A SEMANTIC WEB-BASED APPROACH FOR ENHANCING ORAL HISTORY MANAGEMENT SYSTEMS

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Abstract*: Semantic web (SW) technologies have become one of the well-accepted tools for enhancing web application usages. However, the technology has been immature for the enhancement of knowledge management (KM) systems usages. This paper reports an investigation on current issues of a KM system, so-called Oral History Management Systems (OHMS) and benefits of SW over the issues. The study first conducts interviews to identify issues and benefits of the current applications in parallel to a literature survey that finds potential benefits and issues of SW technologies. The initial outcomes are then used to develop both frameworks of current OHMS and preferred SW based in order to compare for achieving the betterment of OHMS usages in the targeted problem context, specially for enhancing decision making provisions. In this paper, we summarize the entire research project highlighting not just a conceptual and theoretical issue, but also for the enhancement of practical usages of OHMS across the Universities in Malaysia.*

Keywords: *Semantic Web, knowledge management, records management systems.*

1. INTRODUCTION

Semantic web (SW) technologies have been a well-accepted tool for enhancing web application usages. Examples can be viewed in educational institutes (Cardoso, 2007) for developing a semantic course management system; and in law firms (Gliozzo et al., 2007) for enhancing their legacy system. However, there are limited studies on how the SW can be used to improve the practical usages through enhancing the capability of knowledge management (KM) system (In our case, an electronic document and records management systems- EDRMS is a type of KM system) for regular users. This study conducts an investigation on the current issues of the traditional OHMS in the Universiti Teknologi MARA, Malaysia. The aim is to improve overall OHMS application for users such as educators and students at both levels of postgraduate and undergraduate, specially to improve their searching and navigating abilities for quick decision making. With this aim, our study first empirically conducts interviews to identify issues and benefits of the current traditional applications in parallel to a theoretical analysis through literature survey that finds potential benefits and issues of SW technologies. The initial findings are then used to develop both frameworks of current OHMS and preferred SW based options, in order to compare for achieving the betterment of the traditional OHMS usages in the targeted problem context, specially for enhancing decision making provisions. The frameworks are based on taxonomy descriptions that demonstrate benefits and issues related to traditional OHMS and SW based approach. In this paper, we summarize the entire research project to

highlight not just conceptual and theoretical issues, but also for the enhancement of practical usages of OHMS across the Universities in Malaysia.

The key purpose here in this study is to improve the decision making abilities through the implementation of SW functionalities within the current OHMS platform. As mentioned the decision makers are the university educators and students who use OHMS as a tool for making decision regarding the person/figure (e.g. Celebrities in any domains) to be selected or interviewed as part of the fulfilment in the course works (undergraduate and post-graduate) mandated by the faculty. However, the traditional OHMS features demonstrate the limitations in many cases (Gustman et. al, 2002; Muhd Ashfee et al., 2009). For instance, the search process in the OHMS system is constructed on keywords-based searching that does not provide a full guide with options of directions and context sensitive meanings to the users, in order to achieve better results (Bates, 1977; Rabiyathul, basariya and Nisha, 2012). Most of the times, the keyword searching technique fails to bring expected outcomes due to mismatches with user's desires and the content of the database. In addition, user options of OHMS seem to be firm to navigate through the systems interface that result inadequate options for decision makers.

Thus, the specific research question is to be addressed: *How could Semantic Web-based solutions be used to improve the usages such as for decision support over traditional OHMS?* To address this, the study conducts an empirical investigation within the practical context to develop a new solution framework that could be implemented within the current organizational settings. The paper is organized as follows. The next section of the paper provides the study background of the targeted problems following by the research procedure. The paper then focuses on the frameworks that are developed from the findings of our case study and theoretical understanding from the literature survey. Finally, discussion and conclusion section provide the overall value of the study followed by the further research directions.

