

Review on Application of Ontology in E-Business

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Abstract— Knowledge representation is the demonstration of the way things are and the relationships between them. Knowledge based Information System correspond to different facts and their relationship. Semantic model is a kind of knowledge representation. Semantic model is composed of a system of concepts and the relationships between those concepts. Concepts are often those subjects with which the user is concerned. Ontology is defined as the combination of both concepts and their relationships. Ontology can be used in various applications of e-business and best product can be given to the customer based on ontology relationships defined. The combination of ontology with knowledge based architecture allows composition of representation of different e-business processes.

Keywords: E-business, Knowledge representation, Ontology

I. INTRODUCTION

The main concept of ontology to define all the possible relationships among different concepts in all manner. Ontology proposed in this paper represents knowledge of a particular process based on the definition of various situations that may come and the actions that should be taken in each of those situations. This ontology is based on the decision making process of an expert. Facts are the main concept of the process using which its application is done in sales process of e-business. Facts associated with a particular process are taken into consideration. These facts are analyzed and actions which should be taken are taken into consideration. Action further takes into consideration the situations associated with the process. At the end as a part of sales process product suggestion for the customer decisions are taken. Action associated with a process focuses on the automatic execution of Web services and application interaction through Web browser. Ontology architecture supports the automation of different processes. The ontology combined with the architecture allow for the rapid creation of automated decision making processes that represent different business processes. The ontology allows the semantic representation of the process which enables reusing of the existing elements described by means of the ontology. The semantic representation describes the definition of each concept of the model and its relationships with each other by means of an ontology. This shared conceptualization and relationships between concepts are the key of knowledge sharing and automatic execution of business processes.

II. ONTOLOGY DEFINITION

The most used ontology definition is “an ontology is a formal, explicit specification of a shared conceptualization” [1]. ‘Conceptualization’ is a representation of model of phenomena in the world. ‘Explicit’ is type of concepts used and the constraints. ‘Formal’ that the ontology should be machine readable. ‘Shared’, means that it should capture

knowledge. A more generalized definition of ontology is “an ontology is a formal explicit representation of concepts in a domain, properties of each concept describes characteristics and attributes of the concept known as slots and constrains on these slots” [2].

Another definition which relates ontology to knowledge base is, “an ontology is a hierarchically structured set of terms to describe a domain that can be used as a skeletal foundation for a knowledge base” [3]. In actual applications, an ontology represents a set of vocabulary and related content theory [4]. The vocabulary consists of terms that are used for capturing the conceptualization of the domain, and the content theory refers to the identification of specific classes of objects, their properties, and their relationships that exist in the domain. Both are applied together to express entities and relationships between entities of a domain and establish a meta-information that could be shared and reused. Another paper states that “every information system has its own ontology, since it ascribes meaning to the symbols used according to a particular view of the world” [5].

III. LITERATURE REVIEW

The most important semantic approaches for the means of representing business process and its related knowledge are:-

- 1) Web Services based method
- 2) Systems Integration based method
- 3) Knowledge Management based method

A. Web Services based method

A Semantic Web Service is the combination of semantic web technology and web services. Semantic Web Services technology provides an infrastructure in which new services can be discovered, added and composed continually. Using Semantic Web Service business process automation can be achieved. A property of semantic web content is that it is annotated in a machine-understandable manner. Annotation provides additional information about an existing data. The process of upgrading the actual web pages to be machine-understandable semantic web pages is known as web semantic annotation. The various Web Services Based Method are:-

Semantic Business Process Modeling [6]

Semantic annotation can be done to business process models using Semantic Business Process Modeling. The combined use of ontology and semantic annotation of process models enables various tasks in business process to be automatized. Business process models can be used for documentation of business processes, automatic model transformation and code generation. Business process models in an organization gives an abstract idea of structure and flow of tasks. Many notations can be used for modelling a business process model such as UML activity diagram, BPMN. But the problem is that process model automated processing can't be done because of different terminologies which are included by the modeller

in natural language. Two things that need to be considered in a process model are:

- semantics of the metamodel elements when different representations are used.
- the terms that describe the model elements.

