An Organizational Memory and Knowledge System (OMKS): Building Modern Decision Support Systems

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Abstract

Many organizations employ data warehouses and knowledge management systems for decision support activities and management of organizational knowledge. The integration of decision support systems and knowledge management systems has been found to provide benefits. In this paper, we present an approach for building modern decision support systems that integrates the data warehouses and organizational memory information systems processes to support enterprise decision making. This approach includes the use of Scenarios for capturing tacit knowledge and ontology for organizing the diverse data and knowledge sources, as well as presenting common understanding of concepts among the organizational members. The proposed approach, which we call Organizational Memory and Knowledge System approach, is expected to enhance organizational decision-making and organizational learning.

Keywords: DSS, Decision Support Systems, Decision Making, Tacit Knowledge, Organizational Learning, Organizational Memory, Knowledge Management, Data Warehousing, Ontology, Scenarios, Metadata

1. INTRODUCTION

Individuals in organizations have to make on-going decisions. In view of the complexities of decision-making, organizations provide Decision Support Systems (DSS) to enhance the decision making process. Hence, DSS are critical in the daily operations of organizations.

Data warehousing has become an integral component of modern DSS.The data warehousing infrastructure enables businesses to extract, cleanse, and store vast amounts of corporate data from operational systems which, when queried, can provide answers to the questions posed by decision makers. On-Line Analytical Processing (OLAP) is used heavily by Data Warehouses to make aggregate queries to answer domain specific questions. In addition, OLAP, data mining, and other knowledge discovery techniques are used to establish relationships existing in the data that reside in the warehouse repository. These relationships are used to create, access and reuse knowledge that supports decision-making[HYPERLINK \l "DOL98" 1].

Modern DSS require that various types of knowledge are captured and used in decision-making2]. More so, the importance of tacit knowledge in the knowledge management domain has received great attention [HYPERLINK \l "Bus00" 3]. Tacit knowledge is valuable organizational knowledge, whichresides in the minds of individuals. These persons build up their knowledge by working on the job over extended periods of time. The organization is limited in its ability to leverage this expertise as much as this knowledge remains personal to the individual.

Repeated studies have documented that tacit knowledge can be articulated, captured, and represented 4], [HYPERLINK \l "Gra97" 5], 6], [HYPERLINK \l "Rag96" 7], 8], [HYPERLINK \l "Gol90" 9], 10]. However, the traditional data warehouse does not possess capabilities to acquire, store, and use tacit knowledge[HYPERLINK \l "Bus00" 3], 11], [HYPERLINK \l "YuN99" 12].Researchers have indicated that integrating knowledge processes and decision processes would enhance decision-making13][HYPERLINK \l "Nem02" 11].

In this paper, we present an approach for modern decision support systems that combine features of data warehouses and organizational memory information systems to form an Organizational Memory and Knowledge System (OMKS) that supports enterprise decision-making.This approach includes capturing tacit knowledge and uses ontology as the metadata for organizing the diverse data and knowledge sources, as well as presenting common understanding of concepts among the organization'smembers. This approach is expected to enhance organizational decision-making and organizational learning. Other benefits of integrated decision support system such as a data warehouse and an organizational memory information system include real-time adaptive decision support, support of knowledge management activities, facilitation of knowledge discovery and efficient ways of building organizational memory 13]. We discuss the theoretical foundation for the approach and explain how it meets the requirements for the foundational data warehouse architecture and organizational memory information systems.
The organization of the paper is as follows. In section 2, we review the decision making process, data warehousing,Organizational Memory Information Systems (OMIS), and the knowledge conversion processes. Following, we present and describe our proposed approach of modern DSS that integrates functional features of data warehousing and OMIS. This is done using Scenarios to facilitate the acquisition, storage, use and sharing of tacit knowledge and Ontology for metadata specifications. In Section 4 we discuss the implication of this novel approach for practice and research. Finally, we conclude the paper with suggested future research directions.

2. THEORETICAL BACKGROUND

We draw on several theoretical foundations in proposing the approach for building modern decision support systems. In the following, we present the diverse theoretical foundations that include the decision-making and decision support systems, data warehouse, organizational memory information systems, integrated process management, and the knowledge spiral.

2.1 Decision Making and Decision Support Systems

The works of Gorry and Scott Morton [HYPERLINK \l "Gor71" 14], 15],[HYPERLINK \l "Bon81" 16],17],[HYPERLINK \l "Spr82" 18], define the conceptual and theoretical foundations of decision support systems (DSS). Coined by Gorry and Scott Morton 15], decision support systems are motivated by decision making, as opposed to systems supporting problem or opportunity identification, intelligence gathering, performance monitoring, communications, and other activities supporting organizational or individual performance. Using Simon's [HYPERLINK \l "Sim55" 19]classical four phases of the decision-making process (intelligence, design, choice, and implementation and control), a typical DSS concentrates on the design and choice phases20].