2. BACKGROUND

Knowledge management (KM) is a huge research area of the information systems discipline. The KM focuses on systematic and active management of data, information and knowledge residing in organisations for their users' decision making. The information systems technology that makes KM workable throughout an organisation are referred as KM systems (Park and Kim, 2006 ; Zhang and Zhao, 2006). Under this classification, an electronic document and records management systems- EDRMS can be grouped as a KM system that *"an automated system which supports the creation, use and maintenance of paper or electronic documents and records for the purposes of an organization's workflow and processes. An EDRMS includes record keeping functionality and also manages documents of informational rather than evidential value. The EDRMS includes, the whole of documents, records, methods, procedures, tools, [meta] data, (index terms), knowledge, means and persons with which an organization operates and fulfils its requirements to preserve evidence of its activities, maintain its memory, and preserve its knowledge"* (Johnston and Bowen (2005, p.133). However, a very limited number of studies identify issues of such system specially aiming at maximizing the benefits of users, across the university academic and student community, over the past. For example, Issues such as search-ability, navigability and data management are common in terms of the practical use of OHMS, but no particular study highlights these issues over the past. Our empirical study investigates issues associated with a current EDRMS (locally called OHMS) in the case context of educational institute.

There is an obvious requirement of an approach to information retrieval in terms of better search-ability, navigation-ability to improve decision support provisions that could offer significant benefits to decision makers who deal with electronic documents and records management. Such retrieval system for better information support may be used for many purposes as highlighted by Johnston and Bowen (2005). Typically, information retrieval with unstructured data is accomplished using keywords. Research has shown, however, that one of the major problems with information retrieval in this environment is its inability of searchers to translate their information needs into appropriate search terms or keywords (Bates, 1977; Rabiyathul basariya and Jannath Nisha, 2012). Among the various means of addressing current difficulties with Web-based environments are the systems that are based on the so-called 'Semantic Web' and ontologies (Van Harmelen et al., 2000; Joo and Lee, 2009; Rabiyathul basariya and Jannath Nisha, 2012). According to World Wide Web Consortium (W3C1), "Semantic Web technologies enable people to create data stores on the Web, build vocabularies, and write rules for handling data in more effective way. Linked data are empowered by technologies such as OWL. Over the traditional web technologies, semantic web systems enable complex and precise queries to be formulated and executed more than it is possible with traditional keyword-based approaches (Abrahams, 2006: Asiaee et al., 2011).

One of the examples of SW applications in the education domain identified by Cardoso (2007). Cardoso (2007) demonstrated the applicability and the benefits of using SW technologies, by developing a real-world application. The application is called a Semantic Course Management System (S-CMS) which entirely based on the semantic web that uses the latest technologies of this field such as Web Ontology Language (OWL), RDF Query Language (RQL), RDF Data Query Language (RDQL), Semantic Web Rule Language Combining OWL, and RuleML (SWRL). It is noted that the more expressive mark-up languages like SWRL allow developers to write application-specific declarative knowledge, and can improve the ontology and annotation richness of information on the SW. Miah (2010) utilized SW technologies for enhancing knowledge management in an application development context of e-government as the SW enables development of business systems that not only deliver information and services, but also help for better interpretation on meanings of information and services for the targeted users. The study by Miah (2010) argued about the use of OWL (OWL can be seen as a form of language that is used to develop tools and ontologies for particular user groups in company or business-specific application developments) provides effective user-oriented features to develop sustainable web-based application.

Domingue, Dzbor, and Motta (2004) explained ontology as "an explicit, declarative representation of a discourse. Ontologies are the cornerstone of the emerging semantic web. They provide conceptual interoperability, allow agents to 'understand' information on the web and to collaborate with other semantically aware agents" (pp. 191). In educational institutes, the application has been employed successfully to manage student enrolment to class project at University of Madeira. It shows that SW technologies can contribute to improve the process of managing course management system. Gliozzo et al. (2007) also developed the SW technologies to enhance legacy system. The study introduces a framework to add a semantic web layer to legacy organizational information. The finding shows that semantic web layer can enhance legacy system by providing an intelligent and collaborative front-end to the legacy systems. Drawing from the aforementioned ontology definitions towards vocabulary and meanings enhancement, in our study, a conceptual SW based framework will

1 The World Wide Web Consortium (W3C) is an international community where Member organizations, a full-time staff, and the public work together to develop Web standards. Led by Web inventor Tim Berners-Lee and CEO Jeffrey Jaffe, W3C's mission is to lead the Web to its full potential.

be an important indicator to improve the searchability of OHMS through the utilization of ontology based features.

