

# RESEARCH PROCESS ORIENTED INTELLIGENT DECISION SUPPORT SYSTEM FRAMEWORK

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**Abstract:** According to the overall development of intelligent decision support system (IDSS), we sum up the features of some existing basic framework and lacks in dealing with problems. Based on the basic framework and hierarchical thinking of intelligent decision support system, we make the research progress-oriented hierarchical framework of intelligent decision support system and briefly describe the function of each module. Finally, starting from the acquisition of knowledge system in hierarchical framework, we analyse the knowledge's collection and processing in intelligent decision support system, explicit of tacit knowledge and module-chain solutions of and process knowledge.

## 1 INTRODUCTION

Intelligent Decision Support System (IDSS) is one kind of Decision Support System (DSS) developed by American scholar Bonczek and others in the 80s. Its core idea is to combine artificial intelligence with other relevant scientific findings to make an intelligent decision support system, which can deal with not only quantitative issues but also qualitative issues.

IDSS is the combination of artificial intelligence (AI) and decision support systems (DSS), it is actually composite system, which integrates decision support system (DSS) and expert system (ES). ES simulates the ability of experts to solve problems and to support the policy-makers to make their decisions. DSS, which is built on the integration of data processing and model-driven, focused on quantitative analysis during the 1970'. Because of having no human intelligence, lacking of knowledge and expert support, the result of processing uncertainty and unstructured problems was unsatisfactory. And knowledge-based expert system was smart enough to focus on qualitative analysis. IDSS, which integrates ES on the basis of DSS, was developed since then. DSS's main parts include the database system, model base system, human-computer interaction system components, etc. ES is made of knowledge, its management system and the inference machine. The traditional way to combine

these two was to separate ES in different parts of DSS, or the whole ES to act as a separate component inside DSS.

IDSS, which takes advantage of both ES and DSS, fully achieve the combination of qualitative and quantitative. Its problem-solving ability has greatly improved.

After years of in-depth research, intelligent decision support system theory has been infiltrated into the structure, problem solving and other aspects, which has significant impact on strategy methods and process. IDSS research has developed from decision-making components to the components of the comprehensive integration, from quantitative-relied models to knowledge-based intelligent decision-making methods, to make intelligent decision support system theory and method more mature. Although the theory of intelligent decision support approach is becoming more and more mature, but there is not too much real success, because there is great relation between intelligence reality and system knowledge domination, system application framework and integration methods and so on.

## 2 THE HIERARCHICAL STRUCTURE FRAMEWORK OF INTELLIGENT DECISION SUPPORT SYSTEM

### 2.1 The Hierarchical Structure Framework of Intelligent Decision Support System

#### 2.1.1 The Integrated Architecture based on Components

Since R.H. Sprgue brought up Two Libraries (database and model base) theory of Intelligent decision support system's basic architecture in 1980, there has emerged the framework based X library and the problem processing mode, and later it developed into IDSS consisting of the problem-solving ,human-computer interaction System, model base systems, database systems and knowledge base system, and knowledge systems, known as the expert system (ES), consists of three parts including the knowledge base, knowledge base management system, inference engine. Its basic structure is shown in Figure 1.

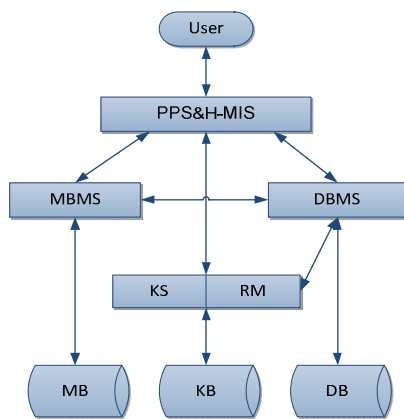


Figure 1: The three libraries basic framework of Intelligent Decision Support.

When IDSS deal with a particular problem, it will combines with the corresponding data into its database, model base and knowledge base, or add a related field database in its three-library system. Based on this, there emerges five libraries system structure which also includes methods and text database. But with the increase of the number of libraries in IDSS, the structure becomes complicated as the function is enhanced, which make it difficult to achieve.

#### 2.1.2 The Structure based on the Problem-Processing Mode

The DSS model structure based on issues-dealing Bonczek proposed consists of knowledge system, language system and the problem processing system. Decision problems in which language subsystem provides representation of decision problem and interpretation of the decision-making structures; knowledge subsystem is responsible for issues related to decision-making; problem processing subsystem gets decision problem from the language subsystem, and through relevant knowledge operation of knowledge subsystem, results in rational decision-making results. The structure uses a unified structure of knowledge- processing, which is good to the expansion of system functions, and can be considered as an evolutionary structure. However, the model follows the idea of expert system in problem solving, and can not fully reflect the role of decision-makers in model structure and model selection. As the knowledge required for decision-making process are very complex, which include factual knowledge, reasoning knowledge and expertise knowledge in decision-making areas. Yet such a system as a decision support system will make the system too large and difficult to achieve, for knowledge of this structure lack of indiscrimination in knowledge concept and specific issues in specific areas.

