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Bring enterprise knowledge management into the WEB

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ABSTRACT

Knowledge management have emerged as an effective means to provide timely and valuable insight to business decision makers. In order to share, exchange, and disseminate enterprise knowledge on the WEB, a shared understanding and a uniform representation and store for enterprise knowledge is necessary. In this paper, we introduce Ontology as a basis for modelling enterprise knowledge and XML as a key technology for the knowledge representation and store. Five core enterprise ontologies are developed and an enterprise knowledge representation language–EKML is presented, and then the design and implement of EKML is described.

KEY WORDS: Knowledge Management, Knowledge representation, Ontology

1. INTRODUCTION

Knowledge management(KM) has become the next research point of enterprise IT strategy. IT managers use KM tools to capture, maintain and exploit strategic knowledge that enterprise need to conduct business. There are two kinds of knowledge exist in enterprise: explicit knowledge and implicit knowledge. Usually, Explicit knowledge, such as company regulations, process planning and technical document, is presented by the form of document, spreadsheet and book etc., which can be acquired directly. While implicit knowledge represents the experience or skills that exist in the minds of employees, or the strategy, culture and relationship that exist virtually anywhere within an enterprise.

An efficient KM system must process the two kinds of knowledge with a synthetical mode. KM is a successive process. It begins with the acquisition of implicit knowledge, from outside and from within, and with the formulation of a sound strategy for storing and organizing the results. Thus, the implicit knowledge is transformed into the explicit knowledge and then the explicit knowledge will be distributed to the entire enterprise. Finally, the knowledge will be learned and mastered by others and then become the new implicit knowledge to guild their behaviors.

There are two key problems must to be solved in sharing, exchanging, and disseminating knowledge through an enterprise: the shared understanding and the uniform representation and store of enterprise knowledge. In this paper we introduce Ontology as a basis for modelling enterprise knowledge and XML as a key technology for the knowledge representation and store. Firstly, the core enterprise ontologies (EOs) are established to identify the key concepts and relationships in the domain of interest. This allows us to define what is relevant to a particular problem and what should be ignored in an enterprise and provides a rich and precise representation of generic knowledge, such as activities, processes, resources, time, organization structure, and enterprise functions. Next, an XML based knowledge representation language--EKML is presented to formally describe the enterprise ontologies. EKML offers major advantages for knowledge management, combining the benefits of SGML and the Web. By defining a DTD according to the EOs, enterprise can facilitate communication and exchange of information or knowledge. Enterprise members can then express enterprise knowledge with the defined XML markups and exchange them using these markups. As an example, a part of DTD and XML presentations is derived from enterprise ontologies to illustrate the implement of enterprise knowledge management combining with XML and ontology.

2. BUILDING THE ENTERPRISE ONTOLOGIES

Enterprise is a complex system . People, organization and software system involved in it must communicate between and among themselves. However, due to different needs and background contexts, there can be widely varying viewpoints and assumptions regarding what is essentially the same subject matter. Each uses different terms; each may have differing, overlapping and or mis-matched concepts. The consequent lack of a shared understanding leads to the difficulties of conducting an efficient knowledge management strategy. It will embarrass the communication of knowledge within peoples. People with different concepts and terms will not understand each other and cannot exchange knowledge freely. Moreover, it will hinder the knowledge exchange between people and knowledge system or between

Process Ontology (PO)	Organization Ontology (PO)	Resource Ontology (RO)	Function Ontology (FO)	Information Ontology (IO)
Process	Organization Unit	Resource Type	Function Activity	Entity
Sub-process	Organization Description	Resource-Type description	Input	Attribute
Process Specification	Superior Organization	Resource Capability	Output	Relation
Activity	Location	Resource Entity	Control	Key
Activity Specification	Roles	Status	Mechanism	
Pre-activity	Role Specification		Relationship	
Conditions	Functions			
Inputs	Resource			
Outputs	Person			
StartTime	Description			
EndTime	Capability			
Roles				
Resources				

Table 1 Overview of the Enterprise Ontologies

different knowledge systems due to the difficulties in the defining of a specification of the system.

The way to address these problems is to reduce or eliminate the conceptual and terminological confusion and come to a shared understanding. Such an understanding can function as a unifying framework for the different viewpoints and serve as the basis of knowledge exchange among people, organizations and software systems.

In this paper, we exploit the power of ontology for enterprise knowledge management. Ontology is the term used to refer to the shared understanding of some domain of interest. An ontology necessarily entails or embodies some sort of conceptualizations about the world view with respect to a given domain. Sometimes, the word “ontology” may refer to such a conceptualization corresponding to some implicit knowledge existing in somebody’s head, or embodied in a piece of software. However, the more standard usage is that the ontology is an explicit account or representation of a conceptualization.