Modern DSS are, however, called to support all the phases of decision-making process [HYPERLINK \l "Bol02" 13]. Data Warehouses, Knowledge Management Systems, and Organizational Memory Information Systems are forms of DSS that help decision makers in the decision making process. Recently these systems have received greater attention.

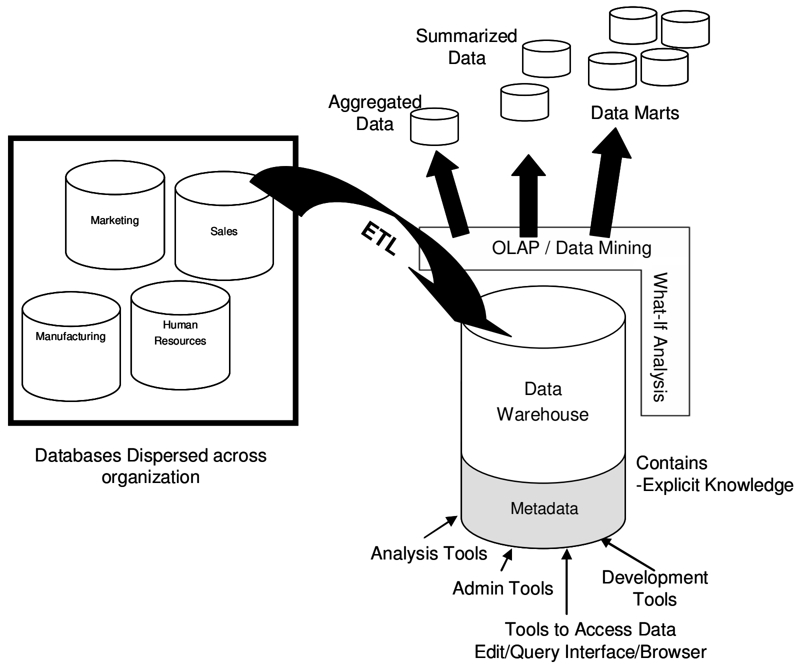

FIGURE 1 : Typical Data Warehouse

2.2 Data Warehousing

Bill Inmon 21]defines Data Warehousing as "… a subject-oriented, integrated, time-variant, and non volatile collection of data in support of management's decision-making process" (p. 1).As can be seen in Figure 1, Extraction, Transformation, and Loading (ETL) tools are used to extract transactional data from diverse sources and transform and load these datainto the warehouse repository. OLAP tools are then used to aggregate data to answer queries. Data mining and other knowledge discovery tools are used to establish relationships that have not been specified in the data sources. These relationships are used to create knowledgeto support decision-making.

A critical element of the data warehouse architecture is metadata management. Metadata defines a consistent description of the data types coming from the different data sources. It provides comprehensive information such as the data sources, definitions of the data warehouse schema, dimensional hierarchies, and user profiles. A metadata repository is used to manage and store all of the metadata associated with the warehouse.Also, the repository allows the sharing of metadata among tools and processes for the design, use, operation, and administration of a warehouse [HYPERLINK \l "Sta99" 22].

2.3 Knowledge Management and the Knowledge Spiral 23]

Knowledge Management

The field ofKnowledge Management continues to grow and stems from the realization that an organization cannot afford to lose knowledge as individuals leave. Knowledge management is not a product or solution that can be bought or sold; it is a process that is implemented over time [HYPERLINK \l "Ben98" 24],

Knowledge comes in two forms: explicit and tacit 25]. Explicit knowledge is systematic and can be expressed formally as language, rules, objects, symbols, or equations. Thus, explicit knowledge is communicable as mathematical models, universal principles, or written procedures[HYPERLINK \l "Nem02" 11].

Tacit knowledge includes the beliefs, perspectives, and mental models ingrained in a person's mind. This type of knowledge is hard to transfer or verbalize because it cannot be broken down into specific rules.

However, many authors have purported that this type of knowledge can be articulated, captured, and represented 4], [HYPERLINK \l "Gra97" 5], 6], [HYPERLINK \l "Rag96" 7],8], [HYPERLINK \l "Pyl81" 10].

