International Journal of Advances in
Soft Computing and Intelligent Systems (IJASCIS)
2024, Vol 03, Issue 02, 291-300
ISSN: 3048-4987

Original Paper

SEMANTIC WEB TECHNOLOGY FOR DEPLOYMENT OF WORKFLOW WITHIN ASPOCMS SERVICES

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ABSTRACT

An Agent-based Semantic Web for Paperless Office Content Management System (aSPOCMS) [5] has designed to provide the paperless environment of offices especially higher education institution in which workflow plays the crucial role in circulation of documents. This article examines the development of workflow and its deployment for ontology enabled office content management system i.e. aSPOCMS and services in paperless regime incapsulated with Semantic Web technologies. We will focus on the challenges of workflow management of administrative process especially higher educational institutions and will also identify different tasks and problems during the development of workflow processes and their management based on ontology. These tasks are: feasibility study and analysis, requirement analysis and specification, preference for effective utilization of Semantic Web technologies, representing the metadata of informational resources, designing of ontology and unambiguous reasoning and filtering the ambiguous inferences. In this article, we will also analyse that how much the Semantic Web technology is suitable for information and knowledge management which is needed to aSPOCMS services for intelligent knowledge processing.

KEYWORDS

Semantic Web, aSPOCMS, Workflow Management, Paperless Environment, Unambiguous Reasoning, Designing of Ontology

1. INTRODUCTION

Modern organizations are leveraging with technologies and span the area of working as globally. Most of organizations are embracing the technologies to move towards the paperless environment and trying the reduce the tons of paper from their filing work. Paperless environment of offices is the challenging entity at present digitization era and workflow management is the hectic task. The workflow within aSPOCMS will be a difficult articulation for administrative processes. Ontology enabled workflow [21] mechanism will play the significant role for providing the paperless environment to higher educational institutions in proposed system, which is called aSPOCMS. The main tasks are ontology-based workflow management which draws on and combines employee's activities and requirement of these activity as input (such as document, actor etc.). It is focus on information of workflow as resources which are significant for system. The following workflow management challenges are specifically identified in administrative processes of higher educational institutions:

a. The users and processes will produce informational output. Each informational output will have relevancy for a particular context of administrative work.
b. Privacy and security related to the metadata and workflow.
c. Highly expectations about accuracy, transparency of works and account-ability about processing of information and knowledge intelligently.
d. Availability of identical informational resources for several works and services.
e. Enactment of personalized services for each employee.

The advancement of workflow management in the administration of higher educational institution will improve the efficiency by minimizing the use of paper and efforts of manpower. The quality in terms of accuracy, scope, personalization, interoperability of information and knowledge of workflow process will also improve. The aSPOCMS services are based on university ontology, which is further divided into four levels e.g. top-level ontology, domain ontology, task ontology and application ontology. Above listed challenges are concerned with management of workflow and administrative informational resources. It is also important that how the workflow resource organize based on administrative knowledge.

The organization of this paper is structured into five key sections. The introduction section outlines the brief of Semantic Web and ontology with their effective use in workflow management specially in higher educational institutions. It is also pointed the key challenges which are faced during administrative processes. The second section explains the deployment of workflow enabled with Semantic Web for service composition and reuse of the resources. The third section explores the cooperation of Semantic Web for implementation of workflow. It describes the requirement analysis and specification of Semantic Web with step-by-step activities involved in workflow management. The fourth section highlights the observation of Semantic Web enabled and Non-Semantic Web mechanism for workflow management. According to various facts and facets, observation of both mechanism is depicted in table which will be helpful to deploy the Semantic Web for workflow management. Finally, the conclusion synthesizes the key insights of Semantic Web for workflow management with consideration of key challenges discussed in previous section.

2. DEPLOYMENT OF WORKFLOW ENABLED WITH SEMANTIC WEB

The use of aSPOCMS services will extent across distinct departments and sections of higher educational institutions and universities. Hence, this article focuses on Semantic Web based regime of workflow management. In this section, we have discussed the relevancy and efficiency of Semantic Web for aSPOCMS services especially for workflow management. This technology is technically and operationally capable to workflow management and knowledge management.

