Framework for using Ontology Base to Enhance Decision Support System

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Abstract – **In recent years, decision support systems (DSS) are witnessing continued growth. Many organizations employ data warehouses and knowledge management systems for decision support activities. Decision making has been a topic of research of many years. There is no standard method in which decisions could be modeled in ontologies. The ontology-based decision support system platform can provide tools and services for end users to develop one's own DSS verticals.**

This paper will introduce the proposal ontology decision support system (ODSS) framework which use ontology base to enhance DSS in different places. There are many papers suggested ontology decision support system, but this paper proposal is pattern method. So it's more general; universal use of ontology and reusable. Also using ontology based reengineering give the proposal framework benefits.

***Key words** - Decision Support System, Ontology based, OLAP, Data Warehouse, Data Mining, and Analytic Hierarchy Process.*

I. INTRODUCTION

Decision support system (DSS) has been proposed since 1960s to help decision maker improve the efficiency in decision making [23].

Individuals in organizations have to make decisions, because of the complexities of decision making, organizations provide DSS to enhance the decis ion making process [31]. DSS is an interactive computer based system intended to help decision makers use communications technologies to identify and solve problems, complete process tasks and make decisions [12].DSS based on data warehouse is providing with three kinds of decision tools are data warehouse, OLAP and data mining [27]. Data warehousing has become an integral component of modern DSS [31]. Data warehouse is the database that stores a copy of operational data with an optimized structure for query and analysis; the data coming from the sources are integrated in the data ware house to provide an historical vision of the data of different operational systems. Describing data warehouse with ontologies can lead to better information to allow the better decision making.

The organization of this paper is as follow: section II, represents related reviews on current practices of ontology to supporting decision support system. In section III, we represent the main concepts for this framework. In sub section A, we review the decision support system. In sub section B, review on data warehousing. In subsection C, we review the ontology and the reasons for using ontology. In section IV, we present how this framework is implemented. Finally, we present the summary of this paper.

II. RELATED WORKS

In recent years, ontology has been increasingly used for various different purposes. Here, the use of ontology is discussed in the implementation of ontologies to decision support system. There is no standard method in which decisions could be modeled in ontologies. We can find some references worked in this step as: There was a method that systematically defines the decision making process using ontology as the base construct, but did not use ontology base to enhance DSS in different places [38], there was also framework for ontology based data integration and decision support by using variety of heterogeneous data resources. But did not use ontology based re-engineering [16], and proposed a model of an ontology learning knowledge support system (OLEKSS) from heterogeneous knowledge sources, but did not use ontology reengineering [40].

There is no difficult in creating ontologies as which is found in previous references, but the newest is the merging between fuzzy ontology and ontology data warehouse.

III. MAIN CONCEPTS

A. Decision Support System

By the late 1970s, number of researchers had developed interactive information systems that used data and models to help managers analyze semi- structured problems. In the early 1990s, a major technology shift occurred from mainframe-based DSS to client/server – based DSS [29].

Decision support system is defined as interactive computer based system intended to help decision makers utilize data and models in order to identify and solve problems and make decisions [4]. The decision support is one of the main objectives of ontology-based knowledge management systems [38].The primary role of DSSs is to assist a decision maker through a series of procedures. DSS [29] is such applications of management information system where it aims at helping decision maker to analyze complex factors before arriving at decision. DSS couples intellectual resources of individuals with capabilities of the computer to improve the quality of decisions [27]. DSSs are classified into four main categories: data, model, process and communication oriented**.**

B. Data Warehouse

Since the data by themselves are useless, they must be put together to produce useful information. The information becomes the basis for relational decision making [6]. To facilitate the decision making process, new piece of technology was developed and called data warehouse. Data warehouses are designed to aggregate data and allow decision makers to obtain accurate, complete and up to data information. A critical element of the data ware house architecture is metadata management [1].

