©2007 IEEE. Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to reuse any copyrighted component of this work in other works must be obtained from the IEEE

Application of Protégé and SPARQL in the Field of Project Knowledge Management

Hai Dong
Curtin University of Technology
hai.dong@cbs.curtin.edu.au

Farookh Khadeer Hussain
Curtin University of Technology
hussain.farookh@cbs.curtin.edu.au

Elizabeth Chang
Curtin University of Technology
elizabeth.chang@cbs.curtin.edu.au

Abstract

Protégé is a set of open-source ontology design software developed in Stanford Medical Informatics. SPARQL (Protocol and RDF Query Language) is recommended by W3C, to represent the RDF (Resource Description Framework) graph – a set of triples that consist of a subject, a predicate and an object as the basic expression of data stored in OWL-based knowledge base.

In this paper, we propose an ontology-based project knowledge management methodology, by means of Protégé and SPARQL, to solve the issues in project management activities. By introducing a set of new ontology notations, we present the conceptual model of our ontology to realize the function of knowledge management in project organizations. Following that, we realize the prototype in Protégé and validate it by means of SPARQL. Finally we make comments on our project and plan our future work.

1. Introduction

One typical feature of current project organizations is that people in the organizations are geographically dispersed [3]. With the increase of project outsourcing, project groups and its members are probably located in different areas, from different cultural background and even speaking with different languages [2]. Knowledge management activities among these groups and members could be challenged by the cultural issues and geographical issues.

OWL (Web Ontology Language) is a web language which intends to interpret the web information into the machine-readable content with semantics [4]. Protégé-OWL which is a set of open-source ontology design software developed in Stanford Medical Informatics [5]. SPARQL (Protocol and RDF Query Language) is recommended by W3C, to represent the RDF (Resource Description Framework) graph – a set of triples that consist of a subject, a predicate and an object as the basic expression of data stored in OWL-based knowledge base [6].

In this paper, we propose an ontology-based project knowledge management methodology, by means of Protégé-OWL and SPARQL. By introducing a set of new ontology notations, we present the conceptual model of our ontology to realize the function of project knowledge management. Following that, we realize the prototype in Protégé-OWL and validate the prototype by means of SPARQL. Finally we make comments on our project and plan our future work.

2. Notation system for ontology representation

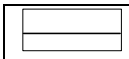
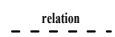
Before we represent the ontology model for project knowledge management, a notation system is introduced in this section. The notation system utilized in the ontological representation is based on Chang et al. [1]'s work, which consists of three basic notations as Table 1. Although in the past we usually used to employ UML to represent ontology model, due to its complex symbols categories, UML cannot efficiently help people better understand the shared knowledge. This notation system simplifies the symbols and its symbols are closer to the principle of ontology which is the combination of shared concepts and relationships between concepts [1]. (Table 1)

Table 1. Ontology notation system

Ontology Notation	Semantics of the Notation

Second International Conference on Systems and Networks Communications (ICSNC 2007)
0-7695-2938-0/07 $25.00 © 2007 IEEE

IEEE COMPUTER SOCIETY

	Double-field Box represents the Ontological Concepts.
	A dotted line represents Ontology Concept Association Relation which represents a Concept is closely related to another concept. The relationship name can be noted above the dotted line.
	Open-arrow line represents Composition and Aggregation or Part-of relationship between Upper Ontology Concept and Lower Ontology Concept.

3. Project knowledge management ontology

In this section, we propose the project knowledge management ontology, which consists of the hierarchy of project organization domain concepts and the ontology of employee and its sub-composition, project ontology and criterion ontology.

3.1. Hierarchy of Project Organization Domain Concepts

In a Project Organization Domain, the Project Organization concept can be seen as a combination of Employee concept and Project concept. Employee also consists of:

CEO who is responsible for managing all projects in Project Organization;

Director who is responsible for managing the projects which belong to his/her department in the Project Organization;

Manager who is responsible for managing the projects which belong to his/her division in each department;

Personnel who are responsible for the implementation of arranged projects.

The graphical view of Hierarchy of Project Organization Domain Concepts is shown in Fig. 1 through the use of the ontology notation.