So here an ontology is necessary so that semantics of each element in a business process model can be defined in a machine-understandable fashion to support the whole business process management lifecycle. Advantages of semantic business process models are:-

- Advanced search in process models.
- Enhanced validation of process models.
- Automatic process execution.
- Better reuse of process fragments.
- Replacement of process fragments.
- Integration of different departments or companies.

Disadvantages of semantic business process models are:-

- The lack of machine readable representations is a major obstacle.

Semantic Business Process Management[7]

SBPM aims at accessing the process of an enterprise at its knowledge level. SBPM has ontologies as a component which provides the required semantic information. Current approaches to Business Process Management suffer from a lack of automation that would support a smooth transformation between the business and the Information technology world. Advantages of Semantic Business Process Management are:-

- Increases the automation of business tasks by providing semantic descriptions.
- Increase in overall manageability of business processes within enterprises by allowing more tasks for automated machine interpretation.

Disadvantage of Semantic Business Process Management are:-

- The ontology proposed in this paper needs to be enhanced and refined.

Web Service Execution Model [8]

An execution model for Web Service is introduced which operates on semantic descriptions of services allowing flexible integration of services. There are two phases in the service integration process of Semantic Web Services late-binding phase and execution phase. The Late-binding phase enables binding a user request and execution phase allows invocation and conversation of bound services. These services have heterogeneous descriptions in terms of data and protocols so interoperability should be achieved in both phases. So Semantic Web Service technology uses Web Service Modelling Ontology (WSMO) for its implementation. Advantages of creating Execution Model for Web Service are :-

- Web Service Execution Model allows reasoning tasks of varying complexity.
- Web Service Execution Model enables automatic adaptation to the changes in service descriptions.
- Use Web Service Modelling Ontology(WSMO) enables representation of information Semantically.

Limitation of the approach is:

- It is still a human user who must adjust and approve the results.

Semantic Web Service Supply Chains Coordination [9]

Semantic Web services (SWS) combines Web services architecture and Semantic Web. SWS is more adapted to facilitate supply chain coordination than existing information technologies. OWL-S is an ontology for describing heterogeneous Web services in supply chains. OWL-S can interpret and reason with semantic descriptions in the deployment of Semantic Web services. Advantages of Semantic Web Service Supply Chains Coordination are:

- The process of Supply Chains Coordination in business becomes more adaptive, accurate and effective due the use of Semantic web Services.
- Technologies such as EAI (Enterprise Application Integration) and EDI (Electronic Data Interchange) to support supply chain coordination are expensive, inflexible and not dynamic. Supply chain coordination using SWS overcomes all these factors.

Disadvantages of Semantic Web Service Supply Chains Coordination are:

- Sometime all of the motives in Supply Chain Coordination is failed to achieve.

M3PO [10]

Multi Meta-model process ontology (m3po) is based on workflow and choreography models. M3PO enables coordination of Internal and External Business Processes. Workflow models represent process and execute business processes. Choreography model enable to interact with different services that an organization is providing. This ontology allows the extraction of arbitrary choreography interface descriptions from arbitrary internal workflow models. This kind of ontology also allows converts workflow model into a choreography model. Advantages of using M3PO:

- M3PO incorporates and unify the different existing workflow metamodels and workflow reference models.
- M3PO provides necessary properties for extracting choreographies from internal business processes.

Disadvantage of using M3PO:

- M3PO does not guarantee complete mappings from arbitrary workflow models.
- More work is still required in M3PO for the construction of mappings from the Workflow Management Systems (WFMS) and choreography languages.

Semantic Situation-Driven Processes [11]

User objectives of an organization are modelled using Situation process model. A meta model for Situation-Driven Processes (SDP) enables the description of a process in terms of user perspective and system perspective. This meta model for Situation-Driven

Processes (SDP) is mapped to Semantic Web Service. Advantages of Semantic Situation-Driven Processes are:

- The user perspective can be described as a composition of user Goals
- The system perspective can be described in terms of services which support each user Goal.

Disadvantage of Semantic Situation-Driven Processes

- Semantic Situation-Driven Processes approach requires an initial effort to produce domain models following the SDP which include semantic descriptions.

