# Research and Application of an Intelligent Decision Support System

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*Abstract*—This paper discusses a new decision-support system that integrates data warehouse, knowledge warehouse and model warehouse. Contrast to the fixed model of the old decision-support system and its limited application, the new system can overcome the shortcoming of the old system efficiently, and also it can simplify model-obtaining and coding. So the new system strengthens the effectiveness, intelligence and efficiency of the decision.

*Keywords-Decision-Support System; Data Mining; Knowledge Discovery; Model Warehouse*

## I. INTRODUCTION

Although DSS (Decision-Support System) can supply timely, accurate and scientific information, the most advanced SDSS (Spatial Decision Support System) has defects. SDSS integrates the traditional and the new DSS (including data warehouse, OLAP (On-Line Analysis Processing), data mining, data base, and ES), so it can solve many questions. But due to the fixed model of the model warehouse, which cannot adjust according to the change of the condition parameter, the application of the SDSS is limited. So the paper is tries to introduce a new decision-system system that is based on the data warehouse, knowledge warehouse and model warehouse. The new system can update the knowledge of the knowledge warehouse freely by using knowledge warehouse and date warehouse. And also the new system can strengthen the effectiveness, intelligence and efficiency of the decision by the management of the MWMS and the study of the system.

## II. MAIN MODULES

The system is composed of model warehouse, knowledge warehouse, method base, data warehouse, OLAP and data mining modules.

### A. Model Warehouse

Model warehouse has the following functions: management with classification, memory the necessary model (including using date-mining model) and comprehensive model parameter (in order to choose out the proper model). Machine-detecting technology integrated the artificial intelligence (AI) can accomplish model creating by computer by simulating the data of the date warehouse/ database. The Self-study algorithm by the nerve network of the model-study can adjust the model fine and update the parameter to get the optimal practical model, so the model can keep in chorus with the fact. Flexible software development technology integrated Software Engineering supports model-coding. Model management system is to manage model of the model system and to call/operate model.

### B. Knowledge Warehouse

Knowledge Warehouse has the function of obtaining, clearing/transforming/coding, organizing, memorizing, adjusting, and propagating knowledge. KW can accomplish the function by expanding system structure of the date warehouse. KW is composed of six components. ① knowledge/date-obtaining module. It is to switch recessive knowledge to dominant knowledge, which is to say to get recessive knowledge from decision-maker. ②Two feedback loops. One is between knowledge-obtaining module and knowledge-memorizing module. The other is between Extract-Transform-Load (ETL) module and mutual management module. And it is to memorizing the knowledge, which has been verified by the system and to update knowledge warehouse timely. ③ETL module. It is similar with the corresponding module of data warehouse. ④ Knowledge warehouse module. One of the main components is Knowledge Base Management System, which accomplishes the analysis both by knowledge warehouse and

model warehouse. ⑤Analysis worktable. It is composed of task controlling, conclusion getting and technology-Management modules. ⑥Interface module. It is to handle the interaction between KBMS and user's interface. The knowledge warehouse system is as following figure 1.
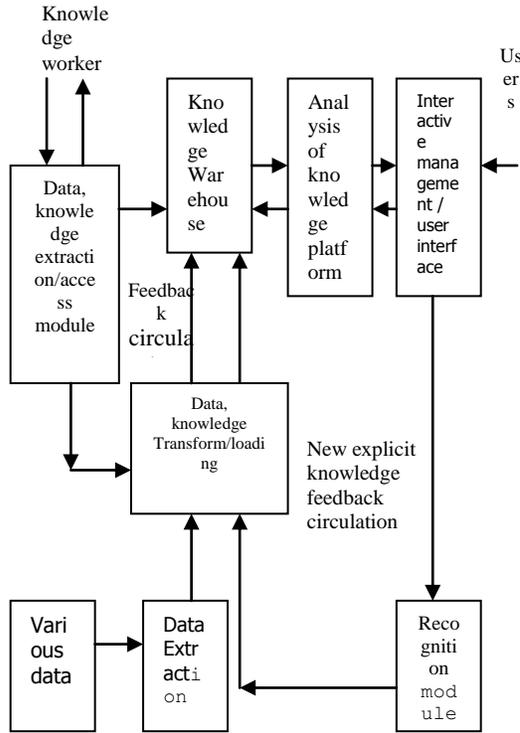


Figure 1.   Knowledge warehouse system

### C.  Method base

Method should be based on the model and be adjusted according to the model in order to calculate. But one model can have several methods. Method base is to supply method for DSS problem model to calculate. And method base management system is to add, delete, revise and search method and to give service for model solving.

