Research on decision support system of ship planning management based on data warehouse

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Abstract. This paper discusses the basic principle, model construction and theoretical framework of a new decision support system based on data warehouse, and applies this method to the data extraction process of shipyard plan management. The practice shows that the method is applicable and reliable in complex engineering systems such as shipyard planning management.

1. Introduction
Since the American scholar M.S. Scott Morton put forward the concept of decision support system in the early 1970s, decision support system has been full developed in various disciplines[1]. At first, DSS consists of three parts: Dialogue part, data part (database and database management system) and model part (model base and model base management system). The structure forms the composition of decision support system, and also reflects the key technologies of building decision support system: model base management system; component interface; system integration, etc. With the introduction of intelligent decision support system in 1990s, the development of decision support system has stepped to a new level, that is to say, knowledge components (knowledge base, knowledge base management system and reasoning machine) are added on the basis of three components, and decision support system and expert system are combined. In recent years, the emergence of online analytical processing and data mining based on data warehouse has opened up a new way for the development of decision support system.

2. Decision support system based on data warehouse
Data warehouse and on-line analytical processing (OLAP) are the concepts put forward in the early 1990s, and have become the trend by the middle of 1990s. Data warehouse focuses on storing and managing subject oriented data, while OLAP focuses on data analysis in data warehouse and transforms it into decision-making information.

2.1. Data warehouse
The so-called data warehouse refers to the collection of topic oriented data extracted from multiple data sources that are related in content but independent in both physical and logical aspects. These data sources may be files, hierarchical databases, network databases, reverse list databases, relational databases, or a hybrid system composed of the above systems. The extracted data is usually placed in a relational database. Therefore, data warehouse actually provides a unified data platform based on
multiple data sources, which makes decision makers not spend a lot of time to understand the system environment and data semantics of various data sources[2], but only to operate the data warehouse. Figure 1 is a typical basic architecture diagram of data warehouse. The basic structure of the whole data warehouse system consists of data warehouse, integrator, monitor diagram and metadata. Real view is the data that is extracted and transformed from other data sources. Metadata is similar to the data dictionary in the traditional database system. It mainly describes the logic of data transformation and synthesis, and defines the data model of data warehouse[3]. The integrator completes the transformation from the data in the data source to the real view (i.e. integration) according to the relevant definitions in the metadata. When the data in the data source changes, the monitor is responsible for monitoring and obtaining the contents of these changes. Data warehouse has the following characteristics: theme oriented; integrated; time-varying; stable data collection, which is used to support the decision-making process of business management.

![Data Warehouse Architecture](image1)

Data warehouse is developed on the basis of the original relational database, but it is different from the organization form of database system. The basic data and comprehensive data obtained from the original business database are divided into different levels. The structure of general data warehouse includes: historical basic data; current basic data; light comprehensive data; high comprehensive data, and its general structure is shown in Figure 2. The organization structure of the whole data warehouse is organized by metadata, which does not contain any actual data information in the business database. Metadata plays an important role in data warehouse.

2.2. On line analytical processing

Data warehouse is only the data base for analysis and decision-making, but in order to realize decision support, there must be powerful analysis tools. In 1993, Codd put forward the concept of on-line analytical processing, which is mainly to realize multidimensional data analysis in the way of client / server. OLAP is a special technology to support complex analysis and operation[4] It focuses on the assistant decision-making of decision-makers and senior managers. It can quickly and flexibly realize the complex query processing of large amount of data, and the form of human-computer interaction is intuitive and easy to understand. Multidimensional database is widely used in OLAP technology. Traditional relational database usually uses the form of two-dimensional table to represent data, that is row column structure. The intersection of rows and columns is the data element. Multidimensional database extends the relational database model and adopts a data structure that can contain more than two dimensions. Multidimensional database is also called data cube. At the intersection of dimensions, there may be more than one element. In multidimensional database, the intersection of dimensions is called measurement. There are two physical storage forms of multidimensional data structure: ROLAP based on relational database and MOLAP based on multidimensional database.

2.3. Data mining

Data mining is considered as a specific step in the process of knowledge discovery. It is a new technology to find and extract hidden patterns from large databases or data warehouses. Its purpose is
to help decision makers to find potential relationships between data and find neglected factors, which are very useful for decision-making behavior. DM technology involves database, artificial intelligence, machine learning, statistical analysis and other technologies, mainly dealing with related analysis, clustering, concept description, deviation detection and prediction tasks. Its specific methods and techniques include: decision tree method; artificial neural network method; covering positive examples and excluding negative examples method; rough set method; concept tree method; genetic algorithm; formula discovery; statistical analysis method; fuzzy theory method; visualization technology, etc.

2.4. Decision support system based on data warehouse

With the emergence of new assistant decision technology, a new decision support system architecture has emerged, which includes data warehouse, OLAP and data mining. As three independent information processing technologies, data warehouse is mainly used for data storage and organization. OLAP focuses on data analysis, while data mining focuses on automatic knowledge discovery. These three technologies have internal connection and complementarity, and combine them to form a new decision support architecture, as shown in Figure 3.

The feature of this structure is based on a large amount of data, and the system is driven by data: the data warehouse integrates, transforms and synthesizes the underlying business data, and reorganizes it into a global data view oriented to decision-making topics; online analytical processing is multidimensional data analysis based on the global data view; data mining is mining from the database or data warehouse, Obtain decision support information.

3. Application of decision support system in ship planning management

Plan management is the core of ship construction management. By establishing a proper plan, the complex design process and production activities can be linked orderly, which can effectively reduce costs, shorten the construction period and improve the economic benefits of the enterprise.

3.1. Framework of decision support system for ship planning management

The ship plan management decision support system is composed of database and database management module, model base and model base management module, knowledge base and knowledge base management module, data warehouse management module, data mining module, human-computer interaction and other modules, and its structural framework is shown in Figure 4.

The planning database includes ship plan type, ship plan operation task package, monthly and weekly plan record form, etc[6]. The ship model database mainly includes the main scale factor nonlinear statistical regression model, neural network prediction model, project health model, monthly plan assessment model, monthly plan tracking model, overall schedule model, etc. The knowledge base includes the practical experience accumulated by decision-makers in the process of ship design and construction, laws, regulations and rules in different codes required by different classification societies,
And the actual working environment of the ship. The function of the data mining module is to query, analyze and mine the data to mine hidden decision information. The human-computer interaction module converts the user's thought into a computer-recognizable language, and at the same time joins the human subjective evaluation to obtain a reasonable output result.

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