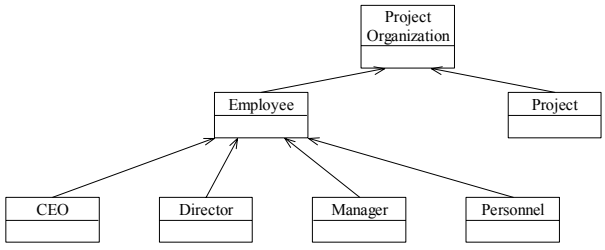


Figure 1. Project Organization Domain Concepts Hierarchy

3.2. The ontology of employee and its sub-compositions

In a project organization, the Employee Ontology is defined as the conceptualization of the Employee who has an Employee Position in the organization and is identified by an Employee Name as well as has Responsibilities which include some Projects. (Fig. 2)

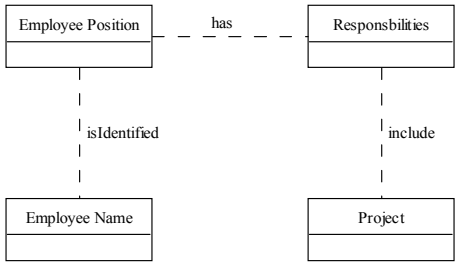


Figure 2. Employee Ontology

We present the Employee Ontology as the combination of the ontology name and a tuple where the elements of the tuple can be complex elements as defined below:

Employee [Employee Position, Employee Name and Responsibilities] where:

'**Employee Position**' is a unique identification of Employee in a project organization.

'Employee Name' is a unique identification of Employee Position in a project organization.

'**Responsibilities**' is an aggregation of Projects which Employees should take part in. Different Employee Positions are in correspondence with different Responsibilities.

The four sub-compositions of Employee Ontology – CEO Ontology, Director Ontology, Manager Ontology and Personnel Ontology inherit all the relations from Employee Ontology and the only difference is the scopes of the inherited concepts' properties.

3.3. Project Ontology

In a project organization, the Project Ontology is defined as the conceptualization of the concept of Project that is identified by Project Code, is shown Date Started, is responsible to Employee and is evaluated by Project Status. (Fig. 3)

IEEE COMPUTER SOCIETY

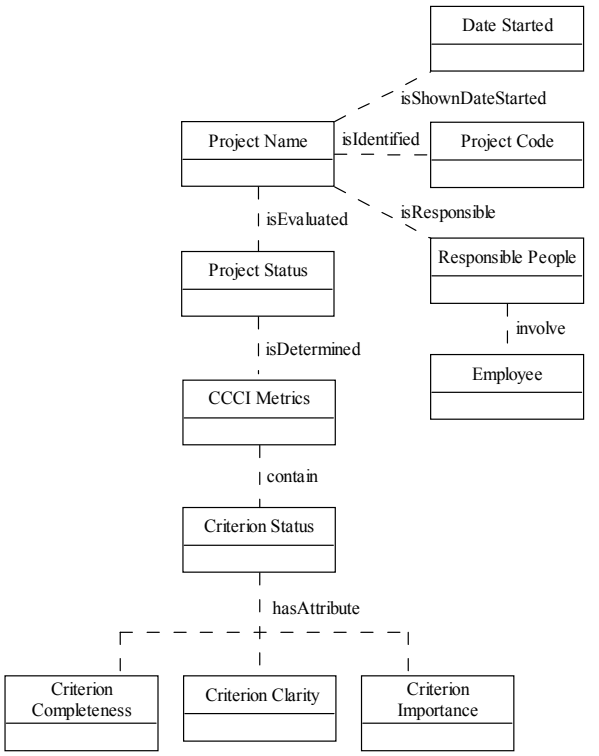


Figure 3. Project Ontology

We represent the Project Ontology as the combination of the ontology name and a tuple where the elements of the tuple can be complex elements as defined below:

Project [Project Name, Project Code, Date Started, Responsible People, Project Status and CCCI Metrics] where:

'**Project Name**' usually refers to a Project itself. In project organization environments, a Project Name is seen as a unique identification for Project.

'**Project Code**' is the mixture of numerical symbols and alphabetic symbols, which also can be seen as the unique identification for Project. The use of Project Code mainly focuses on the storage of Projects' records in databases, which is beneficial to the pick-up and the storage of Projects' documentations.