### D.  Data warehouse and OLAP

OLAP is one kind of data warehouse application and it is based on data warehouse. So it can provide decision-makers with analysis results by analyzing and handling. Data warehouse organizes data according to function requirement, the use and granularity of DSS. The key point of OLAP is how to organize data to satisfy user's multi-dimension data analysis.

### E.  Data-mining

Data-mining module is to mine data to get the needed knowledge according to the model, method and knowledge provided by relevant warehouse. And the result of data mining can be used as new knowledge and model to solid knowledge warehouse and model warehouse.

### F.  Problem solving and interactive system

Problem solving module is to solve problem by using knowledge, model, method and knowledge of relevant warehouse. Non-structure problem, which cannot be structured, may be solved by deduction system.

### III.   THE FRAMEWORK AND STRUCTURE OF NEW DECISION-SUPPLY SYSTEM

Figure 2 is the structure of DSS, which integrated DW, KW, MW, MB, OLAP, Data-mining and Problem Solving system. Data mining, knowledge-deduction centers, model-creating units of model warehouse are the intelligence center of DSS which strengthens intelligence property of DSS. And problem solving and interactive system are the function center.
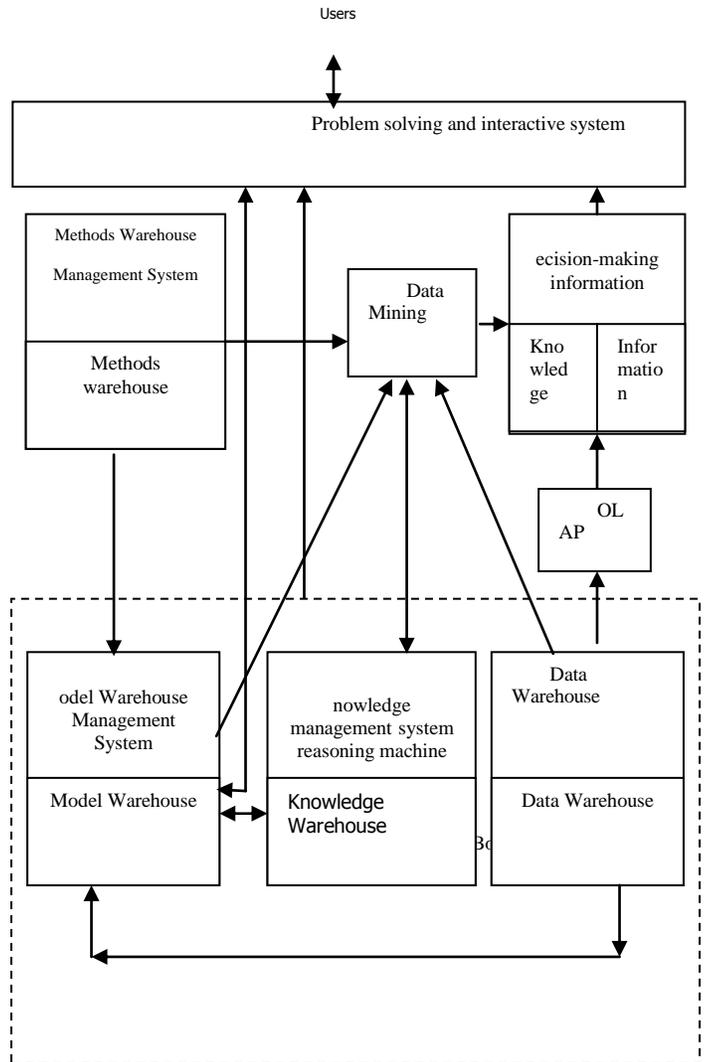


Figure 2.   Integrated DW, KW, the MW DSS system structural drawing

DSS comprises three main parts. The first one is the integration of MW system, DS system and DW system. And

it is the basis of decision-support system to provide assist decision-making information of Quantitative analysis (Model Calculation). The second one includes DW and OLAP, which extract spatial data and information from DW. The third one is the integration of experts system and data mining system. Data mining mines knowledge from DB and DW and puts it into knowledge warehouse of experts system, then experts system analyzes. The three parts are integrated. Users can choose one part for decision, either two or three according to the fact. The traditional DSS chooses the first part, IDSS chooses the first part and the third part, and the new DSS chooses the second part and data mining of the third part. The new DSS integrates the three parts by using problem solving and interactive system can give better assist decision-making decision.