The OHMS is currently being developed and implemented within the Faculty of Information Management, Universiti Teknologi MARA, Malaysia (Muhd Ashfee et al., 2009). It is developed on open source Web-based applications such as KOHA which allows access to and the sharing of oral history materials through the internet connectivity. The application facilitates the storage, organization, retrieval and dissemination of oral history documents to ensure their availability, accessibility and usability; and to allow access to and the sharing of oral history materials among a wider audience. However, OHMS has followed what might be described as a 'traditional' approach to KM development. There have been a few studies conducted on OHMS. Apart from focusing on its decision support functionalities development, many studies highlight the requirement for understanding, conceptualizing, and designing a database system (Gallacher and Treleven, 1988); improving bibliographic control and access to oral history interviews (Bruemmer, 1991); metadata model (Hunter and James, 2000); the creation, indexing and provision of access (Gustman et. al, 2002); and more recently on the provision of online access to oral history (Daniels, 2009). There, however, appears to be a significant development area to date that will enhance the benefits of decision makers using OHMS.

Our project differs from the previous work in that it identifies the decision support issues and benefits associated to the current OHMS. In this study, we aim to improve the system's dynamicity in terms of decision support for educators and students, by enabling better searching techniques which will be based on SW technologies such as ontology. The benefits of SW approaches also are to be explored through the literature review in order to develop a SW framework.

3. PROCEDURE OF THE RESEARCH

As mentioned the aim of this study is to improve current practice of traditional OHMS usage throughout new intervention using SW technology. With this aim, our study first empirically conducts interviews to identify issues and benefits of the current traditional applications. As part of a theoretical analysis, we have conducted literature survey and found 30 relevant articles that helped us identify potential benefits and issues of SW technologies in many aspects of application development in the broader knowledge area of KM. Then we develop frameworks of benefits and issues of current OHMS and preferred SW based in order to compare for achieving the value to the traditional OHMS usages in the targeted problem context. We develop a 4-phases procedure to conduct the research study. The following figure 1 shows the activities in the defined phases.

