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DEPLOYMENT OF SEMANTIC WEB MINING: IN ENTERPRISE APPLICATION INTEGRATION, KNOWLEDGE MANAGEMENT AND E-COMMERCE

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Abstract:

During last decade, Semantic web mining grasps the attraction of research and industry people. Besides several semantic web mining solutions offered by several vendors, Industries have started introducing semantic web technologies to increase the values of their external customers and internal employees. The main objective of semantic web mining is to organize the information on the web in order to make it more compatible and understandable. Then it can integrate various concepts of information in an efficient and recyclable way. The semantic web is an added layer of existing layered architecture of web, created as an explicit representation of concepts of information and its associations such as ontologies and taxonomies. More over semantic web technology is merely suitable for free ended environments, but also for closed environments such as industries. Therefore it can be efficiently implemented in various fields with Web services, knowledge management, Electronic Application Interchange and e-commerce. In this paper, the semantic web standards, technologies and languages are discussed. It mainly focuses on difficulties on theoretical aspects and uses of semantic web technologies in industries.

Keywords: Semantic web, Knowledge management, Semantic web services, Enterprise Application Interface, E-commerce.

I. Introduction:

Today, in modern business the greatest communication medium is web. To develop the productivity many industries are re-engineering their business. Consumers and partners can find their product and specific business by doing business over internet. The time and space are greatly reduced by online business while comparing to traditional office works. To

increase their services and to compete in today's market most of the companies have realized the use e-commerce. Besides buying and selling it is also used to develop their businesses. To improve the efficiency of a business, data mining plays an important role. Semantic web mining is a data mining methodology that is valuable to www, which acts as a strong platform for information distribution, retrieval and analysis of information.

Semantic Web Mining is the new development from two novel fields: Semantic Web and Data Mining. The Semantic Web is a development of the recent web in which information is given a definite meaning and facilitating computers, people to work together [1]. These days, web is much popular for storing large heterogeneous data, in which information is hidden [2]. Its objective is to extract useful and interesting patterns from large volume of heterogeneous data such as web structure data, web content data and web log data. Also it supports numerous recognized models, languages and technologies such as RDF, RDFS family of OWL languages, family of WSML languages and SPARQL to make use of information. It is added layer of the existing web architecture .The peak of the Semantic web, semantic web services are built, which support semi-operable or automated interoperable applications.

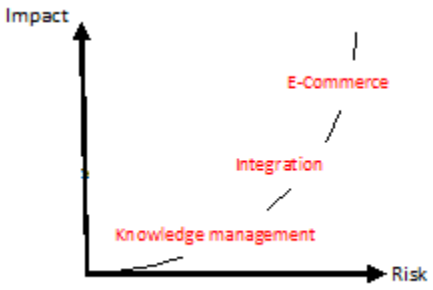

Fig 1: Analysis of Risk factors of Semantic web service and semantic web technology in organizations.

The main objective of this manuscript is to depict the semantic web and the technologies in semantic web services, which act as a basic layer for different types of business applications. There are three core subdivisions for these applications: enterprise application integration, Knowledge management and e-commerce. Fig 1 describes the above mentioned areas.

In this figure, the impact of implementing the semantic web in industries is represented in y – axis and -axis represents the risk factor for implementing the semantic web in industries. For Example: implementing the semantic web in knowledge management field might not provide much impact as deploying e-commerce. But the risk factor is less

compared with the risk of e-commerce. Two important research fields are developed based on these above mentioned areas. They are Semantic web and Semantic web services.

This paper pointed up the principle technologies, tools, and various limitations of implementing semantic web.

II. The Semantic Web

The semantic web is used to append a number of meaningful structured information to the data on the web both by automatically and manually. It provides some facts along with web resources through the use of metadata. The metadata contains some definite vocabularies or ontologies. Meta data can be defined as 'data about data'. According to web resources metadata means some descriptive information attached along with the web, which support wide variety of operations [3].

The structure of the resource can be described as metadata. For example in an online business, the metadata may include the category level, product name, product ID, model no, Color, price, seller details, offer, etc. An URI is used identify the resources on the web. Its metadata are described by RDF (Resource Description framework). Generally RDF has two features. Multiple statements of triples in data can be represented by graphically and RDF syntax which contains a number of serialization to signify the triples in understandable format. For example some formats such as turtle, RDF/XML, N3, RDFa can be used to embed RDF annotations within the XHTML pages

Normally, the triples can be represented as directed graph. The subjects are connected to the objects via directed arc. For each identifier the subject, object and predicate are provided by the corresponding URI. Ontologies provide formal specification to understand the domain[4]. Two languages have been introduced by W3C as a standard proposal to implement ontologies. The RDFS (RDF Schema) and OWL RDFS are used to define the RDF ontologies[5].

