Knowledge Based DSS

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INTRODUCTION

"A knowledge based DSS is a computer information system that provides information and methodological knowledge (domain knowledge and decision methodology knowledge) by means of analytical decision models and access to data base and knowledge base to support a decision maker in making decisions in complex and ill structured tasks." (Klein & Methlie)

The conceptual frameworks of knowledge based DSS is the result of the merging of two conceptual frameworks, the DSS framework and the knowledge based framework. These two frameworks were developed in parallel over a period of about 20 years, roughly from 1965 to 1985. We shall briefly recall these two frameworks and then explain why they were merged. The knowledge based DSS framework has since then evolved in its own right, taking into account methodological and technological advances.

BACKGROUND

Concepts Related to the DSS Conceptual Framework

The conceptual framework of DSS is based on the idea that many important classes of decision situations can be supported by providing decision-makers with a DSS application.

The DSS application is the result of two forces, firstly the demand of the decision maker for a better support in order to perform the task he is in charge of more effectively and secondly, the opportunities provided by technology and the culture prevailing in the organisation. (Klein & Methlie, 1990). The type of task we discuss here implies there is a decision to take with some necessary preparatory work. The conceptual framework is, at a given time, embedded in a DSS development environment which uses the available technology at the time of implementation of the development environment. The development environment is software which will be used to speed up the process of application development and produce applications with professional characteristics. The task the decision maker is expected to perform can, in the general case, be broken down into a series of sub-tasks:

- **Recognition** of a problem or situation requiring design of a solution and a decision
- Decision problem **diagnosis** and **structuring**
- generation of **alternatives** and their description (outcomes, uncertainty)
- **Choice of an alternative (**decision criteria, preferences)
- Decision **implementation and monitoring** (in particular for group decision)

For most professional DSS applications, the steps of problem recognition and structuring are bypassed because the application was designed for a class of decisions which is known in advance. For other situations these steps may require analysis. The decision maker can be a single person or a group involved in the decision process. In the case of the more complex situation of a group, the commitment to the decision is made easier if the group has been involved in the different decision steps and is truly convinced by the arguments used for selecting the alternative. In a group, due to possible conflicts of criteria and preferences, it is normal that different alternatives be preferred by different persons facing an identical decision situation. Also **power** and **control** problems related to the design, adoption, and use of DSS applications, exist in organisations (Humphreys, 1998).

The tasks can be supported in a DSS application by the following functions:

- Easy **capture** concerning **information** (variables, facts, documents…) **relevant and useful** for the study of the **decision class**
- **Management** of **data** relevant to the decision class including **analytical** tools

- **Presentation** of information needed for the **analysis** of the decision
- **Computing** of **criteria** associated with alternatives
- **Easy and flexible interaction** between the user(s) and the DSS application
- **Communication** such as PC-based video between the users, allowing DSS application sharing, in case of a decision involving **distant users** in a **group decision.**

For professional DSS applications designed for a **decision class** within a given organisational **context**, that is, designed to support repetitive decisions, the organisation defines, to a certain extent, the method used to make the decision. For example, a DSS application may be used in a bank to provide support to credit employees in deciding to grant various types of loans to companies. The decision class in this example is that of credit decisions to companies in a given country. Such an application requires capturing or accessing relevant data needed to compute decision criteria according to the type of loan. A credit officer in a bank is managing a portfolio of clients; the application should allow him to manage the data of the clients he is responsible for. The client may request several loans over time. The historical record of the client is important for the decisions. The **data-base** of all the clients' records is a very important source of information to improve the quality of the decision of credit officers. This data base will be made up of balance sheets and income statements from the companies requesting loans and other information. Statistics derived from client companies in the same industry provide very useful information to improve decision through comparative analysis and statistical measures of risk. This credit application is an example among many, for which DSS applications have proved highly successful. In many similar situations, the DSS application is provided to a large number of employees and the life span of the application can be of many years. As a consequence, most of the employees were not involved in the design of the application. The application will be shared by all the credit officers of the bank, and the same application will be used to deal with any client or prospect.

The evaluation of decision criteria may imply a **computation**, for example, in our credit example, a variable measuring self-financing computed using accounting variables from historical balance sheets and income statements. The computation may require the use of a **model** to simulate a future state of affairs for the client and to derive the value of decision criteria if this state of affairs becomes reality. For example, the credit officer will evaluate the future repayment capacity of the company over the duration of the loan if the financing of an investment to increase production capacity is granted. In this case some hypotheses are implied by the relationships linking certain variables of the model. In our credit application example, the preference for various decision criteria (return, risk…) should be taken into account. However, the risk preference to be used is not the preference of the credit officer but the risk preference decided, for all loans of the same type, by the management of the bank. In such a case the management preference is enforced by including it in the DSS application. This can be done through a decision rule to select one alternative (accept or reject the loan request) as a function of bank preference for the criteria. A **communication** function may be needed in such a credit example since the delegation of responsibility may vary according to the characteristics of the request for loan (new or existing client, amount of the loan, etc.) and several persons may be involved in the decision. The application can, in such cases, be designed to enforce the domains of responsibility of employees. Other applications may be designed to allow the user to apply his own preferences and not a preference function embedded in the application.

Figure 1 shows a **resources** based view of a DSS application. A first resource is made up of information items, which have proved important to reach the decision. These criteria are often computed from more elementary variables, but can also, according to the decision class, take the form of images or videos. For example, the application for the maintenance of the chemical plant described in Pieri (2001) uses photos of corroded parts. This **list of variables**, often indexed, is a characteristic of the application; it is associated with a file or entity in a data base. This information is captured through input forms, dialog boxes from the user, or from data bases or data feeders (for real time trading support applications for example). A second type of resource is made of **reports** (eventually mixing text, graphics, images**)** which are used to display information relevant for the decision maker. Information displayed in reports can be elementary variables or variables computed through a **procedure**, a **model,** or **a data base query**. **Models** constitute a third class of

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