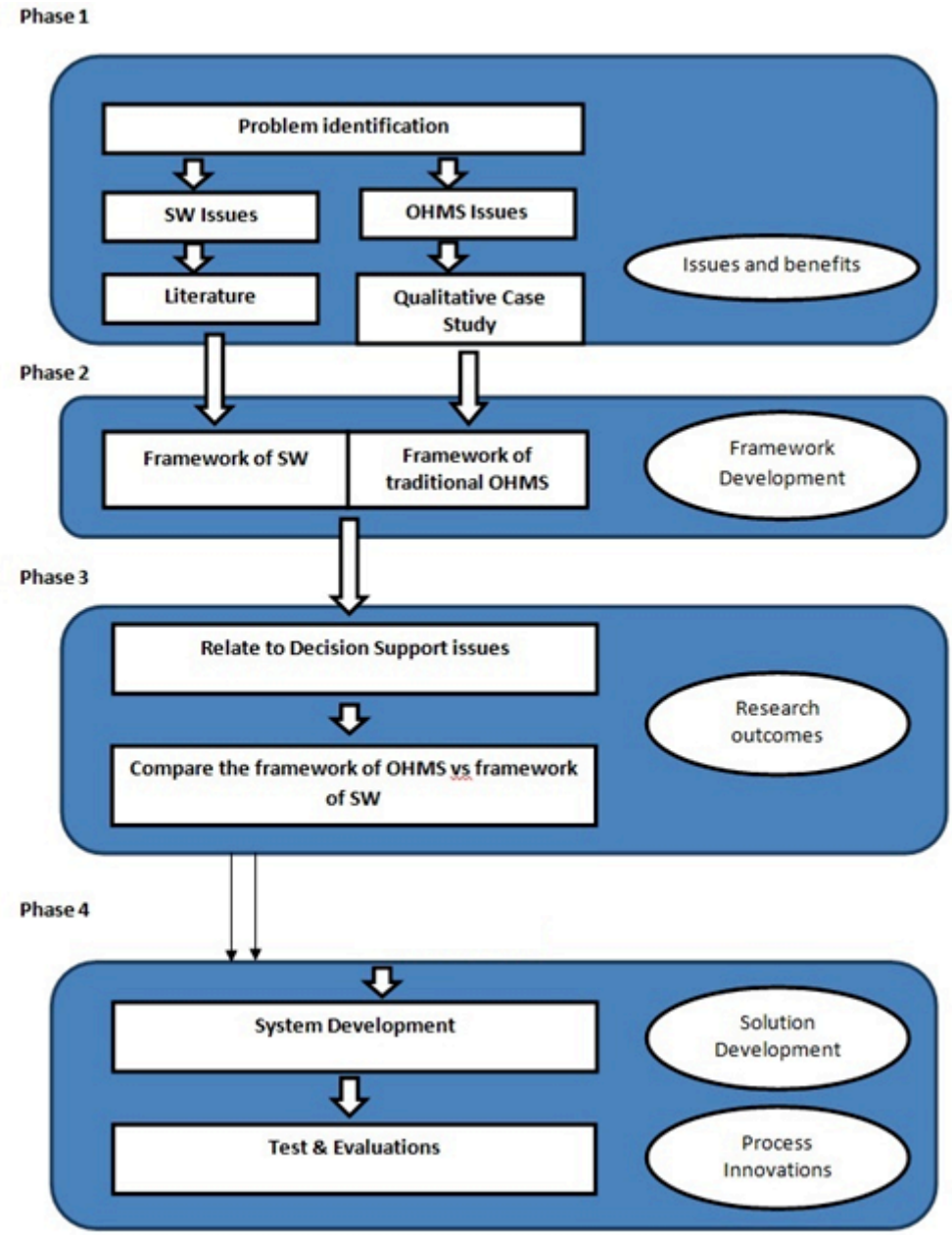

Figure 1: Research procedure adapted in this study

Phase 1 : Problem identification

This phase involved problems identification related to issues and benefits of traditional approaches and SW based approaches. A semi-structured interview (Gorman and Clayton, 1997) is adopted as the data collection approach. In term of selection of the participants, the non-probability sampling i.e. purposive sampling is used as it is appropriate. Purposive sampling is however chosen in view of a large number of the interested groups and will involve about 30 informants (5 developers and 25 users). According to NASA (1993), a system developer "incorporates the technical security specifications into an operational system". In this study, developers refers to the person involved in developing the system (OHMS). Rob and coronel (2002, p.20) stated that “end users are the people who use the application programs to run the organization daily operations”. In this study, end users refer to the educators and students of the Faculty of Information Management (Universiti

Teknologi MARA, Malaysia). The number of samples is reviewed during the research in order to ensure that it is as comprehensive as possible. The developers are included in this study is to get the feedback and overview on current decision support features from the technical perspectives. The issues and benefits of SW approaches are explored through the literature survey. In this case, the sources are based on published literature on potential benefits of SW in supporting features for enhanced decision making.

Phase 2 : Conceptual framework development

The second phase is involved framework development activity. In this phase, data collection and analysis are conducted to have clear understanding of issues and benefits of traditional approach and SW so a new solution can be developed. It is hightlighted that decision making aspects are important to look at in this study. This is due to this activity is very important in improving the learning activities in educational institutes. Enhancing the decision making ability of educators and students (in this context) will contribute to quick decision making. This will save the time and ensure the learning activities run smoothly. The frameworks are based on taxonomy descriptions in that it is developed according to a systematic and reliable process (e.g. protégé knowledge management method). In this study, two frameworks are developed for traditional approaches and SW approaches. For the traditional approaches, framework is developed from the findings of interview data. In this case, we used semi-structured interview. The interviews were then transcribed into MS Word documents, and analyzed according to Strauss and Corbin (1998) coding paradigm. To facilitate the analysis process, qualitative data analysis software called ATLAS.ti version 5.0 was used. Then, taxonomy structure of the framework is developed using Protégé software. For the SW approaches, framework is developed using literature survey on SW. In this case, we used content analysis as a method for data analysis. To facilitate the development of taxonomy structure, Protégé software was used. Table 1 and 2 shows the detail of taxonomy descriptions of the frameworks.