Some more well-known ontologies of semantic web are FOAF (Friend-Of-A-Friend), Dublin core, SIOC (Semantically Interlinked Online Communities). Even though the RDFS are popular, it has some demerits. To overcome the downsides of RDFS OWL (The Web Ontology Language) is used to develop ontologies and to support reasoning systems, Which are used to make new particulars and to verify the reliability of the developed model. OWL Lite, OWL Full and OWL DL are the subcategories of OWL. OWL Lite create hierarchical classification and simple constraints. OWL DL is meant for users who need maximum meanings by keeping the complete computations. OWL full provides maximum expressiveness but without the guarantee of computational completeness.

After constructing meta data with the help of RDF/OWL, it needs a dedicated query language called SPARQL to fulfill the needs. SPARQL is similar to SQL (Structured Query Language). SQL handles RDBMS based queries but SPARQL is a graph based query language. Since semantic web deals with graphs and RDF triples. According to Eric Miller and zepheira[6], the RDF data can be accessed through the queries of SPARQL which would produce relative data to a specific organization. This made organization into a LED (Linked Enterprise Data) frame work. The idea behind LED framework is similar to 'Linked open data. (A Team project aims to present an interwined RDF data from the available open sources). This could provide billions of resources and triples based on the principle of linked data as described in [7]). LED is used for both to describe and to link enterprise data. To achieve the entire semantic web it need the components such as proof, trust, user interface and application, as mentioned in fig 2 , semantic web stack designed by W3C.

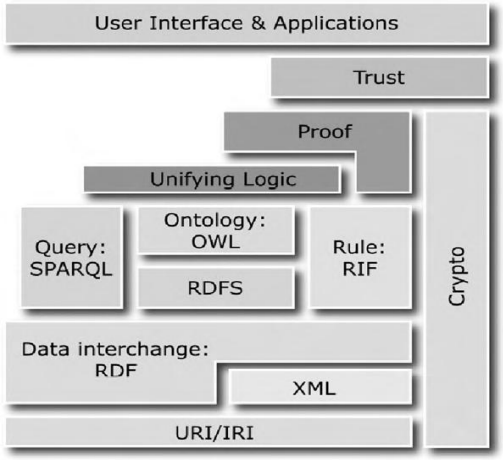

Fig 2: Semantic Web Stack.

This stack is a house of technologies that can be tracked from bottom. That is from XML, RDF, SPARQL, OWL, a logic layer and some top layers**.** The development of languages gradually grew from XML towards RDF and OWL, the WSML language, with the objective of solving some drawbacks of olden technologies related to WSD Logic[11] is being used in the OWL family of languages .

III. Semantic Web Services:

In order to bring less time consumption and to increase the automatic execution of business in a digital environment semantic web services (SWS) are developed. Semantic web service is a combined domain of semantic web with web services. Huge integration problems are faced by the IT industry due to data interoperability issues, heterogeneous formats and several other factors. The semantic technology helps to add 'meaning' to the web services; it can also

integrate distributed independent systems. Ontologies of new language (such as Web Service modeling ontology) are used to define the system components, data definitions and behavior in machine acceptable form. Web services are used to automatically publish contents with the help of open protocols such as XML and HTTP. The constituent elements of web service includes UDDI (Universal Description, Discovery and Integration) , SOAP (Simple Object Access Protocol) and WSDL (Web Service Description Language). Some key languages used to Semantic web services are OWL [8], OWL-S[9] and WSMO/WSML (Web Services Modeling Ontology /Language)[10].

OWL/OWL-S:

This language was used along with web services. It was built with XML to define the customized tagging schemes.OWL mainly designed to fulfill the complete need of web ontology language. For web service usage functionalities such as "service profile", "service model", "service grounding" were created in order to provide information about "what kind of service is provided? ", "How it is provided" and " How it could be used?". In W3C specification these details were defined by OWL-S. There was no standard execution environment for processing and handling the transactions of OWL ontologies and web services.

WSML/WSMO/WSMA:

Web Service Modeling Ontology (WSMO) is a novel approach to handle the bottleneck of OWL. It provides a full fledged framework to handle the web services. There were three activities in this framework such as (i) WSMO, (ii) WSML (Web Service Modeling Language) and (iii) WSMX (Web Service Execution Environment).

WSMO provides formal specifications of services.