Therefore, oriented to the application for different objects, the three library systems should be optimized reasonably to enhance its coordination and consistency, and it also need to be redefined the framework in the problem solving process.

### 2.2 The Introduction of Hierarchical Idea

The significant progress of General system theory provides a new approach to intelligent decision support system. The basic idea is: any complex system can be viewed as a multi-model system. The general system model commonly used has three categories: input / output system model, target acquisition systems model, hierarchical system model. Therefore, the general system model can be used as an important class of model problem in description implementation. The introduction of intelligent decision support method can effectively achieve the control of the evaluation process. Based on the classic three-library system of intelligent decision support system, we optimize IDSS framework referred to hierarchy, and the whole system can be divided into the application layer,

business logic layer and data layer system, shown as Figure 2.

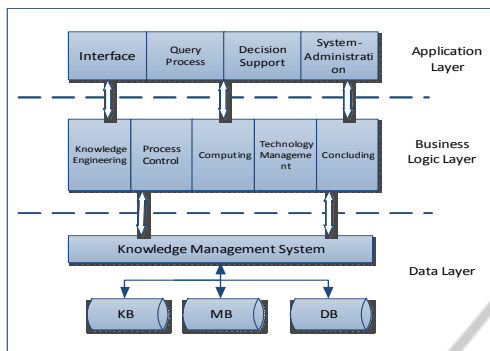


Figure 2: IDSS system architecture based on the Hierarchy model.

After using Hierarchy model, the IDSS top-down framework is divided into three layers: application layer, business logic layer and data layer.

### 2.2.1 Application Layer

The application layer mainly deals with all analysis communication between business logic layer and users, including 4 sub-modules: interactive interface is responsible for passing user requests and results display, etc., it is an important channel to for users to interact with the system. Query processor interprets the user's natural language into executable statements for machine searching. Decision-making is the presenting interface for knowledge the system.

### 2.2.2 Business Logic Layer

Business logic layer handles all activities related to the evaluation process, which includes five modules, namely, knowledge engineering module, process control modules, processing operations module, technology management module and the conclusions generated module. And its overall responsibility is knowledge focus processing, process control and results analysis.

### 2.2.3 Data Layer

Data layer is mainly used for knowledge, models, data extraction, and storage and call management.

## 3 THE KNOWLEDGE-BASED PROCESS IN SYSTEM WITH HIERARCHICAL MODEL

Knowledge Systems is the core components of intelligent decision support system. For quite some time, the decision support system is affected by the structure of multi-database system, it also separate data, model, method and knowledge to build database and management. According to different decision tools applied, there appears several decision support system, such as model-relied system, data-relied system and communication-relied system and so on. Actually, during the decision-making process, no matter what the decision-maker gets, from fact, rules, method to the inferential process. All those things are essential knowledge for making a decision. To manage that knowledge together, it will make a concise system structure, and also a unified dealing method, which then become a main stream of IDSS knowledge research.

### 3.1 Classification of Knowledge

Knowledge involves in IDSS mainly have three kinds: descriptive knowledge, procedural knowledge and reasoning knowledge. Descriptive knowledge defines various environment-related status information for the specific decision-making, including past, present, future and assumed data and information. Procedural knowledge defines process, steps and strategies in the problem solving, such as business-running rules, action programs. Reasoning knowledge defines how to get valid conclusions in various possible situations. The three kinds of knowledge are corresponding to data, models, indicators, methods in traditional multi-database system, and the specified relation is shown in figure3 below:

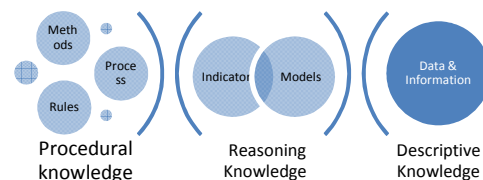


Figure 3: Classification of Knowledge in IDSS.

We can see there are not great differences between descriptive knowledge & reasoning knowledge and traditional multi-database. It needs just slight modifications for the relational database

in knowledge-based system. But for procedural knowledge representation, such as the evaluation process, it is difficult to achieve by traditional methods, so it needs reasonable analysis and design.