'**Date Started**' refers to the date when a Project begins to implement. In project management, Date Started can be utilized as a means to measure the length of a Project period which can be evaluated as an important quality aspect and a Criterion of Project.

'**Responsible People**' is an aggregation of Employees who are relevant to a Project.

'**Project Status**' can be substituted as the concept of Project Status Value. Based on the theory of CCCI Metrics, the scope of Project Status Value is from 0 to 6, which means the different level of Project Status.

3.4. Criterion Ontology

In project organization environments, the Criterion Ontology is defined as the conceptualization of the concept of Criterion that is identified by Criterion No., is shown Date Logged, is responsible to Employee and is determined by Criterion Status which has the attributes of Criterion Completeness, Criterion Clarity and Criterion Importance. (Fig. 4)

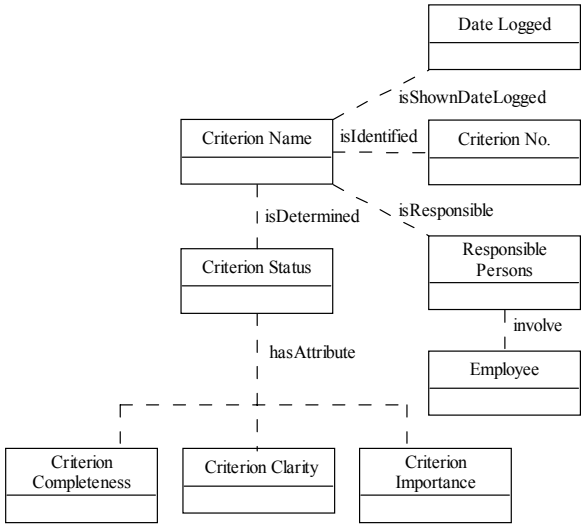


Figure 4. Criterion Ontology

We represent the Criterion Ontology as the combination of the ontology name and a tuple where the elements of the tuple can be complex elements as defined below:

Criterion [Criterion Name, Criterion No., Date Logged, Responsible Persons, Criterion Status, Criterion Completeness, Criterion Clarity and Criterion Importance] where:

'**Criterion Name**' usually refers to a Criterion itself. In project organization environments, a Criterion Name is seen as a unique identification for Criterion.

'**Criterion No.**' is the mixture of numerical symbols and alphabetic symbols, which also can be seen as the unique identification for Criterion. The use of Criterion No. mainly focuses on the storage of Criteria's records in databases, which is beneficial to the pick-up and the storage of Criteria's documentations.

'**Date Logged**' refers to the date when a criterion has been mutually agreed between an evaluating person and an evaluated person.

'**Responsible Persons**' is an aggregation of Employees who are relevant to a Criterion.

'**Criterion Status**' is a sub-tuple of the Criterion tuple, which uses quantitative means to determine the

IEEE COMPUTER SOCIETY

extent to which a criterion has been completed or delivered up on the mutually agreed Criterion. It consists of three elements – Criterion Completeness, Criterion Clarity and Criterion Importance.

'**Criterion Completeness**' is an element of Criterion Status, which qualifies the extent of task completion according to its corresponding Criterion.

'**Criterion Clarity**' is an element of Criterion Status, which qualifies the extent whether a Criterion is mutually agreed between an evaluating person and an evaluated person or not in a Project. Its scope is as below:

'**Criterion Importance**' is an element of Criterion Status, which expresses the importance of a Criterion in a Project.

4. Application of Protégé and SPARQL to realize project knowledge management ontology

The whole implementation and validation process involves four steps: firstly realizing the project knowledge management ontology by means of Protégé-OWL; secondly creating instances for the built ontology concepts in Protégé-OWL; thirdly querying the ontology instances by means of SPARQL; finally comparing the query results with the ontology instances entered in the second step to validate the ontology. Thus, if the results completely match the data stored in the OWL-based knowledge base, the ontology is validated.

In the first step, we build the ontology concepts, the relationships between these concepts and the constraints of the relationships. The graphical view of Hierarchy of Project Organization Concepts in Protégé-OWL is shown in Fig. 5.