The language to represent the WSMO is WSML and to implement this language the WSMX execution environment is used. The fig-3 illustrates the top level concepts of WSMO, which describes the goals, ontologies, web services and its mediators to connect the components.

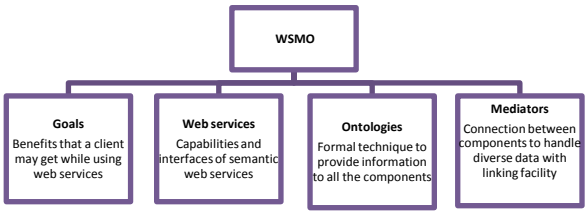

Fig-3: Top level concepts of WSMO.

The goals are described in terms of operative and non-operative requirements of user requests[14]. All WSMO elements are described in WSML. Based on the different levels there are several deviations of WSML. They are WSML-Full, WSML-Core, WSML-Rule, WSML-DL (description logic) and WSML-Flight.

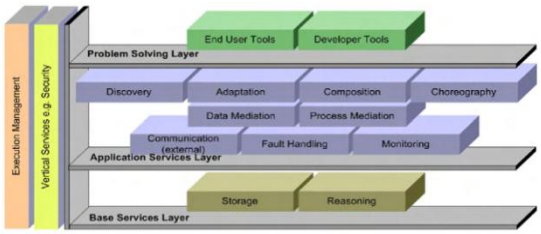

Fig : 4 WSML architecture.

WSMX provides an environment for executing the services of semantic web. The logic constraints are interpreted by a component called "reasoned" within WSMX. KAON2[15], MINS and IRIS[16] are the some famous reasoners available in market. This architecture supports execution of simple and complex operations with web service. This execution environment can be used in various scenarios range from industry tourism, banking and procurement etc.

Therefore by using the services of semantic web the processes can be semi automated and the distributed operations can be executed through the internet. There are variety of prototypes available in the market to build the semi automated process in e-tourism, e-banking and geospatial applications. Examples of such prototypes are DIP[17], SWING[18] and SUPER[19]. Session II and III described the basis of semantic web services. The next session presented some applications such as knowledge management, e-commerce and Enterprise Application Interfaces.

IV Knowledge Management in Enterprise 2.0 and Semantic Enterprise 2.0

Enterprise 2.0 is a tool used in organizations. Like web 2.0 it is used to handle web-based groups and published media services. "Enterprise 2.0" is described as, "the use of emergent social software platforms within companies, or between companies and their partners or customers"[6]. In order to facilitate the collaborative intelligence in organization the enterprise 2.0 is used as a novel mechanism. It can manage and share knowledge in industry. Similarly the extensions of semantic web technology tools are referred as "Semantic Enterprise 2.0". For an instance semantic wikis, semantic blogging, web blogs, micro blogging and semantic tagging abilities are helpful to enhance the communications between the various semantic applications over the internet. Semantic wikis are treated as the major area of semantic web technology and collaborative knowledge management. It enhances the structure of the wiki by adding semantic annotations. Variety of semantic wikis are existing in the market such as Semantic MediaWiki, LkeWiki, KiWi,

OntoWiki and UfoWiki. These wikis helps companies to describe the usage of ontologies and to identify the relevant company for knowledge collaboration and to enhance the structured information. It is also used to increase the use of personal information management of employees. To improve the communication of desktop applications such as calendar, notepad, so on a recent ontology development KDE environment is used. Many companies use number of public web tools where data are maintained in private areas for efficient sharing of knowledge. Some popular public web tools are "Twine" and "Faviki" which allow users to organize information, share and find information from trusted people. But knowledge management is the low benefit area in IT because of low risk of data. To improve the benefits of semantic web high data risk is implemented through the use of Enterprise Data Integration in industry.

V Enterprise Data Integration in semantic web:

In general, EDI and middleware applications[20] are highly benefitted with semantic web technology applications. By using RDFs/OWL, the data in diverse applications are mapped to frequent representative layers. It merges the heterogeneous data structures in a meaningful form. A prominent tool "Ontobroker" is used integrate information from heterogeneous and distributed applications by extracting ontologies. Ontobroker also provides a unique query interface for the users to see the result in a one system. SCORE (Semantic Content Organization and Retrieval Engine) is a recent tool used for data integration in industries.