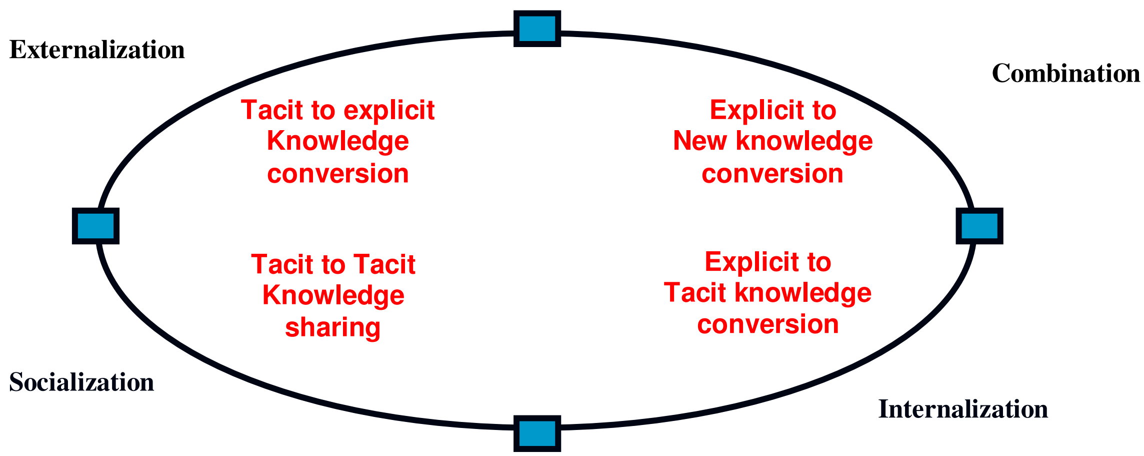

FIGURE 2 : The Knowledge Spiral 23])

Nonaka and Takeuchi [HYPERLINK \l "Non95" 23] assert that new knowledge is created through the synergistic relationship and interplay between tacit and explicit knowledge. This concept, depicted with the Knowledge Spiral (Figure 2), has four spokes: (1) Externalization (conversion of tacit knowledge to explicit knowledge), (2) Socialization (sharing tacit knowledge); (3) Combination (conversion of explicit knowledge to new knowledge); and (4) Internalization (learning new knowledge and conversion of explicit knowledge to tacit knowledge).

The Knowledge Spiral
Externalization involves the conversion of tacit knowledge to explicit knowledge. It allows the explicit specification of tacit knowledge. Socialization is sharing tacit knowledge, i.e. an employee shares their tacit knowledge with other employees during social meetings. Combination is the knowledge conversion step where explicit knowledge is converted to new knowledge. New knowledge is learnt during the Internalization stage. In this process, explicit knowledge is converted to implicit (tacit) knowledge.

2.4 Organizational Memory Information Systems
It has been discussed that an Organizational Memory Information Systems (OMIS) architecture can be more effective in assisting in decision support because it additionally fully supports organizational learning26], [HYPERLINK \l "Lia03" 27].An OMIS is an integrated knowledge based information system with culture, history, business process, and human memory attributes28].

An OMIS is expected to bring knowledge from the past to bear on future activities that would enhanceorganizational responsiveness and effectiveness[HYPERLINK \l "Ste95" 29]. Walsh and Ungson30] proposed that organizational memory occurs in five retention facilities: individuals, culture, structures, transformations (processes such as production and personnel lifecycles), ecology (the physical setting of a workplace), and structures (the roles to which individuals are assigned).

Atwood [HYPERLINK \l "Atw02" 31] presents applications of OMIS in various domains including corporate environments and governmental settings. Hackbarth proposes that direct activities related to

experiences and observations must be stored by an OMIS in a suitable format to match individual cognitive orientations and value systems. These activities refer to decision making, organizing, leading, designing, controlling, communicating, planning, motivating, and other management processes.
Heijst, Spek, and Kruizinga 32] suggest that OMISfacilitates organizational learning in three ways: individual learning, learning through direct communication, and learning using a knowledge repository.

Atwood [HYPERLINK \l "Atw02" 31] suggests three challenges facing OMIS. These challenges include managing informal as well as formal knowledge, motivating knowledge works to generate (for submittal into an OMIS) and using the knowledge in the system, and systems development practices. Having a process view of the knowledge management and data warehouse design, deployment and use can address those challenges. For instance organizations should be cognizant of the processes that the codified knowledge supports as the knowledge has a high tendency to lose its process perspective when stored in the knowledge storage in the OMKS. Similarly, it is critical that both knowledge and its context are captured in the OMKS because information and knowledge are useful only when the context of that knowledge is known.

2.5 Integrated Process Management: Integrating Data Warehousing and Organizational Memory Systems

This research follows the integration process management (IPM) approach prescribed in Choi, Song, Park, and Park 33]. IPM seeks to “provide the theories, techniques, and methodologies to integrate processes and to support design, analysis, automation and management of process knowledge”(p. 86).

The applicability of the IPM to the integration of data warehouse and Organizational memory systems is that both have been characterized as processes [HYPERLINK \l "Cho04" 34], 2]. In fact, knowledge management is considered as a business process [HYPERLINK \l "Ros01" 35].

A process view of knowledge dictates that knowledge management systems and for that matter organizational memory systems take particular focus on the processes that deal with the creation, the sharing, and the distribution of knowledge. Bolloju et al. 13] also claim that knowledge management and decision support are interdependent and propose an approach for integrating those processes for building modern decision support systems.

