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A study of DS with the help AQUA method.

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Abstract: This paper is the study which is referring to and illuminates the meaning of the term Decision Support (DS). DS is put in the environment of Decision Making, and some most important influences of DS are overviewed such as Decision Analysis, Decision Support Systems, Data Warehousing . To do this, it is combined with a query system to answer expert questions about the ideal action for a given instantiation of decision features. The main difficulty is come out precisely answer queries related with incomplete instantiations. Our proposal establishes an automatic and interactive dialogue between the decision-support system and the expert to produce information from the expert to reduce ambiguity. Thus a study of method named Aqua has been made which is a system for providing fast, approximate answers to combined queries. It has been designed to run on top of any commercial relational DBMS.

Keywords: Decision support systems; Artificial Intelligence; Expert system; Query system; data warehousing;

I. INTRODUCTION

The term *Decision Support* (DS) is used often and in a variability of contexts related to decision making.The term "Decision Support" seems rather intuitive and simple; it is in fact very inaccurately defined. It means different things to different people and in different backgrounds. Also, its meaning has lifted during the recent history. A decade ago, it was fixed with Decision Support Systems (DSS).

The confusion is further demonstrated by the gathering of related terms and acronyms that are either equal to, or start with "DS": Decision Support, Decision Sciences, Decision Systems, Decision Support Systems, etc. This paper attempts to clarify these issues. We take the viewpoint that Decision Support is a broad, generic term that incorporates all aspects related to supporting people in making decisions. DS itself is given a role within Decision Making and Decision Sciences. Some most flat DS disciplines are briefly overviewed Decision Analysis, Decision Support Systems, Data Warehousing .

Decision-making has been an important area of study for researchers since the 1940's. Researchers from many areas have contributed to this important human and organizational activity to understand how decisions are made in society, the economy, management, engineering, etc. Faced with new research opportunities from emerging technology and the changing make-up of expertise, researchers andresearch disciplines must evolve in order to understand new methods organizations use in decision-making. This paper presents an evolutionary view of one decision support technology that support the use of expertise. Decision support technology is: expert systems (ES). Aqua is a system for providing fast, estimatedanswers to cumulative queries, which are very mutual in OLAP applications. It has been designed to run on top of any marketable relational DBMS. Aqua precomputesSynopsesof the original data and stores them in the DBMS. It provides approximate answers by rewriting the queries to run on these synopses.

II. WHAT IS DECISION SUPPORT?

A. Decision Making:

Inevitably, DS is a part of decision making processes. A *decision* is defined as the choice of one among a number of alternatives, and *Decision Making* refers to the whole *process* of making the choice, which includes:

i. assessing the problem,
ii. collecting and verifying information,
iii. identifying alternatives,
iv. anticipating consequences of decisions, making the choice using soundand logical judgment based on availableinformation,
v. informing others of decision and rationale,
vi. Evaluating decisions.

According to Simon [1], the decision making process consists of three main stages:

a. Intelligence: Fact finding, problem and opportunity Sensing, analysis, and exploration.

b. Design: Formulation of solutions, generation of alternatives, modeling and simulation.

c. Choice: Goal maximization, alternative selection, Decisionmaking and implementation.

B. Human vs. Machine Decision Making:

The term DS contains the word "support", which refers to supporting people in making decisions. Thus, DS is concerned with human decision making. The definitions of DS rarely mention this characteristic and rather assume it implicitly. However, we have to be aware that there is a variety of artificial systems that also make decisions: switching circuits, computer programs, autonomous expert systems and software agents, robots, space probes, etc. Therefore, we explicitly differentiate between machine and human decision making and associate DS only with the latter (Figure 1). The two disciplines that closely correspond to this distinction are Decision Systems, which (primarily) deals with computer-based programs and technologies intended to make routine decisions, monitor and control processes [2], and Decision Sciences, a broad discipline concerned with human decision making.

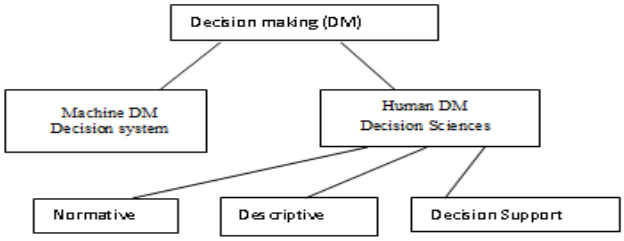

Figure1: The role of DS in Decision Making

C. Decision Sciences:

A somewhat long, but very useful definition of Decision Sciences appears in [3], which we quote in its entirety, adding emphasis: "Decision Sciences is an interdisciplinary field that draws on economics, forecasting, statistical decision theory, and cognitive psychology. Broadly speaking, Decision Sciences addresses three fundamental and inter-related questions.