However all the above mentioned approaches are based on the use of web services. Web services allow the complete automation of the process. However some processes require the human intervention. Also operational expert knowledge is not clearly represented in the reviewed approaches. For this reason in this paper a representation model combining expert knowledge with both human-tasks and web-service tasks is introduced.

B. Systems Integration Based Method

One of the problems with the automation of business processes is integration between different systems. It is here where ontology plays a fundamental role in facilitating the interoperability of the systems involved. The Systems Integration Based Method are:-

Ontology Based Integration of Business Intelligence [12]

Ontology based integration of Business Intelligence enables the semantic interoperability in integrating Data warehouse and Data mining. The ontology introduced includes physical view, conceptual view and analytical view. This enables the smooth mapping from user-defined keywords to metadata items in Data warehouse. This ontology integrates business intelligence applications for efficient decision making. The Advantage of the concept is:

- There is an Ontology based linkage and communication channel among business concepts, analysis models.
- A collection of semantic rules have been designed to make it possible for the automatic mapping of semantic relationships and ontological items.

The limitation of this approach is that:

- This approach is centred on subsystems integration rather than combining experience with existing knowledge.

Conceptual Modelling for Semantics-Driven Enterprise Applications [13]

A conceptual model for the creation of ontology-based applications using existing technologies, contributing modularization and meta-modelling of concepts is introduced. This is an ontology language that allows the scalability and integration. Advantages of this conceptual model are:

- The logical model is hidden from the ontology user.
- This conceptual model approach introduces the notion of lightweight inferences which are intended to be easily implementable with existing systems.

The limitation of the conceptual modelling approach is that:

- This approach does not focus specific issues on business process representation since it is oriented to the conceptual modelling of the system.

The approaches mentioned in the above subsection are based on the integration between systems in order to solve problems. However these approaches are centred in the interoperation between software systems rather than capture expert's knowledge and represent the business process. The proposed model allows the integration between systems by means of special actions that represents the interaction between a problem solver and other enterprise systems required for the process.

C. Knowledge Management Based Method

Internet-based Knowledge Management has a positive impact on e-business performance. The various Knowledge Management Based Method are:-

Process-centered knowledge model and enterprise ontology for the development of knowledge management system [14]

A framework for process-centered knowledge model and enterprise ontology is introduced for the context-rich and networked knowledge storage and retrieval required during task execution. Based on process centered knowledge model and enterprise ontology model a Knowledge Management System is introduced for business process. In the proposed ontology all domain concepts are related to the "process" concept. The knowledge storage and retrieval is done using process-centered knowledge model and enterprise ontology. Advantages of this kind of approach is that:

- By using enterprise ontology multi layered and networked knowledge about a specific knowledge object can be easily retrieved.
- Enterprise ontology facilitates content and context rich knowledge.
- Enterprise ontology is constructed in order to link various enterprise concepts in a process centered way and to retrieve relevant knowledge in a multilayered way.

Disadvantages of this kind of approach are that:

- The developed Knowledge Management System is not equipped with the workflow engine function for the control of the project process and the measurement function for managing the enterprise performance.
- This Knowledge Management System does not integrate Business Process Management and Business Performance Management.

Ontology Development for Designing and Managing Dynamic Business Process[15]

A task based ontological framework for representing dynamic business process networks is developed. This framework is based on the concept of tasks, states and agents that can be implemented with software specific abstractions. These framework link declarative and procedural process representations. Advantage of this approach is:-

- This can be used for managing processes in developing applications for integrating information from disparate information sources in multiple domains.

Disadvantage of this approach is:

- This task-based approaches do not include explicit expert knowledge about the process.

Knowledge Model-driven Recommender System for Business Transformation [16]

A framework for modelling business processes based on a semantic business process knowledge model that can integrate heterogeneous business knowledge is introduced. Advantage of this approach is that:

- This system can effectively address all of the challenges of modelling in business process.

Disadvantage of this framework is that:

- This framework is focused on the evaluation of business information and recommendations with regard to process management.