2.1. Semantic Web technologies

The Semantic Web term was invented by Tim Berners Lee et al. [3], which is raising the future of web with machines interpretable as well as to be understandable by humans. The most essential issue is the annotations of documents and other significant informational resources. The documents and other informational re-sources are not interpreted for display. The expressions of documents and informational resources can be automatically processed by agent of aSPOCMS. The informational resources will be represented in information space by using Uni-form Resource Identifier (URI) [2]. The informational resources will have unique identifier. There are various technologies have been developed and well established to fulfil the vision of Semantic Web which is shown in layered architecture of Semantic Web in figure 1. Now these technologies are ready to use for distinct application domain. XML [6] and its associated standards e.g. Namespaces and Schemas are utilized to arranging the metadata of informal re-sources on the Web. Resource Description Framework (RDF) [7][8][9] is providing a model to construct the metadata of informational resources and signify the complex relationships among these resources. Resources Description Framework Schema (RDFS) [10] provides the description about the classes of informational resources and properties among these resources. It also facilitates the elementary reasoning formalism to infer the new information from existing re-sources. In Semantic Web, ontology is a powerful language which is known as Ontology Web Language (OWL) above the RDF and RDFS that is providing the intricated restrictions on the informational resources.

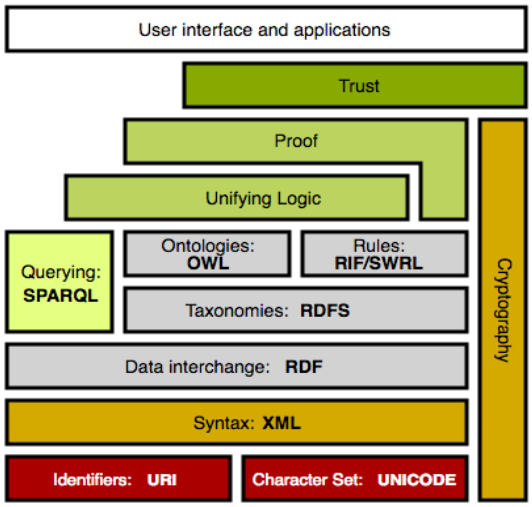

Figure 1. Architecture of Semantic Web by W3C

2.2. Semantic Web for Workflow Management

The real-time projects and domain-specific researches in various organizations are deploying to combine the different informational resources with distinct technical aspects and organizational issues, which is based on knowledge management, information management and Semantic Web [22]. This contraption also employs in the field of workflow management for administrative process. We will need to analyse the workflow and its management based on approach of Semantic Web. There is some relevant factor that can be analysed during the requirement of workflow and its management. These factors are pointed as below:

2.2.1. Service Composition and Reuse

A workflow may involve the set of activities that is formed the composition of services and it can execute to furnish a complex task. Here, it is not mandatory to reuse single-task oriented services only, but it is also to treat a workflow as a major service that can be integrated with another workflow. In other sense of words, both workflows require to be denoted and managed in identical manner.

2.2.2. Flexibility

This factor signifies the capability of a workflow mechanism which can respond the deviations in its environment. Hence, systematic workflows require a flexible structure of workflow ontology to support innovative exploration and flexible alteration at dynamic context during runtime.

2.2.3. Scalability

Systematic workflows are typically accomplished the task in an investigative manner and it can be demanded such resources which does not predefine in workflow ontology. The scaling of workflow can be done based on number of services applied on that workflow, data, information, and/or other calculation resources.

2.2.4. High Usability

Generally, sophisticated users i.e. scientists, engineers and doctors etc. have not proficiency about computer and workflow-based system. Therefore, workflow embedded system should

hide the complication of ontological structure of work-flow and agree to show the abstract information liable on users who is using the system.

2.2.5. Reliability

Fault-tolerance workflow designates the capability of failure-resistant of system. Hence, systematic workflows are frequently accomplished the task in a growing environment with assorted informational resources.

2.2.6. Reproducibility

Systematic workflow should be reproducible and record the precise details about informational resources by capturing the metadata of these resources. Derivative informational resources and step by step sequences of workflow, para-metric settings and intermediate consequences are very helpful for sophisticated users to duplication for workflows. There are concentrated endeavours in knowledge engineering with ontological formalism to support the issues of workflows by defining standardized metadata and their interoperability framework.

2.3. Workflow Management Approaching the Semantic Web

Ontology based workflow management provides the restricted mechanism to the automation of administrative processes [4]. Currently, most of administrative processes depend on the Internet while management of workflow is working based on a network discipline. The elementary concepts and technologies for automation of administrative and business processes can be extended to effectively entirely extents of human effort especially in higher educational institutions. Administrative processed provides the coordination to expand the quality of service with increasing flexibility to facilitate the more complex services with-in system. The collaborative administrative workflows of higher educational institutions need related documents, its information resources, or tasks that can annotate from one participant to another for their action according to systematic workflow. These workflows can accomplish the similar type of tasks with its flexibility factor. Administrative workflows describe the office processes and collaborative workflows emphasize on a group of users working for common objectives. The concept of activities concerned with workflow was emerged in 1980s. Nowadays, it is increased with multibillion-dollar of industry. E-commerce and E-business are mostly dependent on web and internet-based ap-plications with some essential workflow management. Most of technological developments have innovative changes with their work-flow formalism for transparent and quick responses. The internet-based work-flow deployment provides the low cast affordable and comfortable mechanism for administrative processes. Generally, geographically scattered users are in-volved in a workflow-based task by using internet and web-based applications. In this scenario, consensus upliftment between various users is difficult with work-flow-based task execution.