Phase 3 : Research outcomes

The third phase is research outcomes. The proposed framework is related to decision support options for the decision makers such as educators and students who use the system to assist them in the process of selecting the figure/celebrities to be interviewed in their studies. The idea in this phase is to compare both framework to focus of the key uses of SW over the traditional OHMS features. Ontology came into the use as a solution in this study in that it offers enhanced vocabulary, taxonomy and better representation of knowledge. It is also suggested that ontology can improve the database management issues such data redundancy (Iqbal, Ott and Senevirane, 2010). Furthermore, the proposed Semantic Web issues and benefits framework will be compared with the traditional approaches to develop the new solution approach which is currently in our research-in-progress.

Phase 4 : Future research

Due to time constrain and limitations, the fourth phase of this study which involve real system development and testing will be conducted as the future research. The further study is required for developing a proof-of-concept prototype to evaluate through potential users in an educational institute. In this phase, a solution prototype in which protégé II method (Gennari et al. 2003) will be used to construct comprehensive ontologies.

4. DEVELOPMENT OF FRAMEWORKS

Based on the above mentioned procedures, the study comes up with developing two frameworks of SW and traditional OHMS to indicate the benefits and issues so it can easily be compared. The frameworks will be based on the taxonomy descriptions to show categories and sub-categories of the entitled benefits and issues. Taxonomy descriptions as a part of ontology are useful to compare easily through the options in classifications in relation to decision making features. It can be seen through the SW based approach that offered ontology for enhanced vocabulary and meaning so the decision makers can quickly find the relevant information about their targeted celebrities. The following table 1 and 2 include detail of frameworks based on the findings as discussed previously.

Traditional Approach Benefits	SW Approach Benefits
Searching • Improve searching effectiveness • Improve searching precision • Facilitate access to OH collection • Facilitate searching of information • Facilitate storage and retrieval of information	**Searching** (Bonino et al. (2004); Chen et al. (2006); Happel and Seedorf (2006); Bose and Sugumaran (2007); Cardoso (**2007**); Urs and Angrosh (2007); Joo and Lee (2009); Rios-Alvarado, Ramírez and Marcelín-Jiménez (2009); Toledo et al. (2011); Blomqvist (2012); Figueiredo, Dos Reis and Rodrigues (2012); Vandic, Dam, and Frasincar (2012) • Enhance the performance • Effectiveness • Improve access • Improve searching ability • Improve reasoning • Precision • Provide SW vocabularies for expressing metadata • Uniform semantic meaning
Navigating • Facilitate decision making • User friendliness • Improve flexibility of working environment	**Navigating** Domingue, Dzbor and Motta (2004); Chen et al. (2006);Bose and Sugumaran (2007); Castro et al. (2007); Blomqvist (2012); Figueiredo, Dos Reis and Rodrigues (2012). • Improve browsing ability • Linking • Supporting browsing and navigation • Uniform semantic meaning
Knowledge Management • Capturing knowledge • Distribution of information • Facilitate knowledge sharing & dissemination • Historical information • Knowledge capture • Knowledge sharing • Document management	**Knowledge Management** Euzenat (2002); Sriti et al. (2006); Uren et al. (2006); Joo and Lee (2009); Miah (2010); Varlan (2010); Toledo et al. (2011) • Improve KM • Knowledge representation • Semantic annotation

• Facilitate the Oral History Documents Management • Source of reference for decision making	
Database Management • Avoid redundancy	**Database Management** Lausen et al. (2005); Chen et al. (2006); Happel and Seedorf (2006); Bose and Sugumaran (2007); Cardoso (2007); Joo and Lee (2009);Iqbal, Ott and Seneviratne (2010); Blomqvist (2012) • Data integration • Data Extraction • Improve information consistency • Improve Information processing quality • Reduce data redundancy • Simplifies interoperability
Others • Preservation • Preservation of information	**Others** Content management (Happel and Seedorf (2006). • Improve usability • Improve reliability • Improve scalability