We contribute to the discussions on building effective modern decision support systems. While we argue for integration of the data warehouse and organizational memory processes, we use a different approach. We propose the use of scenarios to capture tacit knowledge and ontology to standardize the data and knowledge in the knowledge systems developed to support decision-making and for facilitating the sharing of knowledge across the organization.

3. PROPOSED APPROACH FOR MODERN DECISION SUPPORT SYSTEMS

Data warehouses and OMIS support decision making in organizations. We propose the integration of functional features of data warehousing and organizational memory information systems to produce modern DSS that provide more effective support to decision makers and enhance organization learning. To enable this integration, we present an approach that involves the use of Scenarios [HYPERLINK \l "YuN00" 36] to assist in the acquisition of tacit knowledge from workers in the organization and the use of ontology-based metadata. The approach also incorporates ideas of 23]knowledge conversion process in their Knowledge Spiral. Knowledge has been recognized as animportant critical component of the knowledge management process and modern DSS by otherresearchers (e.g., [HYPERLINK \l "Bol02" 13], 11]). Our proposed approach describes: (1) data and knowledge acquisition processes including the use of Scenarios, (2) ontology-based metadata development and maintenance, and (3) knowledge conversion processes. The remainder of this sectionprovides a detailed description of the components and dynamics in the OMKS approach depicted inFigure 3.

3.1 Data and Knowledge Acquisition Processes

One of the functional benefits of our approach is the accommodation of diverse knowledge sources: explicit knowledge from organizational databases and tacit knowledge from individual decision makers in the organization (see Figure 3). The traditional data warehouse architecture sources it information and data from transactional processing systems. Thus data and knowledge are formally captured and stored in databases, the Internet and transactional data and informally in interpersonal networks, informal common references, and discourse in professional communities that are relevant for decision-making [HYPERLINK \l "Nem02" 11]. ETL tools and other data acquisition modules used in the data warehousing environments would be used in the extraction, transformation, and loading of the data from these diverse sources into the OMKS.