Figure 5. Hierarchy of ontology concepts in Protégé-OWL

After building the ontology model, by survey and collecting data from City of Melville council (www.melville.wa.gov.au) – a real project organization, we create the instances for the ontology concepts based on the council management structure and the hypothesis of project task distribution. (Fig. 6)

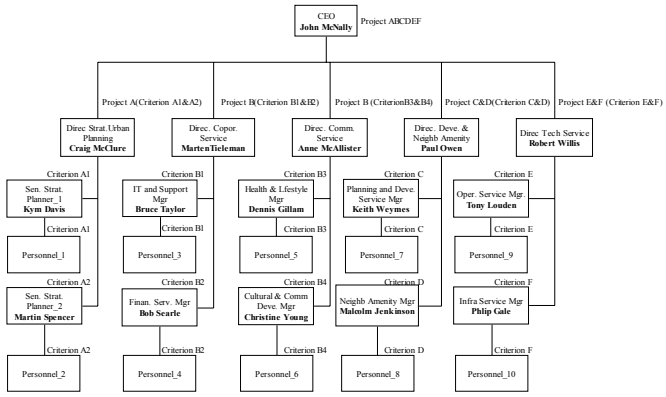
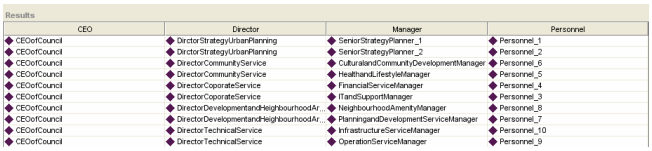


Figure 6. Instances of Project Organisation Ontology

The code below is to query the data from Employee Relationship Ontology which is a tree-like management structure, including CEO, Director, Manager and Personnel. Query results are displayed in Fig. 7.

```
SELECT DISTINCT ?CEO ?Director ?Manager
?Personnel
WHERE
{
?CEO :manage1 ?Director.
?Director :manage2 ?Manager.
?Manager :manage3 ?Personnel
}
ORDER BY ?CEO ?Director ?Manager ?Personnel
```


Results

CEO	Director	Manager	Personnel
CEOofCouncil	DirctorStrategyUrbanPlanning	SeniorStrategyPlanner_1	Personnel_1
CEOofCouncil	DirctorStrategyUrbanPlanning	SeniorStrategyPlanner_2	Personnel_2
CEOofCouncil	DirectorCommunityService	CulturalandCommunityDevelopmentManager	Personnel_6
CEOofCouncil	DirectorCommunityService	HealthandLifestyleManager	Personnel_5
CEOofCouncil	DirectorCoporateService	FinancialServiceManager	Personnel_4
CEOofCouncil	DirectorCoporateService	ITandSupportManager	Personnel_3
CEOofCouncil	DirectorDevelopmentandHeighbourhoodAr...	NeighbourhoodAmenityManager	Personnel_8
CEOofCouncil	DirectorDevelopmentandHeighbourhoodAr...	PlanningandDevelopmentServiceManager	Personnel_7
CEOofCouncil	DirectorTechnicalService	InfrastructureServiceManager	Personnel_10
CEOofCouncil	DirectorTechnicalService	OperationServiceManager	Personnel_9

Figure 7. Query results of Employee Relationship Ontology

The code below is to query the data from Employee Ontology, including employee position, employee name and responsible projects. Query results are displayed in Fig. 8.

```
SELECT DISTINCT ?Employee ?Employee_Name
```


0-7695-2938-0/07 $25.00 © 2007 IEEE

IEEE COMPUTER SOCIETY

```
?Responsibilities  ?Responsible_Project
WHERE
{
?Employee :holdsa ?Employee_Name.
?Employee :has ?Responsibilities.
?Responsibilities :include ?Responsible_Project.
}
ORDER BY ?Employee
```