### 3.2 Knowledge Engineering

Knowledge engineering design is based on expert system, which is responsible for collection, development of knowledge, access to external information, process it by knowledge rules, store information the form of database records to support calling, comparing and choosing in the decision-making process. In addition, an important function of knowledge engineering is to interact with knowledge workers, access to professional and authoritative knowledge as the first reference of the system operation control. The process is as shown in Figure 4:

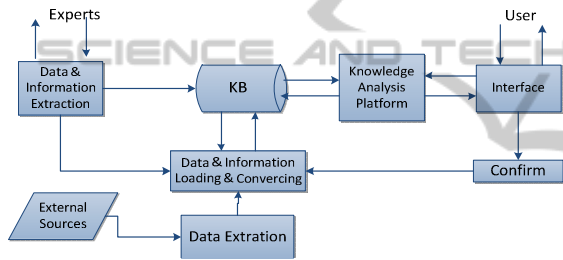


Figure 4: Schematic diagram of the knowledge engineering process.

Ordinary users or knowledge workers and external information are the three main sources for knowledge engineering sources to obtain information. Information got through these three sources will experience knowledge extraction, transformation and loading operations, access to knowledge and analysis platform for analysis and processing, filter out redundant information, and store in knowledge base according to certain rules to for the call.

In addition to knowledge library, the model library can provide information about the limitations and operating parameters on computing model. The database can access a lot of knowledge through data mining, data integration and other technology.

Conclusion is another important function of knowledge engineering. It is responsible for assessing outputs from different types of analysis (including providing specific decision services based on the track and analyse of user behaviour) .Especially for the causal task; it will screen out false or inconsistent results based on a

standard, and generates simple and profound explanation of the model environment the user can understand. In the process, it will use the generation model and knowledge base, model base interaction, deductive knowledge, analogical reasoning and other techniques.

### 3.3 Dominance of Process and Other Hidden Information

The knowledge management system is mainly responsible for dominance of knowledge. It will make the empirical and rational knowledge got from a variety of information sources be structured and formal processed, then dump them respectively, in a particular machine readable format to knowledge base, model base and database. Knowledge management systems manage many knowledge objects including data; text flow, validating model, metadata, process, processing algorithms and the corresponding operating software.to complete the unified function.

Process is an important component of tacit knowledge. A complete process mainly includes model, index data, evaluation criteria and operational control these four types of information. Each model calls indicators and data in turn in accordance with control information for processing operations. Results operations carried out will be determined by the evaluation criteria until the satisfactory results are got. According to the results of different judgments, the model will be called by multiple times, and the model organization called in accordance with the form of a chain is known as the model chain. The model chain is shown as below.

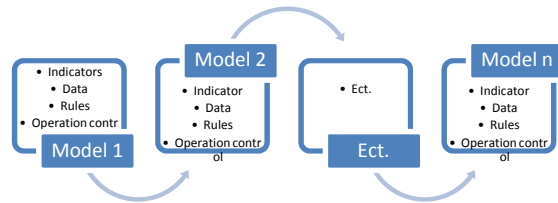


Figure 5: Model chain of the process.

A model chain reflects a process, in control of all kinds of information in the model chain running: such as the evaluation value index which is stored in the database as a record, then can save knowledge of the process.

Process control controls the running process according to a variety pre-qualification before the model chain run , and provides the operation interaction (including the analysis and tracking of

user preference), that is, in the form of Process control platform to provide the tips and guidance of parameters ,input and output, models, knowledge in the process of decision-making process during user Interaction.

## 4 CONCLUSIONS

Intelligent decision support system is a complex system. Using logical framework can make the system structure more clear and the integration of the various parts easier. Good system structure also laid the foundation for future system implementation. Knowledge is the core of intelligent system. How to externalize this knowledge, which decides the system's degree of intelligence e.g. process, experience, becomes increasingly important. Based on these, the paper provides a reference for future researchers. Next research goal is the integration of the various components within the hierarchy framework.

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## REFERENCES

- Shan-Lin Yang, 2004. Machine Learning and Intelligent Decision Support System. *Beijing: Science Press.*
- Wang Lin, Guo'an Gao, 2000. The structure of object-oriented model systems in IDSS. *Computer & Information Technology.*
- Yong Liu, 2005. Research on the Collaboration of Object-Oriented Model & Knowledge Base. *North-western Polytechnic University's journal.*
- Zhejiang Geng translated, 2009. System Analysis and Design in a changing world. *China Machine Press.*
- Guozhou Yang, 2005. R&D of GIS-based intelligent decision support systems research for channel Management. *Chongqing University's journal.*