IV. COMPARISON

The comparison of different methodologies are given below and their limitations are also specified.

A. Semantic Situation-Driven Processes [11]

Takes into account the point of view of the user in the process definition, but the approach is oriented to the existence of web services to execute the process.

B. Ontology Based Integration of BI [12]

Approach centred on subsystems integration rather than combining experience with existing knowledge.

C. Conceptual Modelling for Semantics-Driven Enterprise Applications [13]

Approach does not focus specific issues on business process representation since it is oriented to the conceptual modelling of the system.

D. Process-centered knowledge model and enterprise ontology for the development of knowledge management system [14]

Approach is centred on knowledge management for decision supporting rather than the process automation.

E. Ontology Development for Designing and Managing Dynamic Business Process [15]

This task-based approaches do not include explicit expert knowledge about the process.

V. CONCLUSION

In this paper, a comparison of different important semantic approaches for representing business process and its related knowledge are compared. There are mainly three kinds of methods Web Services based, Systems Integration based method and Knowledge Management based method.

REFERENCES

- [1] Gruber.T. R., A translation approach to portable ontology specifications, Technical Report on Knowledge Acquisition, vol.5, no.2, pp. 199–220, Apr.1993.
- [2] Natalya FridmanNoy, Ray W. Ferguson and Mark A. Musen,The knowledge model of Protege-2000: Combining interoperability and flexibility, In Proceedings of the 12th international conference on knowledge engineering and knowledge management, 2000.
- [3] Bill Swartout ,RameshPatil ,Kevin Knight and Tom Russ,Toward distributed use of large-scale ontologies,In Proceeding of 10th knowledge acquisition for knowledge-based system workshop,pp.9-14, 1997.
- [4] B. Chandrasekaran, John R. Josephson and V. Richard Benjamins,What are ontologies, and why do we need them?, IEEE Transactions on Intelligent Systems, vol.14, no. 1, pp.20-26,Feb. 1999.
- [5] N. Guarino,Formal ontology and information systems, In Proceedings of FOIS'98, pp.3-15, June 1998.
- [6] F. Lautenbacher, B. Bauer and C. Seitz, Semantic business process modeling –benefits and capability, AAAI 2008 Stanford Spring Symposium Business Rules and Process Management (AIBR), 2008.
- [7] C. Pedrinaci, J. Domingue, C. Brelage, T. van Lessen, D. Karastoyanova and F.Leymann, Semantic business process management: Scaling up the management of business processes,IEEE International Conference on Semantic Computing, pp. 546–553, 2008.
- [8] T. Vitvar, M. Zaremba and A. Mocan, Execution model for heterogeneous web services, IEEE Congress on Services, pp. 219–222, 2008.
- [9] Y. Liu and G. Nie, Implementation of supply chains coordination using semantic web service composition, IEEE International Conference on Service-Oriented Computing and Applications, pp.249–254, 2007.
- [10] A. Haller, E. Oren and P. Kotinurmi, An ontology for internal and external business processes, Proceedings of the 15th International Conference on World Wide Web, pp.1055–1056, 2006.
- [11] S. Dietze, A. Gugliotta and J. Domingue, Situation-driven processes for semantic web services, 32nd Annual IEEE International Computer Software and Applications,pp. 987–992, 2008.
- [12] L. Cao, C. Zhang and D.T. JimingLiu,Ontology-based integration of business intelligence, Web Intelligence and Agent Systems: An international journal, pp.313–325,2006.
- [13] B. Motik, A. Maedche and R. Volz, A conceptual modeling approach for semanticsdriven enterprise applications,CoopIS/DOA/ODBASE, pp. 1082–1099,2002.
- [14] K.H. Han and J.W. Park, Process-centered knowledge model and enterprise ontology for the development of knowledge management system,”pp. 7441–7447, 2008.
- [15] M. Therani, Ontology development for designing and managing dynamic business process networks, IEEE Transactions on Industrial Informatics, vol.3, no.2,pp.173–185,2007.
- [16] M. Chen and J. Sairamesh, A knowledge model-driven recommender system for business transformation, IEEE International Conference on Services Computing, pp. 77–84, 2006.