Results

Employee	Employee_Name	Responsibilities	Responsible_P...
CEOofCouncil	John_McNally	OrganizationalResponsibilities_1	Project_A
CEOofCouncil	John_McNally	OrganizationalResponsibilities_1	Project_B
CEOofCouncil	John_McNally	OrganizationalResponsibilities_1	Project_C
CEOofCouncil	John_McNally	OrganizationalResponsibilities_1	Project_D
CEOofCouncil	John_McNally	OrganizationalResponsibilities_1	Project_E
CEOofCouncil	John_McNally	OrganizationalResponsibilities_1	Project_F
CulturalandCommunityDevelopmentManager	Christine_Young	DivisionalResponsibilites_CulturalandCommunityDevelopment	Project_B
DirctorStrategyUrbanPlanning	Craig_McClure	DepartmentalResponsibilities_StrategyUrbanPlanning	Project_A
DirectorCommunityService	Anne_Mcallister	DepartmentalResponsibilities_CommuntyService	Project_B
DirectorCoporateService	Marten_Tieleman	DepartmentalResponsibilities_CorporateService	Project_B
DirectorDevelopmentandHeighbourhoodAmenity	Paul_Owen	DepartmentalResponsibilities_DevelopmentandNeighbourhoodAmenity	Project_C
DirectorDevelopmentandHeighbourhoodAmenity	Paul_Owen	DepartmentalResponsibilities_DevelopmentandNeighbourhoodAmenity	Project_D
DirectorTechnicalService	Robert_Willis	DepartmentalResponsibilities_TechnicalService	Project_E
DirectorTechnicalService	Robert_Willis	DepartmentalResponsibilities_TechnicalService	Project_F
FinancialServiceManager	Bob_Searle	DivisionalResponsibilites_FinancialService	Project_B
HealthandLifestyleManager	Dennis_Gillam	DivisionalResponsibilites_HealthandLifeStyle	Project_B
ITandSupportManager	Bruce_Tayor	DivisionalResponsibilites_ITandSupport	Project_B
InfrastructureServiceManager	Philp_Gale	DivisionalResponsibilites_InfrastructureService	Project_F
NeighbourhoodAmenityManager	Malcolm_Jenkinson	DivisionalResponsibilites_NeighbourhoodAmenity	Project_D
OperationServiceManager	Tony_Louden	DivisionalResponsibilites_OperationService	Project_E
Personnel_1	PersonnelName_A	ProjectResponsibilites_A	Project_A
Personnel_10	PersonnelName_J	ProjectResponsibilites_J	Project_F
Personnel_2	PersonnelName_B	ProjectResponsibilites_B	Project_A
Personnel_3	PersonnelName_C	ProjectResponsibilites_C	Project_B
Personnel_4	PersonnelName_D	ProjectResponsibilites_D	Project_B
Personnel_5	PersonnelName_E	ProjectResponsibilites_E	Project_B
Personnel_6	PersonnelName_F	ProjectResponsibilites_F	Project_B
Personnel_7	PersonnelName_G	ProjectResponsibilites_G	Project_C
Personnel_8	PersonnelName_H	ProjectResponsibilites_H	Project_D
Personnel_9	PersonnelName_I	ProjectResponsibilites_I	Project_E
PlanningandDevelopmentServiceManager	Keith_Weymes	DivisionalResponsibilites_PlanningandDevelopmentService	Project_C
SeniorStrategyPlanner_1	Kym_Davis	DivisionalResponsibilites_SeniorStrategyPlan_1	Project_A
SeniorStrategyPlanner_2	Martin_Spencer	DivisionalResponsibilites_SeniorStrategyPlan_2	Project_A

Figure 8. Query results of Employee Ontology

The code below is to query the data from Project Ontology, including project name, project code, date project starts, value of project completion extent and responsible people. Query results are displayed in Fig. 9.

```
SELECT DISTINCT ?Project ?Project_Code
?Date_Started ?Project_Status ?Responsible_People
WHERE
{
?Project :isIdentified1 ?Project_Code;
:isShownDateStarted ?DateStarted;
:isResponsible1 ?ResponsiblePeople;
:isEvaluated ?ProjectStatus.
?DateStarted :dateStarted ?Date_Started.
?ProjectStatus :isShownProjectStatus ?Project_Status.
?ResponsiblePeople :involve1 ?Responsible_People.
}
ORDER BY ?Project
```