First, howshoulda 'rational' *person make* decisions? This question is at the heart of economics, and often serves as a baseline for evaluating human decision making. Second, how do people really make decisions? Recent research has explored the ways *in* which people are 'boundedly rational,' and utilize rules-ofthumb and shortcuts to formulate judgments and to choose *among* alternatives. Often these shortcuts do well, but equally often they lead to systematic biases and serious errors. Finally, given what we know about rational decision making and actual behavior, *how can we help people*, especially managers, *improve their decision making*? Decision researchers employ a variety of techniques to improve decision making, ranging from sharpening statistical intuition to quantitative decision analysis." In other words, Decision Science covers three–possibly overlapping–aspects of human decision making (Figure 1):

a. Normative, which includes theoretical approaches such as Decision Theory, Multi-Attribute Utility Theory, Game Theory, Theory of Choice, and others;

b. Descriptive, which is closely linked with Cognitive Psychology, and Social and Behavioral Sciences; and

c. Decision Support itself.

In summary, we have identified DS as a discipline within Decision Sciences, which is concerned with human decision making, especially in terms of "helping people improving their decision making".

III. DECISION SUPPORT DISCIPLINES

The above broad definition of DS covers a number of more expert disciplines; some most important ones are briefly overviewed in this section.

A. Decision Analysis:

Decision Analysis (DA) in popularly known as "Applied Decision Theory". Decision analysis includes many procedures, methods, and tools for identifying, clearly representing, and formally assessing important aspects of a decision, for prescribing a recommended course of action by applying the maximum expected utility action axiom to a well-formed representation of the decision, and for translating the formal representation of a decision and its corresponding recommendation into insight for the decision maker and other stakeholders. It provides a framework for analyzing decision problems by [4]:

- structuring and breaking them down into more manageable parts;
- explicitly considering thepossible alternatives, available information, involved uncertainties, and relevant preferences;
- combining these to arrive at optimal or "sufficiently good" decisions.

The DA process usually proceeds by building models and using them to perform various analyses and simulations, such as "what-if" and sensitivity analysis, and Monte Carlo simulation. Typical modeling techniques include decision trees, influence diagrams, and multi-attribute utility models.

B. Decision Support Systems:

Decision Support Systems (DSS) are defined as interactive computer-based systems intended to help decision makers utilize data and models in order to identify and solve problems and make decisions [2]. Their major characteristics are:

a. DSS incorporate both data and models;
b. they are designed to assist managers in semi-structured or unstructured decision-making processes;
c. DSS support, rather than replace, managerial judgment;
d. They are aimed at improving the effectiveness–rather than efficiency–of decisions.

DSS are further classified into four main categories: data, model, process and communicationoriented. In addition, thereare the so-called DSS Generators, which facilitate the development of dedicated DS Systems. Specifically, the term DSS encompasses many types of information systems that support decision making. These typically include [5]: Executive Information Systems (EIS), Executive Support Systems (ESS), , OLAP, Software

Agents, Knowledge Discovery Systems, Group DSS, and some types of Expert Systems (ES) [6].

C. Data Warehousing:

Data Warehouse is a repository of multiple heterogeneous data sources, organized under a unified schema in order to facilitate management decision making [7]. Data warehouse technology includes data cleansing, data integration, and OLAP, that is, analysis techniques with functionalities such as summarization, consolidation, and aggregation, as well as the ability to view information from different angles. In warehouses, data is typically represented in the form of decision cubes.

IV. EXPERT SYSTEM

A. What is Expertise?:

Though no agreed upon definition exists within the literature for expertise, researchers would agree expertise is multidimensional [8], with expert knowledge as the essential part. Three main components make-up expert knowledge: (1) formal knowledge, (2) practical knowledge, and (3) self-regulative knowledge [9]. Formal knowledge is explicit where learning is the focus of factual information.

For instance, a lawyer would know the laws and case histories from schooling. Practical knowledge develops in the skill of "knowing-how" and is tacit, where intuition plays a role making expert knowledge difficult to explicitly express. Lawyers have practical knowledge through their experiences from being in a legal setting which better prepares them to make a legal argument or judgment. The third component, self-regulative knowledge consists of the reflective skills that individuals use to evaluate their own actions. For self-regulative knowledge, a lawyer would monitor his argument, presentation, and reasoning while presenting to the judge or jury.As elusive as a definition is for expertise, its short supply and difficulty to represent makes owning expertise extremely valuable because of its influence on decision-making.

B. Introducing Expertise by means ofTechnology:

Considering expertise is not only restricted to human beings- rather technology's capacity to possess "expert" ability to influence decision-making, organizations have allocated significant resources to leverage expertise using technology. Each technology or system has been built to better capture knowledge or represent expertise in the cognitive process of the decision-maker(s) for effective decision-making to occur [10][11][12]. Though managed differently, expertise used within these support systems underline the foundational theories for use. A review of the literature shows how the use expertise in decision support technology has been implemented and how the level of expertise for decision-making can be augmented by increasing the amount of participants in the decision-making processusing emerging technology (Figure 2).

