the Web more useful for humans. Facilities and technologies to put machine-understandable data on the Web are rapidly becoming a high priority for many communities. The Web can reach its full potential only if it becomes a place where data can be shared and processed by automated tools as well as by people [3].

2. State of the art

Why has knowledge management become so popular recently? There are several reasons: (1) The collaborative space: it is now more virtual than physical. Companies are increasingly distributed worldwide. (2) The intellectual capital: in this age of information, knowledge is the most important factor. (3) Information technology (IT): as a result of IT, it is now possible to do something about knowledge management. Today's Internet, Intranet and Web technology permit practical capturing, sharing and leveraging of information and knowledge throughout organizations [4].

2.1 Intranet portal

A portal on the Web can be seen as a kind of node where a user can be routed to find elements that can be of interest for him. In our approach, we consider a portal as a point in a multidimensional space. The multidimensional space corresponds to the model of the enterprise (including people, knowledge and documents). A point in this space puts elements in relation along each dimension, e.g. people with knowledge pieces, documents with people or with knowledge pieces. *One central problem is to provide the right information to the right person at the right moment.* This is one question that has to be answered in a corporate knowledge portal.

Building an Intranet portal is today a standard first step in knowledge management. A portal is a single point of access to knowledge; a kind of "reference point" through which information may be available. A portal is an application that gives users a single gateway to the information and applications they need to do their jobs. It draws together on the desktop all the important information from both inside and outside a company. A portal provides unified access to all the organization's information, both unstructured (mostly Web pages and documents) and structured (usually stored in databases).

3. Our proposition

We present our proposition for a "multidimensional portfolio for corporate knowledge organization and indexing". An example of a primitive architecture for a prototype knowledge management problem is shown in Figure 1. In the architecture we distinguish three dimensions: people, documents, and knowledge. The three dimensions are connected by the knowledge portal, i.e. this referential is the model of the portal. Some kind of communication protocol is needed between the dimensions. It could be done by Web Services.

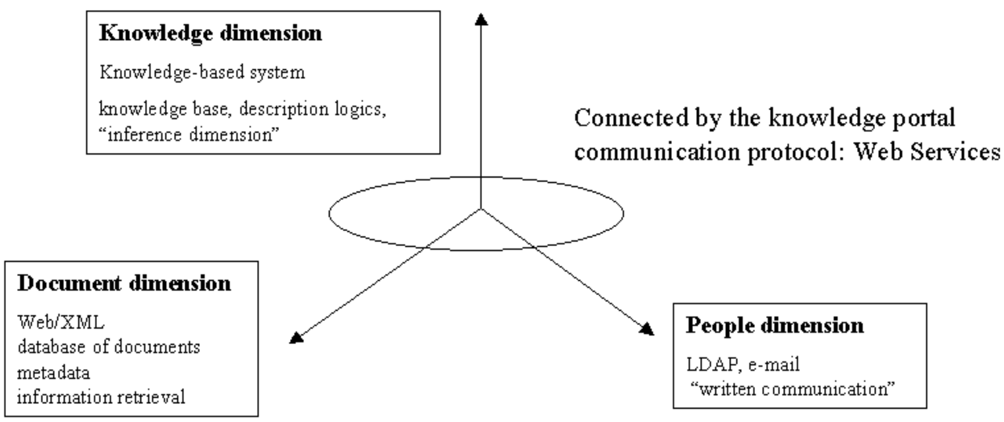

Figure 1: primitive architecture

3.1 Dimension of knowledge

Knowledge is broader, deeper, and richer than data or information [5]. Knowledge for an employee means organized, applied information, that is a justified true belief [6]. In the knowledge-based system knowledge is syntax, semantics, and inference. Knowledge units in a knowledge-based system are based on a syntax with an associated semantics, and are used to infer new facts from already known facts. For example, such knowledge units can be encoded within description logics where the main reasoning mechanisms are classification and instantiation [7].

Knowledge management needs, for example:

(1) A knowledge base: different words can be used, corporate memory, knowledge repository, best-practices database, etc. A high-quality knowledge base is fundamental for successful knowledge management. Ontologies are needed. It is also very important to have reasoning formalisms for decision helping, in particular case-based reasoning. We have decided to investigate this research line in the next step.

Knowledge itself must be captured by either interviewing experts or by using knowledge discovery processes. It is rather difficult to capture knowledge considering non expert people.

(2) Search: agents and distributed problem-solving technologies will play an increasingly important role. Moreover, but this is not already the subject here, data mining tools are also needed.

We plan to use Description Logics (DLs) that describe knowledge in terms of concepts and role restrictions, which can then be used to automatically derive classification hierarchies. DLs allow the definition of classes in terms of descriptions that specify the properties satisfied by objects belonging to the concept. DLs will, in general, supply a range of concept forming operators that can be used in these descriptions, including conjunction, disjunction, negation, and various forms of role quantification. A key aspect of DLs is their formal semantics and reasoning support. DLs define fragments of first-order logic which in general have high expressive power but which still allow for decidable and efficient inference procedures [8] [9] [10].

4. Semantic Web and Web Services

The Semantic Web should enable greater access not only to content but also to services on the Web. Users and software agents should be able to discover, invoke, compose, and monitor Web resources offering particular services and having particular properties.