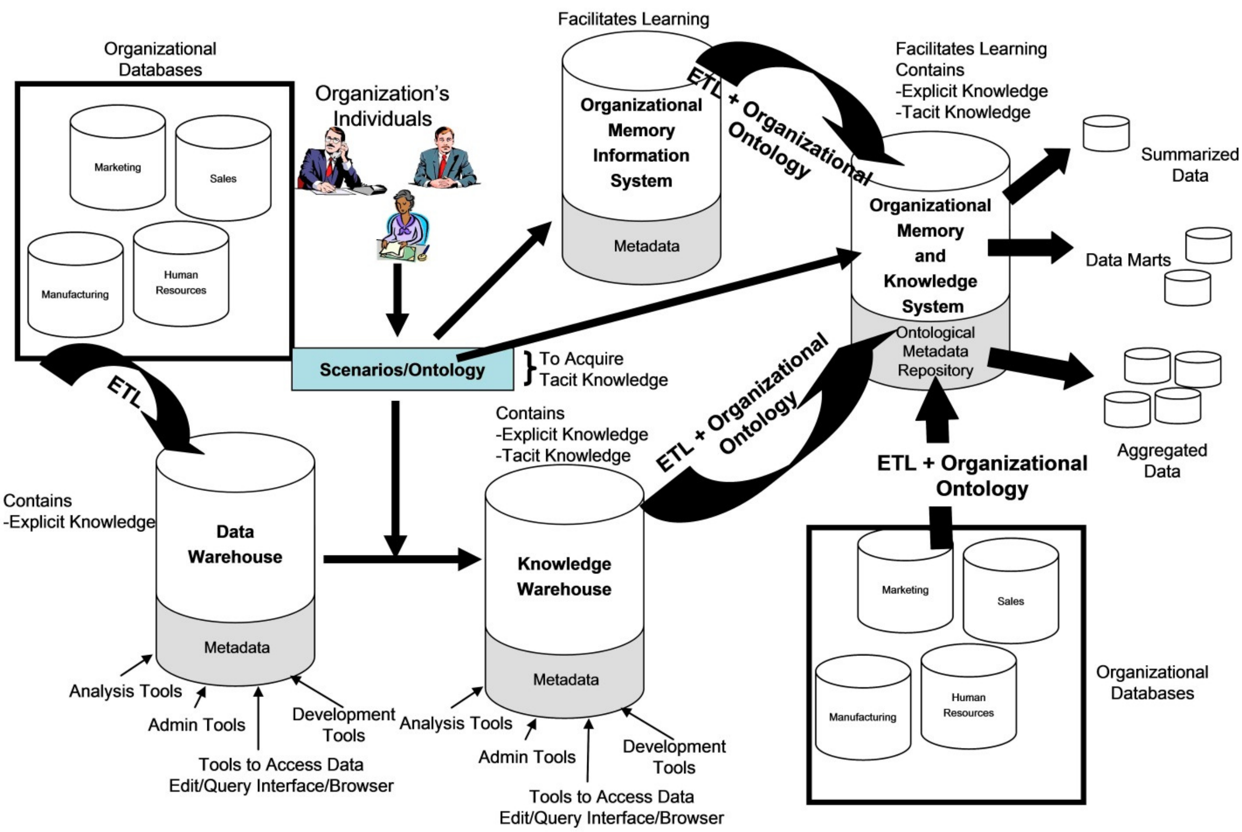

Figure 3 Organizational Memory and Knowledge System

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Knowledge workers in the organization would be involved with the acquisition of data and information and the assessment of the validity of such data for their suitability as knowledge models for supporting decision making.

OLAP and other knowledge discovery tools would be employed to create data and knowledge models. In addition, tacit knowledge would be captured into the OMKS using Scenarios and ontology. The capture of such knowledge and its conversion in the OMKS is elaborated in a subsequent section. Thus, one issue that needs critical attention, and is therefore discussed later in this paper, is that unlike the data warehousing environment, the OMKS requires an ontology-based metadata for the management of the metadata that are associated with the diverse data and knowledge sources.
Scenarios and Tacit Knowledge Acquisition

Scenarios
A scenario, as described by Yu-N and Abidi **36]**, is a customized, goal-oriented narration or description of a situation, with mention of actors, events, outputs, and environmental parameters. Similarly, a scenario

can be considered an ordered set of interactions between partners, usuallybetween a system and a set of actors external to the system for generating some output.

Tacit knowledge acquisition using Scenarios

Yu-N and Abidi [HYPERLINK \l "YuN001" 37] use ontology with Scenarios to standardize how tacit knowledge is acquired from multiple healthcare practitioners. Scenarios have also been used in other information technology areas such as: human-computer interaction, software requirements engineering and system requirements38]. In each case, Scenarios are useful for capturing tacit knowledge from experts about some business activities or processes.

By placing domain experts into contextual and realistic situations, Scenarioscan capture tacit knowledge from these employees. Scenarios are typically custom designed to reflect atypical problems[HYPERLINK \l "YuN00" 36] and Scenarios can be used to play out what-if situations 39]. This facilitates the capture intentions of domain experts in response to atypical situations [HYPERLINK \l "YuN001" 37]. This is useful because the instinctive aspects of tacit knowledge are best captured while domain experts are actively using their mental models to solve realistic problems. Scenarios enable domain experts to reflect on potential occurrences, opportunities, or risks and therefore facilitate the detection of capable solutions and reactions to cope with the corresponding situations and provide an outlook on future activities 40]. Domain experts are presented with hypothetical or atypical situations in their domains, which allows for the acquisition of tacit knowledge by recording the expert's problem-solving responses. As such, scenario components aim at addressing concrete business situations and make intelligent use of them, in order to drive and reason about decisions without having to expend valuable resources in true trial-and-error ventures [HYPERLINK \l "Kav96" 41]. A further benefit is that they can formalize possible organizational goals held within domain experts' tacit knowledge 41].

Yu-N and Abidi [HYPERLINK \l "YuN00" 36] explain why using Scenarios is a viable method to capture tacit knowledge. The authors' strategy is ground in the assumption that domain experts' knowledge can best be explicated by provoking them to solve typical problems. This is done by repetitively giving domain experts hypothetical scenarios that pertain to typical/novel problems. Then, the domain experts are observed and their tacit knowledge-based problem-solving methodology and procedures are analyzed. As Yu-N and Abidi (p. 2) state, "…the proposed problem-specific scenario presents domain experts the implicit opportunity to introspect their expertise and knowledge in order to address the given problem, to explore their 'mental models' pertaining to the problem situation and solution, and finally to apply their skills and intuitive decision making capabilities. This sequence, allows tacit knowledge to be 'challenged', explicated, captured and finally to be stored."

Ontology and Scenarios

Benjamins et al. 24] describe ontology as a common and shared understanding of some domain that is capable of being communicated across people and systems. Ontologies are applicable to many domains. For instance, van Elst and Abecker [HYPERLINK \l "van02" 42] indicate that ontologies have been used in areas such as agent based computations, distributed information systems, expert systems, and knowledge management. Further, van Elst and Abecker succinctly cite the benefits of using ontologies as "… the major purpose of ontologies is to enable communication and knowledge reuse between different actors interested in the same, shared domain of discourse by finding an explicit agreement on common ontological commitments which basically means having the same understanding of a shared vocabulary…" (p. 357).