As can be seen in figure (1), Extraction, Transformation and Loading (ETL) tools are used to extract transactional data from different data sources and transform and load these data into the data ware house which is divided into a set of data marts.

Alberto, Francis and Cecilia [6] proposed this architecture of data warehouse.

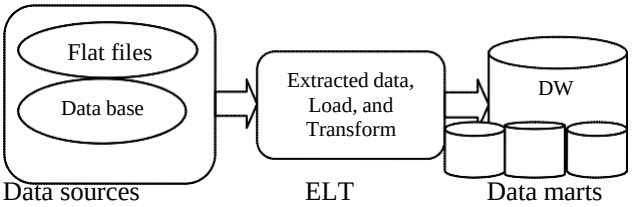

Figure (1) the architecture of Data warehouse

Data mart is a simple form of data warehouse that is focused on a single such as sales or marketing [35]. Data marts are often built and controlled by a single department within an organization; data marts usually draw data from only few sources, these sources could be international operational system, central data warehouse or external data.

C. ONTOLOGY

Ontology is a specification of conceptualization [38]. It is a description of concepts and relationships that can exist for an agent or a community of agents [18].
Reasons for the need of ontology are [14]:

- To share common understanding of structure of information among people.
- To enable domain knowledge reuse.
- To make explicit domain assumptions.
- To separate domain knowledge from operational knowledge.
- To analyze domain knowledge.

Building ontology is a complex work; in order to build ontology you need a domain expert to help you to declare all domain concepts and the relationship between them [26]. Ontology web language (OWL) [12] is a standard ontology language from the World Wide Web consortium. OWL ontology consists of individuals, properties and classes.

IV. ODSS FRAMEWORK

We suggest the proposal ODSS framework which use ontology base to enhance decision support system. Building ontology is "content-driven" work as DSS so in our proposal each DSS have its own ontologies. This system framework consists of four phases.

ODSS phases:

The first phase is Extraction knowledge from data sources phase:

Ontology extraction tools support the automatic extraction of concepts and/or their relations by applying some techniques such as natural language processing or machine learning. Successful ontology extraction tools are as OntoLT, Text2Onto, Onto Builder, and DODDLE-OWL from references [9] [39] [24].

We convert every data source into ontology base. Other examples for extraction tools for different kind of data source; references [41] [20] [19] represented DB2OWL tool for automatic database to ontology mapping. References [5] [7] [8] used ontology for integrated geographic information system. References [5] [30] used text to ontology mapping. Ontology extraction tools like other software programs, the efficiency of a tool should be considered. Efficiency measures how fast a tool can extract concepts and/or relations from source data under stated conditions. This measure computes the total time taken by the tool to read the source data and to present the target output to the user. Some tools may take a longer time to extract concepts due to their inefficient extraction algorithm. If tools present similar extraction results, it is better to choose more efficient ones. Another measure is reliability. Reliability reviews whether the output remains consistent over repeated tests with the same input data under identical conditions. If a tool shows different extraction results from the same input data, we can conclude that the tool and its results are not reliable. Note that this criterion examines whether a tool produces consistent results, not the quality of the output.

Then the benefit of using ontology appears when using merging ontologies tools in second phase.

The second phase is merging ontologies in universal ontology ODWH:

That solves the redundancy which resulted from extraction knowledge from data sources; we use ontology merging which is recognized as an important step in ontology engineering. We merge an ontologies resulting from extraction knowledge from data sources. References [33][17][3] used ontology merging .Then filtering the redundancy from the merging of ontologies in the first phase and integrate the result to universal ontology data warehouse, which it is resulted from dividing DWH into data marts.

The third phase: Enhancing ODWH by fuzzy ontology and merging fuzzy ontology with universal ontology data warehouse

That is creating by merging the ontologies which created in the second phase. Furthermore, we will integrate fuzzy logic with ontology to obtain a solution that is more suitable for solving the uncertainty and reasoning problems to make intelligent decision support solution. References [2] [36] [32] used fuzzy ontology.