Among the most important Web resources are those that provide services. By "service" we mean Web sites that do not merely provide static information but allow one to effect some action or change in the world, such as the sale of a product. In the Semantic Web, the word "service" has been extended to any application on the Web (just like the common life term "service"). The Semantic Web should enable users to locate, select, employ, compose, and monitor Web-based services automatically. To make use of a Web Service, a software agent needs a computer-interpretable description of the service, and the means by which it is accessed [11]. Knowing that Web resources exist is not enough for processing: they must be located and available. There is a need for getting Web resources: "where can I find a knowledge base about hotels in Paris", "where can I book a flight to Paris" are meta-questions that the agents will have to ask. Getting the answer necessitates a kind of registry. The infrastructure must support this, and the agent must at least know a search service that can answer its question [12].

A more formal definition of a Web Service is the following. "Web services are a new breed of Web application. They are self-contained, self-describing, modular applications that can be published, located, and invoked across the Web. Web Services perform functions, which can be anything from simple requests to complicated business processes... Once a Web service is deployed, other applications (and other Web services) can discover and invoke the deployed service" [13].

On the surface, a Web Service is simply an application that exposes a Web-accessible API. That means the application can be invoked programmatically over the Web. Applications invoking this Web Service are referred to as clients.

4.1 The Web Services platform

The basic platform is XML and HTTP. HTTP runs practically everywhere on the Internet. XML provides a metalanguage in which one can write specialized languages to express complex interactions between clients and services. XML is the basic format for representing data on the Web Services platform. In addition to being simple to create and parse, XML was chosen because it is neither platform nor vendor specific. The full-function Web Services platform can be thought of as XML + HTTP + SOAP + WSDL + UDDI [14]. Web Services will be used as an enabling technology to integrate applications together more quickly and easily. Web Services are a new, standard platform for building interoperable distributed applications.

5. Related works

We would like to mention the work of Rose Dieng, who has written several articles about knowledge management, and also implemented with her team a knowledge server, called WebCokace, that enables to distribute expertise on the Internet [15]. In the following, the other works are mainly in the field of the so-called Semantic Web. The research in this field are very important for us because we believe that systems for managing knowledge in an enterprise have to take into account a local Web – the enterprise world – and the global Web. Furthermore, the management of the two conjoint Webs has to be built on the model of the Semantic Web.

The vision of the Semantic Web introduces the next generation of the Web by establishing a layer of machine-understandable data, e.g. for software agents, sophisticated search engines and Web Services. Ontologies play an important role for these knowledge-intensive applications as a source of formally and semantically defined terms for communication. They aim at capturing domain knowledge in a generic way and provide a commonly agreed understanding of a domain, which may be reused, shared, and operationalized across applications and groups. Ontologies are emerging as a key solution for knowledge sharing in a co-operative business environment. An ontology describes some sort of world view with respect to a given domain. An ontology is a representation of a shared conceptualisation of a domain. Such a shared conceptualisation is necessary for establishing effective communication among actors (human or not) that operate in the domain. In particular, this is why ontologies are also very important in knowledge management. In recent years, research aimed at paving the way for the construction of ontologies by ontology development environments. SymOntoX is a web-based ontology management system [16]. It is an open source environment supporting collaborative and distributed ontology construction and maintenance. SymOntoX is able to manage several ontologies. It has been conceived to be a service available on Internet. It is mainly based on XML technology, to guarantee maximal flexibility, interoperability and platformindependence. Furthermore it has been developed as a client-server architecture. OntoEdit is an ontology editor that integrates numerous aspects of ontology engineering. This ontology engineering environment is rather unique in its kind as it combines methodology-based ontology development with capabilities for collaboration and inferencing [17].

DAML-S is a DAML+OIL ontology for describing the properties and capabilities of Web Services [18]. Web Services – Web-accessible programmes and devices – are gathering a great deal of interest from industries, and standards are emerging for low-level descriptions of Web Services. DAML-S complements this effort by providing Web Service descriptions at the application layer, describing *what* a service can do, and not just *how* it does it. The Semantic Web is rapidly becoming a reality through the development of Semantic Web markup languages such as DAML+OIL. Web Services – Web-accessible programs and devices – are among the most important resources on the Web. Languages such as WSDL provide a communication level description of the messages and protocols used by a Web Service. DAML-S is being developed with the objective of making Web Services computer-interpretable and hence enabling the following tasks: discovery, invocation, interoperation, composition, verification and execution monitoring. DAML-S complements WSDL, by providing an abstract or application level description lacking in WSDL. Because DAML-S is an XML-based language, it is easy to extend existing WDSL bindings for use with DAML-S, such as the SOAP binding.

The are two major ongoing efforts to advance the World Wide Web. On one side there is the Semantic Web research, on the other side is the Web Service research. Both activities aim to make content on the Web accessible and usable not only for humans but also for machines in order to create a foundation for intelligent automated services and business processes. Peer presents a method of connecting Web Services descriptions with Semantic Web ontologies [19]. Adding semantic information to syntactical Web Service definitions can help an automatic agent to better interpret the purpose and usage of Web Services, thus leading to a higher level of flexibility. Peer presents a concept of semantic annotations of WDSL which link the structural elements of WDSL documents to semantics contained in DAML-S models. This concept contributes to the improvement of the current usage of Web Service technology.

6. Conclusions

We have presented our proposition for a multi-dimensional classification-based system for corporate knowledge management. In this multidimensional view of the enterprise we distinguished three dimensions: knowledge, people and documents. The three dimensions are held together by the knowledge portal, which is a kind of "reference point", a node in the multidimensional space of the enterprise through which information may be made available. In our view we relied on the Semantic Web principles, where the idea is to make data on the Web accessible so that it can be reused by machines across various applications. This is still a vision, but Web Services can help us to realize it.

Knowledge Management needs a knowledge base, where reasoning formalisms for decision helping are very important, in particular case-based reasoning. We have decided to investigate this research line in the next step.

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