Generally speaking, three integrated parts; three warehouses and the application of closed cycle free back and the introduction of MW system is the characteristic of the framework, which makes it more intelligent.

## IV. KEY TECHNOLOGY TO ACCOMPLISH THE DECISION-SUPPORT SYSTEM

### A. Data mining and text mining

Data mining is to find out unobvious pattern and to acquire needed knowledge in order to help enterprises make decision more scientific and more accurate by analyzing and handling large number of data. Text mining is to acquire valuable information from all kinds of text information. The text source can be Web, fax, E-mail, example and other kinds of text. The decision-makers can extract useful information according to rules and guides who have been defined advanced to make decision.

### B. Modeling

Workers should define objective function, decision variables and its' weight. They also should make definite restrictive conditions and coefficients of variables according to the decision variables. So the model that comprises the elements (decision variables, coefficients, restrictive conditions and objective function) can reflect the invisible knowledge obviously.

### C. Decision-support tools

It is the tool which uses existed knowledge to help make decision. It needs much technology and tools, including AI, expert system, software engineering, knowledge search tool, knowledge explaining tool and multi-dimensional tool and so on.

### D. Intelligence-support technology

it includes: ① model warehouse system should be designed to accomplish its function. ②Interface: All parts are joined by interface. Model, data and knowledge are separated parts that should be integrated. So the interface is very important. Interface should have the function of saving and extracting data, calling and operating the model, and knowledge reasoning. ③system integrated: an integrated system should integrate all parts by words according to the fact.

## V. EXAMPLES

Here is an example for a domestic large-scale machinery limited corporation. The old quality management decision-support system of the corporation cannot adjust effectively due to the fixed model coefficients and cause low efficiency. In order to increase production the decision must be changed. Generally, quality breakdown and quality cost will be the core after checking relevant files and investigating the decision-makers. And the analysis should be started from suppliers, manufactories, employees, products and time.

As for products, they should be analyzed by one product or product classification. But one unit can analyze manufactories, employees and suppliers. Time itself is a dimensional data. The quality analysis for every employee, product, supplier and manufactory can be made yearly, quarterly and monthly and the result (graph or table) can help make decision. But if the model coefficients cannot adjust finely, the above result cannot be obtained. The new decision-support system that integrated KW, MW, and DW can be developed and it is based on Windows2000, SQLServer2000, and Excel 2000. The new system can revise model coefficients automatically according to the change of time, employee, product and manufactory. It also can call method of method base and handle by OLAP; the results are as figure 3. So decision-makers will know the worse part and can make better decision by getting the right reason.
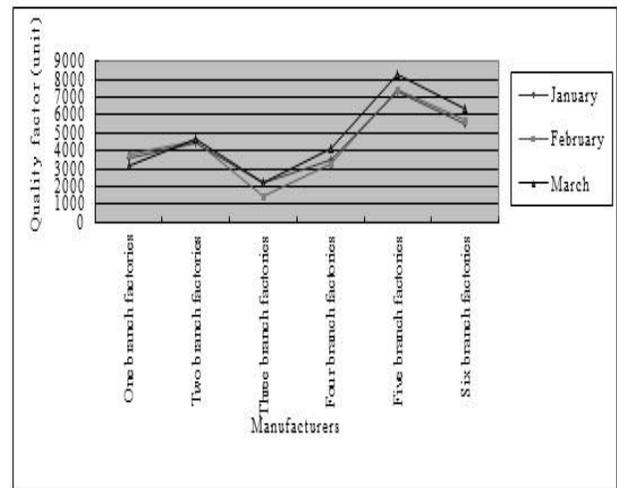


Figure 3. Product qualities pursues every branch factory comparatively

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