Results

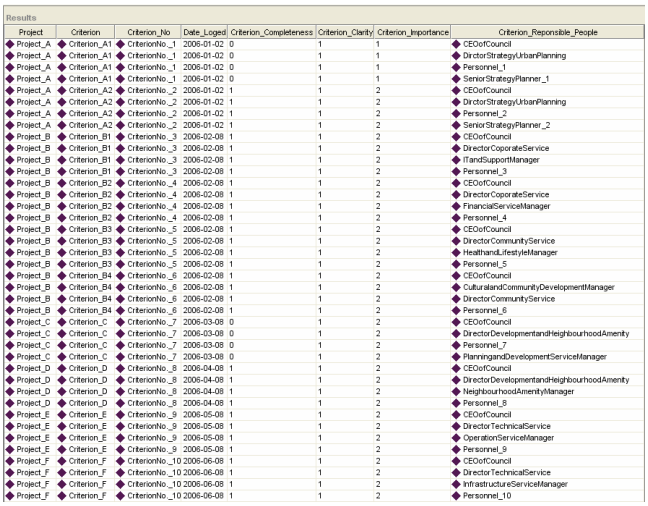
Project	Project_Code	Date_Started	Project_Status	Responsible_People
Project_A	ProjectCode_1	2006-01-02	3	CEOofCouncil
Project_A	ProjectCode_1	2006-01-02	3	DirctorStrategyUrbanPlanning
Project_A	ProjectCode_1	2006-01-02	3	Personnel_1
Project_A	ProjectCode_1	2006-01-02	3	Personnel_2
Project_A	ProjectCode_1	2006-01-02	3	SeniorStrategyPlanner_1
Project_A	ProjectCode_1	2006-01-02	3	SeniorStrategyPlanner_2
Project_B	ProjectCode_2	2006-02-02	6	CEOofCouncil
Project_B	ProjectCode_2	2006-02-02	6	CulturalandCommunityDevelopmentManager
Project_B	ProjectCode_2	2006-02-02	6	DirectorCommunityService
Project_B	ProjectCode_2	2006-02-02	6	DirectorCoporateService
Project_B	ProjectCode_2	2006-02-02	6	FinancialServiceManager
Project_B	ProjectCode_2	2006-02-02	6	HealthandLifestyleManager
Project_B	ProjectCode_2	2006-02-02	6	ITandSupportManager
Project_B	ProjectCode_2	2006-02-02	6	Personnel_3
Project_B	ProjectCode_2	2006-02-02	6	Personnel_4
Project_B	ProjectCode_2	2006-02-02	6	Personnel_5
Project_B	ProjectCode_2	2006-02-02	6	Personnel_6
Project_C	ProjectCode_3	2006-03-03	0	CEOofCouncil
Project_C	ProjectCode_3	2006-03-03	0	DirectorDevelopmentandHeighbourhoodAmenity
Project_C	ProjectCode_3	2006-03-03	0	Personnel_7
Project_C	ProjectCode_3	2006-03-03	0	PlanningandDevelopmentServiceManager
Project_D	ProjectCode_4	2006-04-01	6	CEOofCouncil
Project_D	ProjectCode_4	2006-04-01	6	DirectorDevelopmentandHeighbourhoodAmenity
Project_D	ProjectCode_4	2006-04-01	6	NeighbourhoodAmenityManager
Project_D	ProjectCode_4	2006-04-01	6	Personnel_8
Project_E	ProjectCode_5	2006-05-01	6	CEOofCouncil
Project_E	ProjectCode_5	2006-05-01	6	DirectorTechnicalService
Project_E	ProjectCode_5	2006-05-01	6	OperationServiceManager
Project_E	ProjectCode_5	2006-05-01	6	Personnel_9
Project_F	ProjectCode_6	2006-06-01	6	CEOofCouncil
Project_F	ProjectCode_6	2006-06-01	6	DirectorTechnicalService
Project_F	ProjectCode_6	2006-06-01	6	InfrastructureServiceManager
Project_F	ProjectCode_6	2006-06-01	6	Personnel_10