Table 1: Traditional approach benefits vs SW approach benefits

Traditional Approach Problems	SW Approach Problems
Searching • Effectiveness • Precision	**Searching** (Benjamins et al. (2002); Euzenat (2002) • Availability • Enhanced meanings • Interoperability between ontologies • Reasoning • Visualization • Vocabularies
Navigating • Browsing • User interface • User Friendliness • Flexibility of web environment • Language	**Navigating** (Benjamins et al. 2002; Heath, Dzbor and Motta 2005) • User interface • User friendliness • Multilinguality • Personalization
Knowledge Management • Data integration • Representation • Abstract • Description of collection • Description of figure	**Knowledge Management** (Euzenat 2002; Uren et al. 2006) • Lack of access control • Semantic annotation
Database Management • Data quality • Data redundancy • Display • Maintenance • System feedback • System performance • User guide	**Database Management** **(**Euzenat 2002; Blomqvist 2012) • Efficiency • Data visualization • Interoperability
Others Content • Updating issues • Scope (e.g more content needed)	**Others** Content **(**Benjamins et al. (2002); Blomqvist (2012) • Availability • Scalability • Optimization **(**Blomqvist (2012) • Immaturity • Scalability

Table 2: Traditional Approach issues vs SW Approach issues

As mentioned previously, the aim was to improve overall OHMS application by employing appropriate features of decision support for the users such as educators and students at both levels of postgraduate and undergraduate. The above table shows SW features that are promising to enhance searching & navigating abilities for quick decision making, comparing to the current features of traditional OHMS. At the same time, in term of database and KM, ontology as one of the SW technologies provide options of data integration, data extraction, improved records consistency, reduced data redundancy; improved knowledge representation and semantic annotation. There are some features of SW based approaches that are identified for the other service improvement such as enhancement of the data or record security which will be out of the scope of improving decision suport-ability of this study.

5. DISCUSSION AND CONCLUSIONS

The paper reported initial findings of a doctoral study in the area of knowledge management research in information systems discipline. In this paper, we described the research methodology that is adapted to produce new knowledge in the body of the research area. The new knowledge is about an enhancement of KM system usages for educational users for their effective records management. In this instance, the study focused on innovation of OHMS through identifying issues and how to address them using the SW technologies representing a association between both benefit and issues frameworks of SW and traditional OHMS. The comparision helped find useful features to solution development within the targeted context of use (Universiti Teknologi MARA). As mentioned previously, the aim was to improve overall OHMS application for the users such as educators and students at both levels of postgraduate and undergraduate, specially to enhance their searching abilities for quick decision making. It can be argued that the entire research procedure thus focused on the enhancement of practical usages of OHMS across the Universities in Malaysia.

The study first conducted interviews to identify issues and benefits of the current applications. To identify and analyze the current issues of usage we interviewed developers, educators and students using guidelines of a case study research approach by Yin and Davis (2007). In parallel, our theoretical analysis helped us find the potential benefits of using SW technologies to enhance system's features. The initial outcomes are then used to develop both frameworks of current OHMS and SW based in order to compare for achieving the betterment of OHMS usages in the targeted problem context of the university and in the case of comparison we used the only scale of decision support provisions. It was done to have our scope well-defined for the study timeframe of the doctoral research. For instance, we looked at how to address the identified issues of the traditional systems (such as searchability, navigability, KM and database management issues) through the use of SW for better decision support-ability. In this case we adapted significant development by Joo and Lee (2009) to address the identified issues that have been made in this study that will be used for the solution approach development which is now underway.

The ontology has been the vital features of SW to address decision support issues. The problems are addressed through the solution framework with an ontology based provision in which ontology editor holds ontology and query language to represent semantic meaning of records. It offers enhanced taxonomy to guide the user in the searching process by giving the idea what is the information contain in the database through ontology. It reduces the time taken by the user to search for the information so that the decision could be made quickly. At the same time, by using ontology, it can improve precision and relevancy of searching output. Our view similar to Domingue, Dzbor, and Motta (2004) view that uses ontologies to associate meaning with the information found on a web page. Based on the identified

meanings, relevant services can be invoked, or value-added functionalities offered to the user. We haven't supplemented the technical details of the proposed solution in this paper. However, we identified technical framework as well as the use of case study as method to conduct the study. It is argued that the recognition of the limitations of keyword-based information system could reinforce the needs to use better technological approach. Based on the discussion throughout, the study can have contribution to the body of knowledge in the KM field.

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