3. Co-operation of Semantic Web for Implementation of Workflow

During the design and process to develop the proposed system aSPOCMS several tasks and distinct issue related to ontology development, Semantic Web technologies, workflow management and knowledge management of the resources of higher educational organizations (universities/institutions) are created the effective challenges for the development of aSPOCMS and other Semantic Web based applications [23]. Here, we describe the co-operation and collaboration of Se-mantic Web for workflow management of files/documents in higher educational institutions by using six major activities, which are shown in figure 2. The feasibility study and analysis of Semantic Web for workflow is the first activities, in which

feasibility will study and analyse as technical, economical, legal, operational and scheduling perspectives. Rest of this activity is requirement analysis and specification, effective utilization of Semantic Web, representation of informational resources, ontology designing and filtration of ambiguous inference.

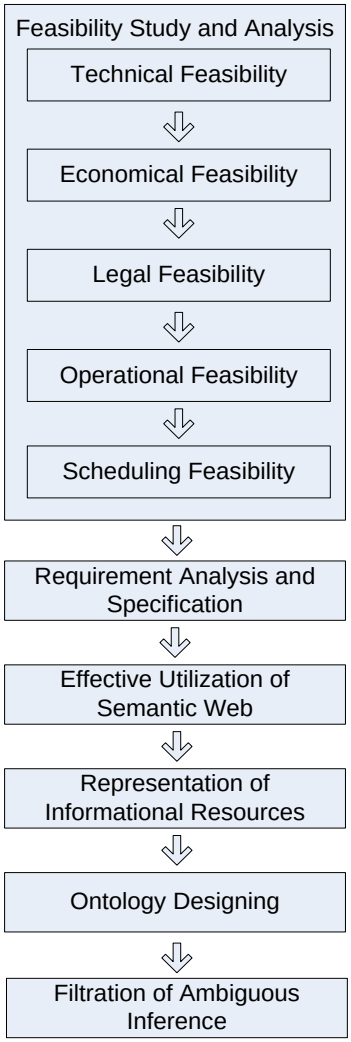

Figure 2. Step-by-step activities for Workflow Management

3.1. Feasibility Study and Analysis

Firstly, we will do the feasibility study and analysis [12] to determine the viability of Semantic Web for workflow management and potential for success of system especially in higher educational institutions. The objective of such a study is to ensure that the services are legally and technically feasible and economically justifiable for organization which will avail the services. We will need to do the feasibility study with following important factors:

3.1.1. Technical Feasibility

The valuation of applied technology and services will be adjusted based on technical aspects which are able to available in institutions/organization. It will sup-port the organizations to fulfil the capacity of required technical resources and the technical team are able to implement the new innovative ideas and technology on current working systems. Technical feasibility will also

comprise the assessment of available hardware and requirements of software for intended system.

3.1.2. Economic Feasibility

It can measure the expenses and its profit capability to implementing the emerging technology to organizations and also measure the required funds and financial allocation for the development of proposed system. It also provides the blue-print for decision-makers to make the positive decisions in respect of organization. This evaluation typically provides the information on cost and/or benefits with the implementation of proposed system.

3.1.3. Legal Feasibility

It is important mechanism of any kind of system and services. We need to investigate the legal conflicts that will be occurred in current intended system and analyse the legal requirements such that data protection acts or/and other social media laws. The legality of user's actions will also analyse to prevent the conflicts between users in future.

3.1.4. Operational Feasibility

The operational feasibility is the study report to examine and regulating that the proposed system will fulfil the current requirements about organizations and institutions with implementation of the system. This study can also measure that how proposed system will solve problems and designated task during defined time slots. Another study under operational feasibility is to investigate that how the proposed system gratifies the requirements which is point out during the requirements analysis phase of system development. Required operational activities and outcomes will ensure the success and directed the design and development of system. All these activities under operational feasibility will comprise various design independent and dependent parameters i.e. reliability, maintainability, supportability, usability, disposability, sustainability, affordability, and some others if any.

3.1.5. Scheduling Feasibility

This activity is the most significant for the success implementation of any project and intended system. An intended system can fail if it is not completed on time because the technology is changing day by day. Scheduling feasibility evaluate that how much time will be required to completely develop the system will take with the technical aspects of requirements of organizations. This phase also re-quires to analyse time duration to fully deployment of intended system.