C. Expertise in Expert Systems:

One method used by organizations to capture expertise is by employing expert systems. Currently, expert systems are playing a critical role for many organizations to deal with the changing environment and are a source of competitive advantage [13].Expert systems, a branch of artificial intelligence, are contributing to decision-making through their representation of knowledge and reasoning of human experts for its users [14].

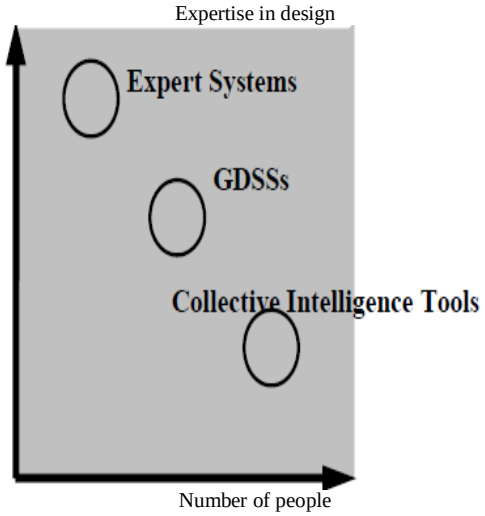

Figure 2: Level of Expertise in Systems Design

By matching an expert's problem-solving ability, knowledge and reasoning are transferred to a user through the use of expert systems for faster learning and decision-making than would occur when developing these skills over time. The main function of an expert system is to represent expertise to its users for decision making when a human expert cannot be found or is in short supply.

Expert systems are constructed with four main components knowledge base component, heuristic engine component, user interface, and explanation module. The knowledge-based component consists of the factual knowledge a human expert would have of a specific and narrow domain, while the heuristic knowledge or expertise is based on intuition, experience, and judgment to apply rules efficiently under uncertainty or with incomplete information. The user interface component allows the user to interact with the system but it is the explanation module that queries the user for more information. As the user responds by answering the questions presented through the explanation module, the new information is then incorporated in the decision-making process of the mimicked expert and finally responds with a justification for solution, which is a critical factor for system intelligence [15].

V. AQUA: A METHOD FOR FAST DECISION SUPPORT

Aqua is designed as a module that sits on top of any SQLcompliant DBMS managing a data warehouse. Aqua precomputes statistical summaries on the relations in the warehouse. Currently, the statistics take the form of varioustypes of samples and histograms, and are stored as regular relations inside the warehouse; they are also incrementally maintained up-to-date as the base data is updated [17]. Aqua answers user queries using the pre-

computed summaries. Approximate answers are provided by rewriting the user query over the summary relations and executing the new query. The rewriting involves suitably scaling theresults of certain operators within the query. Finally, thequery and the approximate answer are analyzed to provideguarantees on the quality of the answer, and report errorlimits. The high-level architecture of Aqua is depicted inFigure 3, along with the steps taken during query processing.As new data arrives, Aqua maintains the synopses upto date, with few or no accesses to the original data.

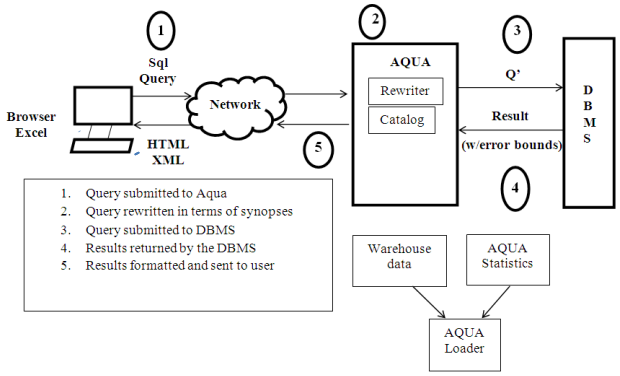

Figure 3: The Aqua architecture

VI. ACKNOWLEDGEMENT

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VII. CONCLUSION AND FUTURE WORK

In this paper we first gave description of DS. DS is put in the environment of Decision Making, and some most important influences of DS are overviewed such as Decision Analysis, Decision Support Systems, Data Warehousing . It is shared with a query system to answer expert questions about the perfect achievement for a given instantiation of decision features. The key trouble is come out accurately answer queries linked with partial instantiations. Our application establishes an automatic and interactive dialogue between the decision-support system and the expert to create information from the expert to reduce ambiguity. Thus a study of method named Aqua has been made which is a system for providing fast, approximate answers to combined queries. It has been designed to run on top of any commercial relational DBMS.

This paper gave a broad analysis for the current challenges and solutions, and critics for these solutions; in our upcoming work we will propose new solutions that will help to maintain a securer aqua Method.

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