Figure 9. Query results of Project Ontology

The code below is to query the data from Criterion Ontology, including criterion name, criterion code, its belonged project, date criterion are logged, value of criterion completion extent, value of criterion clarity extent, value of criterion importance extent and responsible persons. Query results are displayed in Fig. 10.

```
SELECT DISTINCT ?Project ?Criterion
?Criterion_No ?Date_Loged ?Criterion_Completeness
?Criterion_Clarity ?Criterion_Importance
?Criterion_Reponsible_People
WHERE
{
?Project :isDivided ?Criterion.
?Criterion :isIdentified2 ?Criterion_No;
:isShownDateLoged ?DateLoged;
:isDetermined2 ?CriterionStatus;
:isResponsible2 ?RP.
?DateLoged :dateLoged ?Date_Loged.
?CriterionStatus :hasAttribute
?CriterionCompleteness;
:hasAttribute ?CriterionClarity;
:hasAttribute ?CriterionImportance.
?CriterionCompleteness
:isShownCriterionCompleteness
?Criterion_Completeness.
?CriterionClarity :isShownCriterionClarity
?Criterion_Clarity.
?CriterionImportance :isShownCriterionImportance
?Criterion_Importance.
?RP :involve2 ?Criterion_Reponsible_People.
}
ORDER BY ?Project ?Criterion
```


IEEE COMPUTER SOCIETY



Results

Project	Criterion	Criterion_No	Date_Loged	Criterion_Completeness	Criterion_Clarity	Criterion_Importance	Criterion_Reponsible_People
Project_A	Criterion_A1	CriterionNo._1	2006-01-02	0	1	1	CEOofCouncil
Project_A	Criterion_A1	CriterionNo._1	2006-01-02	0	1	1	DirctorStrategyUrbanPlanning
Project_A	Criterion_A1	CriterionNo._1	2006-01-02	0	1	1	Personnel_1
Project_A	Criterion_A1	CriterionNo._1	2006-01-02	0	1	1	SeniorStrategyPlanner_1
Project_A	Criterion_A2	CriterionNo._2	2006-01-02	1	1	2	CEOofCouncil
Project_A	Criterion_A2	CriterionNo._2	2006-01-02	1	1	2	DirctorStrategyUrbanPlanning
Project_A	Criterion_A2	CriterionNo._2	2006-01-02	1	1	2	Personnel_2
Project_A	Criterion_A2	CriterionNo._2	2006-01-02	1	1	2	SeniorStrategyPlanner_2
Project_B	Criterion_B1	CriterionNo._3	2006-02-08	1	1	2	CEOofCouncil
Project_B	Criterion_B1	CriterionNo._3	2006-02-08	1	1	2	DirectorCoporateService
Project_B	Criterion_B1	CriterionNo._3	2006-02-08	1	1	2	ITandSupportManager
Project_B	Criterion_B1	CriterionNo._3	2006-02-08	1	1	2	Personnel_3
Project_B	Criterion_B2	CriterionNo._4	2006-02-08	1	1	2	CEOofCouncil
Project_B	Criterion_B2	CriterionNo._4	2006-02-08	1	1	2	DirectorCoporateService
Project_B	Criterion_B2	CriterionNo._4	2006-02-08	1	1	2	FinancialServiceManager
Project_B	Criterion_B2	CriterionNo._4	2006-02-08	1	1	2	Personnel_4
Project_B	Criterion_B3	CriterionNo._5	2006-02-08	1	1	2	CEOofCouncil
Project_B	Criterion_B3	CriterionNo._5	2006-02-08	1	1	2	DirectorCommunityService
Project_B	Criterion_B3	CriterionNo._5	2006-02-08	1	1	2	HealthandLifestyleManager
Project_B	Criterion_B3	CriterionNo._5	2006-02-08	1	1	2	Personnel_5
Project_B	Criterion_B4	CriterionNo._6	2006-02-08	1	1	2	CEOofCouncil
Project_B	Criterion_B4	CriterionNo._6	2006-02-08	1	1	2	CulturalandCommunityDevelopmentManager
Project_B	Criterion_B4	CriterionNo._6	2006-02-08	1	1	2	DirectorCommunityService
Project_B	Criterion_B4	CriterionNo._6	2006-02-08	1	1	2	Personnel_6
Project_C	Criterion_C	CriterionNo._7	2006-03-08	0	1	2	CEOofCouncil
Project_C	Criterion_C	CriterionNo._7	2006-03-08	0	1	2	DirectorDevelopmentandHeighbourhoodAmenity
Project_C	Criterion_C	CriterionNo._7	2006-03-08	0	1	2	Personnel_7
Project_C	Criterion_C	CriterionNo._7	2006-03-08	0	1	2	PlanningandDevelopmentServiceManager
Project_D	Criterion_D	CriterionNo._8	2006-04-08	1	1	2	CEOofCouncil
Project_D	Criterion_D	CriterionNo._8	2006-04-08	1	1	2	DirectorDevelopmentandHeighbourhoodAmenity
Project_D	Criterion_D	CriterionNo._8	2006-04-08	1	1	2	NeighbourhoodAmenityManager
Project_D	Criterion_D	CriterionNo._8	2006-04-08	1	1	2	Personnel_8
Project_E	Criterion_E	CriterionNo._9	2006-05-08	1	1	2	CEOofCouncil
Project_E	Criterion_E	CriterionNo._9	2006-05-08	1	1	2	DirectorTechnicalService
Project_E	Criterion_E	CriterionNo._9	2006-05-08	1	1	2	OperationServiceManager
Project_E	Criterion_E	CriterionNo._9	2006-05-08	1	1	2	Personnel_9
Project_F	Criterion_F	CriterionNo._10	2006-06-08	1	1	2	CEOofCouncil
Project_F	Criterion_F	CriterionNo._10	2006-06-08	1	1	2	DirectorTechnicalService
Project_F	Criterion_F	CriterionNo._10	2006-06-08	1	1	2	InfrastructureServiceManager
Project_F	Criterion_F	CriterionNo._10	2006-06-08	1	1	2	Personnel_10