Yu-N and Abidi 37] argue that ontology can be used to enforce standardization given that tacit knowledge is deemed to be hierarchical in structure and personal in nature. They also suggest that ontologies hold great potential in facilitating the acquisition of tacit knowledge through the use of Scenarios. In the scenario-based infrastructure, ontologies are used as a means to achieve a defined taxonomy of knowledge items and a standard (conceptual) vocabulary for defining Scenarios to achieve knowledge standardization. In this environment, ontology refers to a specification of a conceptualization that aims to describe concepts and the relationships between entities that share knowledge. The flow of events and structure suggested by the scenario also assist in providing a basis for tacit knowledge capture, which is congruent with the taxonomical nature of ontology [HYPERLINK \l "Gli00" 43].

3.2 Ontology-based Metadata

Metadata design and management is an important process in the OMKS. In the traditional data warehouse environment, metadata may reside in various sources and need to be integrated to ensure consistency and uniform access of data. In the proposed integrated approach, the ontology serves as the global metadata for managing the definition of the data warehousing schema and schema from other data and knowledge sources. Traditionally, different experts, even within a single domain, use different formats in their communications. Issues of data heterogeneity and semantic heterogeneity need to be addressed with respect to the OMKS. Data heterogeneity refers to differences among local definitions, such as attribute types, formats, or precision; and semantic heterogeneity describes the differences or similarities in the meaning of local data. It is noted that two schema elements in two local data sources can have the same intended meaning but different names or two schema elements in two data sources might be named identically, while their intended meanings are incompatible. Hence, these discrepancies need to be addressed during schema integration 44].

While schemas (used in the databases and data warehousing) are mainly concerned with organizing data, ontologies are concerned with the understanding of the members of the community, which helps to reduce ambiguity in communication.Hakimpour and Geppert[HYPERLINK \l "Hak01" 44] present an approach that uses formal ontologies to derive global schemas. Ontologies pertaining to local schemas are checked for similarities. Knowledge about data semantics is then used to resolve semantic heterogeneity in the global schema. Hence, formal ontology can help solve heterogeneity problems.

Several studies in Organizational Memory Information System have used ontology 27], [HYPERLINK \l "She03" 45], 26].Additionally, van Elst and Abecker [HYPERLINK \l "van02" 42] provide a framework for organizational memory technology to support vertical and horizontal scalability. This framework provides means of understanding the issues of integrating organizational memories in distributed environments. The ontology-based metadata specifies validated sets of vocabulary that is consistent among the diverse sources and maintained by the organization's knowledge worker. New vocabulary from new knowledge is used to modify the systems and is communicated among the organization's workers. Each piece of data, information or knowledge has its own data source. As all these sources are captured into the integrated system, inconsistencies may occur. The ontology-based metadata therefore represents a common global metadata that manages all the other metadata associated with the diverse data, information and knowledge sources and also provides explicit semantics. Ittherefore presents a source–independence vocabulary for the domain that the OMKS supports. The ontology-based metadata also facilitates the sharing of metadata among the diverse decision technologies or tools that are present in the OMKS and other processes for the design, use, and administration of the OMKS. It has been recognized that ontology-based metadata enhances organizational members' accessibility to domain knowledge 1].

The Organizational Ontology module should interface with the Data and Knowledge Extraction/Acquisition modules (See Figure 2). The knowledge to be stored in the OMKS must be formally represented and "is based on a conceptualization: the objects, concepts, and other entities that are assumed to exist is some area of interest and the relationships that hold among them" ([HYPERLINK \l "Gen87" 46] qtd. In 47], p. 1). This conceptualization represents the real world and is an abstract and simplified view. The ontology forces the explicit specification of this conceptualization and ensures that information is stored consistently in the OMKS. Given that schema definitions are based on ontology definitions, and vice versa, a symbiotic relationship is constructed between the two.

Knowledge Conversion Activities in Organization Memory and Knowledge System

We have discussed how Scenarios can be used to capture tacit knowledge into the OMKS. This knowledge needs to be made explicit in the system and used to enhance organizational learning and improve the organizational decision through Nonaka's knowledge conversion model. Hence tacit knowledge held in the human mind, and within the shared community/professional memory, will also be managed in the OMKS.

3.3 Knowledge Sources

A knowledge base will store all the different knowledge that are generated by the OLAP and knowledge discovery tools as well as the tacit knowledge that is captured and represented in the OMKS. These knowledge structures serve as sources for enhancing organizational learning and as a basis for enhancing the performance of the ontology-based metadata. New knowledge from these knowledge bases will be used to modify or change the vocabulary and other properties of the metadata. Not only will new knowledge support organizational decision-making, it will also enhance organizational learning because previously learnt knowledge may be modified by the new knowledge. In the following we describe how OMKS supports the knowledge conversion cycle.

Externalization

The Scenarios facilitates the tacit knowledge acquisition from experts from diverse disciplines within the organization. It also enables standardization of the knowledge process that is performed [HYPERLINK \l "YuN00" 36]. Not only does Scenarios capture the instincts of domain experts, they offer an ease of communication and understanding by allowing the domain experts to react from within their own frames of reference and points of view. A scenario is a rich tool, which provides valuable information based on experimenting-in-action on practical cases. Domain experts are able to reason against their experiential knowledge in what is ultimately a sterile environment.