In the context of enterprise knowledge management, the goal of an ontology is to form a shared terminology for the enterprise along with definitions for the meaning of each of the terms and create a formal description of enterprise knowledge. This is called Enterprise Ontology (EO). EO provides a rich and precise representation of generic knowledge in the enterprise, such as, processes, activities, resources, organizations, functions and data. Because of the existence of different domains and views in the enterprise, different EOs should be created to define the terms in a certain context.

In order to get a precise and complete representation of enterprise, referring to the integrated enterprise model[1], we draw out five core enterprise ontologies: Process Ontology (PO), Organization Ontology (OO), Resource Ontology (RO), Function Ontology (FO) and Information Ontology (IO). These ontologies provide common definitions of the terms used in the domain. Table 1 contains all terms defined in the enterprise ontologies.

- Process Ontology depicts business process completely and effectively. The central terms are Process and Activity. Process consists of a series of sub-processes and activities in certain logic relations. It must refer to some specification and should start and end in the proper time when executed. Activity, which is the basic unit of business process, embodies a manual or automatic enterprise behavior in an incessant period of time aimed at fulfilling some definite goal (Activity Specification). The execution of activity can have outputs and inputs, and should be supported by some resources, and should be conducted by some people taking on certain roles.

- Organization Ontology defines the organization model, including definitions of organization tree, team, faculty, role and authority. There are two central terms defined in the organization ontology: Organization Unit (OU) and People. Organization units structured with some cooperative and constrained relationship compose the enterprise organization model. An OU may hold some roles, resources and functions and can include some people with certain capabilities and roles. Also, the superior organization unit and the location of an OU must be

stated in order to facilitate the management of complex enterprise organization structure.

- Resource Ontology defines the enterprise resources. It consists of resource type, resource entity, resource description, resource status and resource capability. Resource Type is the classification of enterprise resources. And Resource Entity actually existed as a part of enterprise assets. According the status and capabilities, a resource entity can be used by processes and organizations.

- Function Ontology represents the enterprise function to depict the work and task which should be finished by the enterprise. The enterprise function commonly consists of a set of activities. Function Activity (FA) is the basic concept of FO. Supported by the basic environment and substance (Mechanism), the input of FA, resources occupied and consumed by an activity, will be transformed into the output under some conditions and constraints (Control). A FA can be decomposed into several sub-activities. The relationship among function activities must be describe distinctly also in order to get a integrated enterprise function description.

- Information Ontology represents the physical and logical distribution of enterprise information. According to the E-R methodology, an information model can be represent as entity, relationship, and attribute. Consider the need of constructing a actual database system, the Key of an entity must be defined.

A detail description of the terms of enterprise ontologies can refer to [2], [3].

Until now, we have mainly discussed informal method for developing enterprise ontologies. The informal ontology can be used as a glossary for shared understanding among users. But the more formal requirements such as inter-operability among software tools is also needed. At this point, we develop an XML based approach for the design of enterprise ontologies to facilitate enterprise knowledge management.

3. EKML: ENTERPRISE KNOWLEDGE MARKUP LANGUAGE

3.1 XML AND ONTOLOGY

Enterprise ontologies give us a shared and consistent understanding about an enterprise and can serve as basis for acquiring and representing enterprise knowledge. However, our key contention is that how ontologies can be used on the WEB to help structure and represent enterprise knowledge. And so, we develop EKML to design and represent enterprise ontologies on the WEB.

EKML is a XML based knowledge representation language. XML is a standard language that simultaneously presents content for display on the Internet and describes the content so that other software can understand and use the data. The success of XML is primarily based on its extensibility: everybody can write a document type definition (DTD) to define the structure of XML documents that represent information in the form he or she desires. If partners agree on a common DTD, documents can be created, transported, imported, and interpreted in a consistent way, preserving the semantics the sender intended [5].

However, the biggest advantage of XML (its extensibility) is at the same time its biggest handicap. XML is so flexible that XML documents cannot be automatically provided with an underlying semantics, XML allows authors to create their own markup (e.g. <ROLE>), which seems to carry some semantics. However, from a computational perspective, tags like <ROLE> carries as much semantic as a tag like <H1>. A computer simply does not know what a role is and how the concept role is related to e.g. a concept person.
In this paper, we use EKML to combine XML with ontology, which is important as a semantic basis for applications that are ontology-aware and can benefit from the knowledge encoded in the ontology. By this means, EKML can offer new general applicability in acquiring, representing, and manipulating enterprise knowledge with the provision of consistent core of basic concepts and language constructs, from which the enterprise can profit:

- Definition of enterprise knowledge in worldwide standardized, non-proprietary format
- Structuring and organizing libraries of knowledge
- Knowledge share and exchange for enterprises among different people and software tools
- Integration of enterprise knowledge from different knowledge repositories into a uniform framework

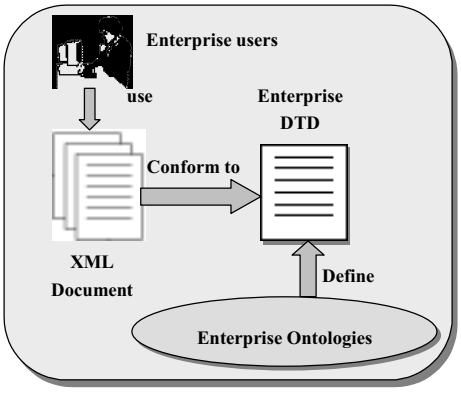

Figure 1 The relationship between ontologies, DTD and XML

The figure 1 shows the relations between XML, DTD, and ontology. In enterprise application scenario, an enterprise DTD can be derive from the given enterprise ontologies to define a standard domain-oriented vocabulary. Enterprise members can then express documents or knowledge with the defined XML markups and exchange them using these markups. The enterprise DTD combined with ontology can guarantee the XML document not only well-formed and structural validity, but also the semantically validity.

3.2 DERIVING DTDS FROM ONTOLOGIES

Enterprise DTD is produced by mapping ontology concepts and attributes to XML elements. Each concept from the ontology is mapped to an element type in the DTD. The content models of these element types consist of elements that represent concept's attributes. All the elements of the DTD were grouped together according to

```
<!ELEMENT Enterprise (#PCDATA | Process | Organization | Resource | Function | Information)* >
<!ATTLIST Enterprise
        EnterpriseName CDATA #IMPLIED >
<! --Process Section -->
<!ELEMENT Process (ProcessSpeciafication, SubProcess+, Activity+ )>
<!ATTLIST Process
        ProcessName CDATA #REQUIRED
        ProcessID CDATA #REQUIRED >
<!ELEMENT ProcessSpeciafication (#PCDATA )>
<!ELEMENT SubProcess (ProcessSpeciafication, SubProcess+, Activity+)>
<!ATTLIST SubProcess
        ProcessName CDATA #REQUIRED
        ProcessID CDATA #REQUIRED >
<!ELEMENT Activity (ActivitySpeciafication, Input, Output, StartTime, EndTime, PreActivities, Conditions, Roles,
Resources )>
<!ATTLIST Activity ActivityID CDATA #REQUIRED >
<!ELEMENT ActivitySpeciafication (#PCDATA )>
<!ELEMENT Input (#PCDATA)>
<!ELEMENT Output (#PCDATA )>
<!ELEMENT StartTime (#PCDATA )>
<!ELEMENT EndTime (#PCDATA )>
<!ELEMENT PreActivity ( EMPTY )>
<!ATTLIST PreActivity ActivtiesID IDREFS #REQUIRED >
<!ELEMENT Conditions ( Condition* )>
<!ELEMENT Condition (#PCDATA )>
<!ELEMENT Roles (EMPTY )>
<!ATTLIST Roles RolesID IDREFS #IMPLIED >
<!ELEMENT Resources (EMPTY )>
<!ATTLIST Resources ResourcesID IDREFS #IMPLIED >
<! --Organization Section -->
<!ELEMENT Organization (OrganizationUnit+, Person+)>
----------
```

Figure 2 Enterprise Ontologies DTD

the Enterprise Ontologies described above. Each element has a tag attached, defining his nature, e.g., occurrence or content of the element. As an example, a part of the enterprise DTD derived from the enterprise process ontology (see above) is presented in Figure 2.

3.3 CREATING XML FILE FROM ENTERPRISE DTD

After deriving the enterprise DTD from the enterprise ontologies, a set of XML documents can be created and accessed using the DTD and ontology. These documents establish a coherent and consistent knowledge base that is connected syntactically via the DTD and semantically via the ontology. Exactly this connection enables the share and exchange of enterprise knowledge.

4. CONCLUSION

In this paper, we showed that the combination of ontologies and XML provides a compact, formal, and conceptually adequate way of describing the enterprise knowledge. By deriving DTDs from ontology the XML documents are grounded on a true and common semantic basis and thus, XML documents become adequate media for enterprise knowledge processing. The described work is considered a starting point showing further potentials for the whole enterprise knowledge management strategy. More work needs to be done to extend the enterprise ontologies and XML representation to cover the full range of enterprise, in order to allow a more complete and precise present for the enterprise knowledge and achieve a free and sufficient communication between people, organization and software systems.

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