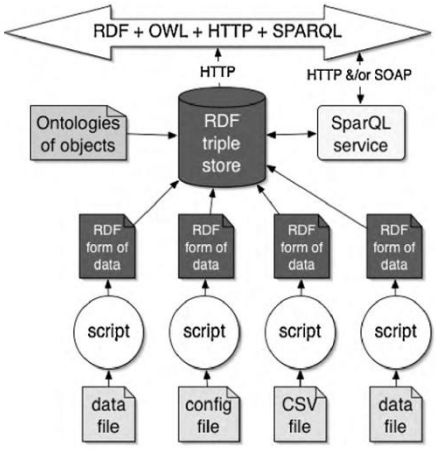

Fig 5: RDF Bus Architecture.

For integrating data from collaborative environments such as blogs, RSS feeds and Wikis, architecture similar to RDF bus is established (In Fig 5). To interlink different kinds of social applications, SIOC[21] and FOAF[5] are used to provide light weight vocabularies. For Implementation, First Collaborative work Environment (CWE) concepts are mapped onto SIOC ontology (Users, Posts, and Documents). Then it can access data from a remote heterogeneous CWE.

Then the user in business collaborator generates a new shadow folder to connect to the remote CWE. Thus it provides transparency in integration between heterogeneous applications.

Next the final part that deals with E-commerce which is highly demanded application for semantic web technology.

VI. E-Commerce and Semantic Web Technologies:

The term "E-commerce" facilitates the usage of semantic web services and technologies in the transactions of "Business to consumer" and "Business to Business" applications. There by involving huge amount of human interaction between co-operative process and the vendor software in each transaction. Semantic web services and technologies supply a virtual business environment for integration of various applications through semi- automatic service discovery and mediation. It is a loosely-integrated framework to accept the changes in market.

The crucial part for B2B and B2C is searching a small piece of data from large amount of integrated information. For this it uses an intelligent solution for mechanizing the structure of process, standardization, configuration of data and personalization of data.

Using ontology based mediation layer, organizations with dissimilar data structures can share information without affecting their basic property. Recently the software entities use ontologies in Artificial intelligence (AI) to provide an approach for specifying content – specific constraints for sharing and reusing the knowledge. Thus reducing the human interaction.

Citing a major report entitled as "Semantic Wave report – industry roadmap to web 3.0"[22] released in 2008 reports the potential market impact and value added services of semantic web technologies. The developments from web 2.0 to web 3.0 are visualized in the chart.

Challenges	Semantic capabilities	Value drivers
1. Development: Complexity, labour-intensity, solution time, cost, risk	Semantic modelling is business rather than IT centric, flexible, less resource intense, and handles complex development faster	Semantic automation of "business need-to-capability-to-simulate-to-test-to-deploy-to-execute" development paradigm
2. Infrastructure: Net-centricity, scalability; resource, device, system, information source, communication intensity	Semantic enablement and orchestration of transport, storage, and computing resources, IPv6, SOA, WS, BPM, EAI, EII, grid, P2P, security, mobility, system-of-systems	In the semantic wave, infrastructure scale, complexity, and security become unmanageable without semantic solutions
3. Information: Semantic interoperability of information formats, sources, processes, and standards; search relevance, use context	Composite applications (information and applications in context powered by semantic models), semantic search, semantic collaboration, semantic portals	Semantic interoperability, semantic search, semantic social computing, and composite applications and collaborative knowledge management become "killer apps"
4. Knowledge: Knowledge automation, complex reasoning, knowledge commerce	Executable domain knowledge-enabled authoring, research, simulation, science, design, logistics, engineering, virtual manufacturing, policy and decision support	Executable knowledge assets enable new concepts of operation, super-productive knowledge work, enterprise knowledge superiority, and new intellectual property
5. Behaviour: Systems that know what they are doing	Robust adaptive, autonomic, autonomous system behaviours, cognitive agents, robots, games, devices, and systems that know, learn, and reason as humans do	Semantic wave systems learn and reason as humans do, using large knowledge bases and reasoning with uncertainty and values as well as logic

Table 1:Value schemes of the sematic web (cited from the Source : Semantic Wave report [22]).

The conclusion of this table describes numerous trends such as intelligent user interfaces, Semantic social computing, semantic infrastructure that supports semantic web technologies and semantic applications to the future transmissions.

VII. Conclusion:

The usage of semantic web technologies and semantic web services are reviewed with respect to industrial domain in knowledge management, Enterprise Application Integration and E-commerce in this paper. It offered enhanced functionality beyond the traditional approach of applications. This leads to the potential development in the use of semantic web in various IT solutions. But still in industry level the usage of semantic web is infancy. From this review semantic web has moved to a commonly deployed application in industry. It will lead the organizations to the next higher level by providing value added services to customers.

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