Figure 10. Query results of Criterion Ontology

By means of SPARQL, we can find that most query results match the instances we enter in the ontology within Protégé-OWL, which reveals that the ontology realizes most functions of proposed project knowledge management. In other words, this ontology is validated by experimental method.

6. Conclusion and possible future works

In the paper, we observe the problematic situation of knowledge management activities in project organizations. To solve the issues, we utilize the theory of ontology into the field of project management and design a solution based on an ontology notation system from Chang et al.'s works. To realize the function of this ontology, we introduce Protégé-OWL and SPARQL to build and validate the ontology prototype.

The benefits of this project are concluded as below:

It realizes the function of tracking and tracing projects completion status from the perspective of project management, which is beneficial to improving the competitive ability of project organizations.

It simplifies the procedure of project knowledge management activities and identifies own task and assessment criteria for each member in a project organization. Thus, the methodology may save the time and the cost of projects completion and help personnel self-evaluate.

It adopts quantitative methodology to measure the project completion status, which is effortlessly understood by organizational management.

The limitation of the project is concluded as below:

The ontology is not tested in practice, and thus we cannot validate its actual contribution to project knowledge management activities in project organizations.

Based on the issue in the current project, in the future we will implement the methodology in the environment of real project organizations to validate its functions. In addition, we will add more contents to the methodology based on different implementation situations.

7. References

[1] E. Chang, T.S. Dillon and F.K. Hussain, *Trust and Reputation for Service Oriented Environments-Technologies for Building Business Intelligence and Consumer Confidence*, John Wiley & Sons, Brisbane, 2005.

[2] E. Chang, M. Quaddus and R. Ramaseshan, *The Vision of DEBI Institute: Digital Ecosystems and Business Intelligence*, DEBII, 2006.

[3] P. Ferronato, "Introduction to the Digital Business Ecosystem Project", *Proceedings of MDA Technical Forum,* Tokyo, 2004.

[4] D. L. McGuinness and F. v. Harmelen, "OWL web ontology language overview: W3C recommendation 10 February 2004", *OWL Web Ontology Language*, W3C, 2004.

[5] J. Gennari, M. Musen, R. Fergerson, W. Grosso, M. Crub´ezy, H. Eriksson, N. Noy and S. Tu, "The evolution of Protégé 2000: An environment for knowledge-based systems development", *International Journal of Human Computer Studies*, 2003, 58(1):89–123.

[6] E. Prud'hommeaux and A. Seaborne, "SPARQL query language for RDF-W3C working draft 4 October 2006", *SPARQL Query Language for RDF*, W3C, 2006.

0-7695-2938-0/07 $25.00 © 2007 IEEE

IEEE COMPUTER SOCIETY