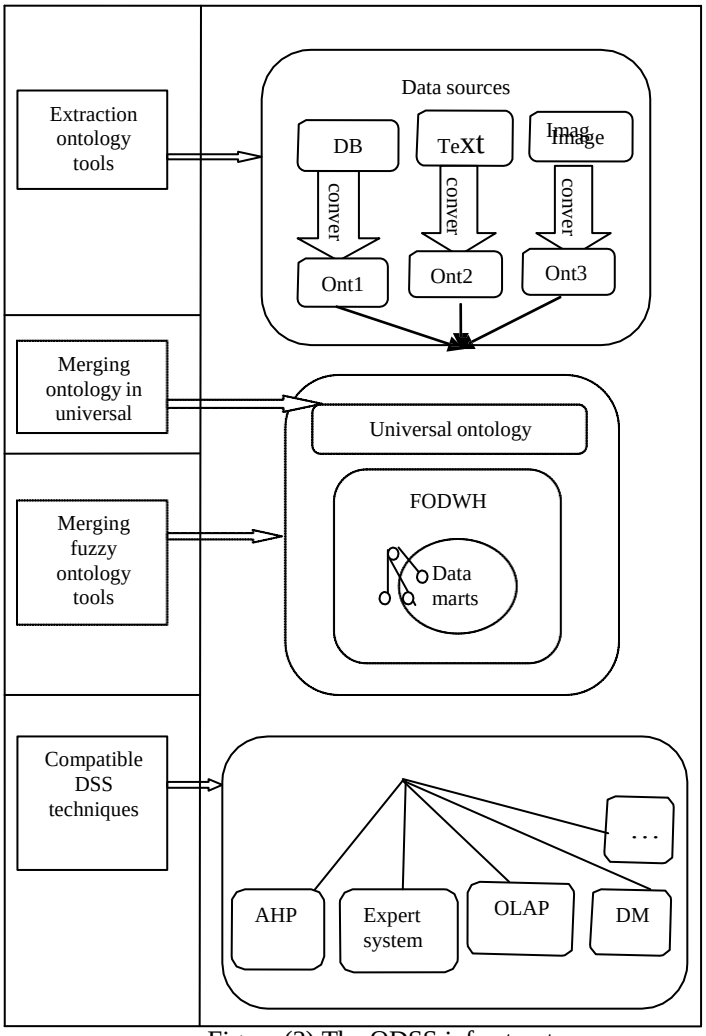

Figure (2) The ODSS infrastructure

The final phase: Compatible DSS Techniques

The compatible DSS techniques are AHP, Expert system, OLAP, Data mining and ….. . In this phase, utilize the analytic hierarchy process (AHP) which is a structured technique for dealing with complex decisions, to make an optimal decision for satisfying the requirement of individual consumer. References [25] [28] [37] used AHP as DSS techniques. The new generation of DS techniques compatible with ontology as expert system tools that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution. References [13] [26] [10] used expert system as DSS techniques. OLAP is used to prepare data for analysis, so OLAP is a powerful tool to analyze and make decision. References [34] [11] [22] used OLAP as DSS techniques. After analyzing data we show results by using data mining. There are different techniques by which data can be mined, so we use ontology to help in choosing this technique and applying association and classification. References [18] [15] [12] used data mining as DSS techniques. The output of DM is that the extracted information which is used to make decision as shown in figure (2).

V. CONCLUSION

This paper proposed ODSS framework which use ontology base to enhance decision support system. Our proposal ODSS classified into four phases. Firstly, extracting knowledge from data sources by using ontology base, then merging these ontologies to generate high level knowledge and enhancing ODWH by using fuzzy ontology , finally using also ontology base to support decision making techniques as OLAP, Data mining, AHP and Expert system. There is no standard method in which decisions could be modeled in ontologies.

In the future, we apply our proposal system in different fields to solve practical problems.

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