The OMKS can enhance tacit to explicit knowledge by using mathematical models. The knowledge worker can produce mathematical models that reflect tacit knowledge that has been built up over many years. Such models can be stored as explicit mathematical inequalities, as graphs of arc descriptions, or as a canonical model formulation with links to relational tables in the DSS 11]. Brainstorming also provides a potential medium for tacit to explicit knowledge conversion. Output from the brainstorming sessions can be captured into the OMKS and shared among decision makers.

Socialization

The Ontology is a common vocabulary for communication among the organization's employees. The shared understanding then serves as the basis for expressing knowledge contents and for sharing and managing knowledge in the organization. It creates a community of individuals that are likely to embrace collaboration using common knowledge that they share. Further, the sharing of tacit knowledge can happen using tasks such as digitized filming of physical demonstrations[HYPERLINK \l "Nem02" 11]. These digitized films are stored for viewing at anytime by anyone in the organization. The films may also include verbal explanations that explain the process. Kinematics, a form of artificial intelligence, can also be used where an individual is suited with probes and a system records the movements of the person. Busch and Richards 3] indicate that people tend to be reliant on electronic and formal information impeding sharing of knowledge through socialization. The Knowledge Management literature suggests that sharing of tacit knowledge through socialization is effective in small groups [HYPERLINK \l "von00" 48].

Combination

The Ontology reconfigures the explicit knowledge in the OMKS. Through the daily interaction with the OMKS, employees perform their duties using the explicit knowledge that has been captured from diverse knowledge and data sources. Further, Text mining tools (AI-based data mining) on the output from the brainstorming sessions is a representation of this step 49][HYPERLINK \l "Kup95" 50]. This provides key words and extracts the appropriate statistical information in a textual document. A set of rules and guidelines are part of the input to the tool for it to appropriately mine the data. The new knowledge are fed into the OMKS to create, delete or modify existing knowledge in the Ontology's metadata which is distributed among the diverse knowledge to revising metadata that exists in these knowledge sources. This then creates opportunity for the organization's members to revise their understanding of some of the processes and activities that support decision-making.

Internalization

As members of the community gain better understanding of how they can improve their work activities through the shared knowledge from the OMKS, they gain new tacit knowledge about their work.New knowledge is learnt during the Internalization stage. Explicit knowledge is converted to implicit knowledge.

Explicit to implicit knowledge conversion occurs with a modification of a knowledge worker's internal mental model. This modification can occur after discovering new relationships. The OMKS becomes support systems as the knowledge workers validate the new knowledge that has been created.

4. DISCUSSION

In this paper, we have looked at how knowledge management systems such as Data Warehouses can be integrated with organizational memory systems to provide enhanced services in the decision-making environments. Knowledge management technologies are expected to create innovation by supporting the following activities: externalization, internalization, intermediation and cognition 51]. According to the author, Externalization is the process of capturing knowledge repositories and matching them to other knowledge repositories. Internalization seeks to match bodies of knowledge to a particular user's need to know (transfer of explicit knowledge). Intermediation matches the knowledge seeker with knowledge by focusing on tacit knowledge or experience level in the organization. Cognition is the function of business systems to make decisions based on available knowledge by matching knowledge with firm processes. Clearly, three of these activities are directly related to the knowledge spiral that the OMKS seeks to support.

Marakas[HYPERLINK \l "Mar03" 52] identified over 30 different design and construction approaches to decision support methods and systems. Of these many different approaches, none have been considered the best. Most of the DSS development processes are very distinct and project specific. There has been proposed DSS methodologies, such as: 53], [HYPERLINK \l "Mar82" 54], 18], and [HYPERLINK \l "Bla79" 55]; cycles, such as: 56], [HYPERLINK \l "Kee78" 15]; processes, such as: 57], and[HYPERLINK \l "Cou79" 58] and guidelines for such areas as end-use computing. Differently, the approach that we present, OMKS, introduces an approach that is general and applicable across multiple organizations and contexts.

In this section, we discuss how the proposed approach can influence research and practice in the areas of knowledge management, organizational learning and decision support systems. We also present some of the benefits for organizations that employ the approach. Nevertheless, there are issues whenever information technologies are used to support organizational decision-making. We therefore highlight some of these issues and how organizations may alleviate problems that they may face.

Like previous work (e.g., 29], [HYPERLINK \l "Bol02" 13], 11], [HYPERLINK \l "Cho04" 34]), our research presented here only presents an approach, but not the actual implementation. Actual implementation of the approach is beyond the scope of the current work. However, in the following, we demonstrate the validity of the approach in terms of how the process approach meets requirements for such systems and how the approach is based on prior theoretical research.