3.2. Requirement Analysis and Specification

It is the first phase of SDLC (Software Development Life Cycle) [13][14] in software engineering that is initially required for any project and proposed system development. Requirement analysis and specification is focusing the study and compromise with users and contractors with its documentation and validation. The developer must discuss and clarify the requirement of the users and also observe that it will be implemented with current available resources and technology or not. Within aSPOCMS, we require to analyse the various workflows and associated constraints that are specially used in are of higher educational institutions.

3.3. Preference for Effective Utilization of Semantic Web Technologies

To achieve the requirements of intended system aSPOCMS, Semantic Web technologies can be used to develop such kind of system in which informational re-sources will represent in such that will be effectively utilized by the system [15]. We decide to incorporate the ontology about various informational resources of administrative processes which will be applicable to deliver the services of administrative processes. Hence, this ontology will be relevant to use and define the informational resources with semantically and this semantical representation of informational resources will provide a machine-readable explanation about those interrelated resources which are will participate for administrative workflow activities. These resources are accessible by web-based applications and may be utilized as backend processes.

3.4. Representing the Metadata of Informational Resources

Before choosing and deployment of Semantic Web technologies and tools, we need to focus on a major challenge within the development of various level of ontology and how to capture and obtain the required services on the conceptual level and to determine the need to process semantic expressions. The technique of creating and editing the informational resources with its semantic senses can explore the details and provide the machine-readable form for intelligent processing.

3.5. Designing of Ontology and unambiguous Reasoning

Designing of ontology for a particular domain is one of the challenging tasks because it differs designer to designer. Therefore, we need to critical observation of information resources and it's concern unambiguous reasoning before the designing of ontology for effective utilization of knowledge. To provide the efficient and unambiguous services by aSPOCMS, it is required that we should categorize the informational resources of university in various level of ontology as top-level ontology, domain ontology, task ontology and application ontology [19][20] with unambiguous reasoning.

3.6. Filtering the ambiguous Inferences

Inference is the mechanism to discovering new information and relationships in Semantic Web environment. In this web, data and its resources are represented with a set of relationships among those informational resources. Inference is automatic procedures that can be able to investigate new relationships based on data, vocabulary and some informational resources. In Semantic Web, ontology focuses to construct the classes, subclasses, reasoning rules of informational resources and its classification. These informational resources will be associated to classes, relationships among classes and their instances.

4. RESULTS

After a deep study on Semantic Web and workflow mechanism, it has been proved that Semantic Web can strongly recommend for workflow management with its enormous features [16] and characteristics. Semantic Web is reflecting the more opportunities [17] rather than without Semantic Web enabled mechanism. I have observed various facts and facets regarding Semantic Web and its deployment with workflow which are listed in following table:

Table 1. Results to deploy the Semantic Web for Workflow Management.

Factors	Web Technology	
	Semantic Web	**(Non-Semantic) Web**
Service Composition	Yes	Yes
Reusability	Yes	No
Flexibility	Yes	No
Scalability	More	Less
High Usability	Yes	No
Reliability	More	Less
Reproducibility	Yes	No
Inferencing	Yes	No
Reasoning Capability	Yes	No
Knowledge Management	Yes	No
Resource Utilization	Maximum	Minimum
Semantic Heterogeneity	More	Less
Information Searching	Easy and Efficient	Time Consuming

It provides high usability of content, knowledge management and reasoning capabilities which enable the semantic annotations [18] and intelligent processing of knowledge not data only. Therefore, Semantic Web can strongly prefer to the deployment of workflow to relay the aSPOCMS services.

5. CONCLUSIONS

The main contribution of this paper is to focus on workflow management based on Semantic Web to provide the services to aSPOCMS. Ontology is one of the significant technologies of Semantic Web for workflow management and other resources required for paperless office content management system. It is reflect-ing the various admissible factors by adopting the Semantic Web based approach. The challenges of workflow management of administrative process especially higher educational institutions are elaborated and identify and described various tasks and problems during the development of workflow processes and their management based on ontology. These tasks, feasibility study and analysis, requirement analysis and specification, preference for effective utilization of Se-mantic Web technologies, representing the metadata of informational resources, designing of ontology and unambiguous reasoning and filtering the ambiguous inferences are discussed in this manuscript that will be helpful in development of ontology for ontology engineering. This article is also emphasized to analyse Semantic Web technology that is enabled intelligent processing of information and knowledge management which are needed for aSPOCMS services.

ACKNOWLEDGEMENTS

I would like to acknowledge all researchers and academicians of the workflow management systems described in the paper. I am grateful to Springer and icSoftCom-2024 for giving the opportunity for this paper presentation and publication, which is providing the incitement of my ideas and research globally.

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