Our approach seeks to take features of data warehouse and organizational memory systems. Hence, the base requirements for such systems should be met. Thus, we demonstrate how our approach meets both the technical and theoretical requirements for data warehousing11], organizational memory information systems [HYPERLINK \l "Ste95" 29], 31] and business process integration [HYPERLINK \l "Cho04" 34]. Atwood 31]notes that OMIS as presented by Stein and Zwass [HYPERLINK \l "Ste95" 29] hasapplication in the real world. Hence, our description of OMIS in this paper refers to systems that have use in the real world1. In proposing an effective-based integrative framework for OMIS, Stein and Zwass prescribes the following meta design requirements (goals) and meta designs (attributes of the artifacts) of four layers of such systems: integrative subsystem, adaptive subsystem, goal attainment subsystem, and pattern maintenance subsystem.

The integrative system enables organization's internal knowledge including technical issues, designs, past decisions and projects to be made explicit. Our approach emphasizes the ability to transform knowledge and make knowledge explicit for reuse by organizational actors across both space and time,

[1] Atwood [HYPERLINK \l "Atw02" 31] provides more detailed examples of how OMIS have been used in an academic setting, a government setting, and businesses such as Anderson Consulting and insurance industries.

which is the meta requirement for this subsystem as prescribed by Stein and Zwass 29]. The meta requirements for the adaptive subsystem include activities “to recognize, capture, organize, and distribute knowledge about the environment to the appropriate organizational actors [HYPERLINK \l "Ste95" 29]. OMKS facilitates these activities. The meta requirements of the goal attainment subsystem are to assist organizational actors design, store, evaluate and modify goals. The OLAP capabilities presented in the OMKS addresses this requirement by enabling the decision maker define key performance indicators in the OLAP environment and to modify, evaluate the specific goals as often as possible. The meta requirements of the pattern maintenance subsystem deal with the values, attitudes and norms of the organizational actors. The use of ontologies enhances understanding of the different organizational actors standardizing practices and norms. These ontologies also enables data from different sources be integrated in such a way that they have consistent meaning for the different actors and therefore enable organization build its culture and value among the diverse actors.

By explaining the various processes in the data warehousing activities such as extraction, transformation and loading of source data into the warehouse and knowledge management as process of creating, storing, sharing and reuse of knowledge, we show the applicability of the integrated process management theoretical concept in the proposed approach34]. Finally, we have presented details of how the traditional extraction, transformation and loading of the data warehouse architecture will progress in the proposed approach.

4.1 Implications for Research

Presented in this paper is an approach that integrates the functions of a typical data warehouse and organizational memory information systems. This approach uses an ontological metadata repository to assist in the structuring of data and facilitating learning, as well as introduces Scenarios as a process to capture tacit knowledge. Researchers in knowledge management, data warehousing, organizational learning, and decision support may use this approach as a way to review how the construction of DSS may be enhanced by looking specifically at the design and maintenance of the components of the OMKS presented in this paper.Systems integration issues are another areas that researchers may want to develop more knowledge.

4.2 Implications for Practice

Realizing all of the benefits of anOrganizational Memory and Knowledge System remains forthcoming because while the approach presented in this paper offers a process and technological means to realizing this end, much of the very important human aspects, which are very important parts of the system, are still evolving. One of the critical issues is the issue of motivating workers to contribute to the tacit knowledge capture and acquisition. Just as we have explained how OMIS have been used in the real world, we believe that building an integrated OMKS have far more reaching benefits. This is because all the processes that involve the building and use of traditional data warehouses and knowledge management systems would be joined; enabling diverse processes to be captured, stored, shared and used from a single unified system.

5. CONCLUSION

The data warehouse is a major component of modern DSS. Others have suggested that theintegration of DSS and knowledge management systems processes can enhance decision-making. In this paper, we have presented an approach for integrating functional features of data warehousing and organizational memory information system to enhance decision-making and organizational learning. We have discussed how Scenarios can be employed to facilitate the acquisition and representation of tacit knowledge into the Organizational Memory and Knowledge System and use ontologies as a metadata for managing other metadata from the diverse sources. The metadata also provides effective standardized semantics for the organization’s members to contribute, use, and learn from the knowledge in the OMKS.

There has been an extensive amount of research on ontology and its application to knowledge management. The use ofontology has been proven to be effective and efficient in this task. The inclusion of *Scenarios* in the solution is justified by appealing to the research and studies that have been presented to show the effectiveness of *Scenarios* in acquiring tacit knowledge.

Future research would involve proving the efficacy of the Knowledge Warehouse architecture and its ability to facilitate tacit knowledge acquisition and schematic integration. We argue that using ontologies is an effective means for tacit knowledge acquisition, standardization, presentation, and storage. This paper is a step in that direction.

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