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Towards a Knowledge-Based Strategic Information System

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This paper presents research findings of a project at an early stage. It proposes a method that can be applied in the EIS environment to assist users interactively articulating and expressing their decision questions and to determine the information requirements. The information is organised according to themes and constitutes some information space within which proper information can be retrieved to meet users' needs. The research project has adopted several theoretical methods of inquiry, such as strategic business objectives (SBO), soft systems methodology (SSM) and a knowledge-based approach, in order to articulate the unstructured decision problems and provide information for decision-making at a strategic level.

1. Introduction

Executive Information Systems (EIS) have been developed into powerful business software technology in assisting decision makers to gain competitive advantage. Today's EIS allow users to access any computerised data source within or outside of an organisation. A variety of business reports can be produced to present information in an understandable format.

One of the key issues in building up EIS is the determination of information requirements, for which many strategies and methods are found (Davis, 1982; Watson & Frolick, 1991). In current practices, when an EIS is installed for users, the developer has to chose one of the strategies or methods to elicit users' requirements and to decide what and how information is organised in the EIS. Many drawbacks rise from such practices and they will be discussed later.

This paper proposes a method of determining information requirements (in this paper it is defined as information space) in EIS. The aims of this method are (1) to assist executive users articulating the questions for decision-making (i.e. decision questions). This process is done by providing knowledge of the critical business processes and principles, thus executive users are able to get an overall view of the current status of the business. (2) to derive information requirements that are grouped by themes or dimensions, thus configuring information space. (3) to provide decision makers the same information if a same decision question occurs.

2. EIS as a Decision Enabler

EIS have become powerful decision support tools for executives as well as managers at all different levels. EIS make all information within or outside of organisations available to managers for decision-making.

2.1 Features of EIS

EIS have evolved by taking advantage of advanced hardware, software, data access, communications between platforms and multimedia technology. EIS provide executives with easy access to internal and external information that is relevant to their critical success factors (Watson et al, 1991). Descriptions of features of EIS can be found in many articles. The most significant features of EIS are reflected in two aspects:

- information retrieval across multiple data source based on business terms without necessarily knowing where data is physically stored,
- information is presented in acceptable formats to the users' individual desire.

'Drill-down' facilities in EIS enable users to go down quickly through aggregated levels of information to obtain an overview of the business in its environment, and to discover problems and opportunities. Hot-spotting shows clearly which areas of information are available for drill-down; navigational aids provide users with guide maps when retrieving in complex information space. Traffic lighting facilities, based on business rules, highlight the areas of analysis results which may be potentially problematic and call for special attention.

EIS as a means of scientific analysis can provide a sound foundation for better informed decision making.

2.2 Determining Information Requirements

To determine users' information requirements at a strategic level is not an easy task. One of reasons is that decision questions at this level are often unknown beforehand and unstructured. Precedents of the same decision questions may be lacking because of the unpredictable and innovative nature of strategic management, therefore it is difficult to learn from the past experience the relationships between decision questions and required information. Moreover, it can be observed that within the same industry, organisations often have different business strategies, and different criteria for judging their success. Therefore no standard information provision functions for the EIS could be pre-set, each system has to be tailored to meet the information requirements of individual users.

A key prerequisite for designing an EIS is a full understanding of executive's information needs. Davis (1982) identified four strategies in determining information requirements. Many methods are derived from these strategies. One of them is Strategic Business Objectives (Volonino & Watson 1992) which will be discussed later as it will be used in this research.

3. To Develop a Method for Deriving Information Space

With respect to the current stage of EIS technology, our research attention has been directed to develop a method to answer the following two questions:

- how executive users can be assisted to articulate their decision questions, and the questions expressed in primitive elements?
- How the primitive elements constitute a decision space, and the decision space determines the information requirements (i.e. information space).

The software tools based on this method of Decision/Information configuration (DeInCon) can be developed and incorporated into EIS software to improve their usefulness.

3.1 Aims of the DeInCon Method

A main aim of the method is to allow EIS users to determine information space via an interactive environment within EIS.

There are normally pre-defined information dimensions in EIS, and an user can simply constitute an information space by performing 'point-and-click'. Sometimes certain information dimensions are not ready-made for selection, because information requirements are not pre-defined in the EIS, though the information is available for retrieval. The DeInCon method aims to identify the relevant business concepts and establish relationships between these concepts and information dimensions so that they can be made available for configuring information space.

This process mainly involves following steps:

- to articulate the decision question based on a management view of the critical business processes,
- to process the decision-making elements associated with the question, and derive information required in the critical elements,
- to aggregate necessary information and constitute the information space.

To realise such a method, one needs to appreciate the nature of strategic decision-making. Mintzberg (1994) states that strategic decision-making is a complex process. It reflects what a manager learns from all sources (his or her personal experiences and the experiences of others throughout the organisations and hard data from market research and the like) and then synthesises the learning into a vision of the direction the business should pursue. This indicates that the decision-making process is intuitive and creative (Hathaway & Newton, 1994). It needs management experience, domain expertise and a knowlwdge of business objectives. Decision-making is often in a dynamic situation. Executive's information requirements change in order to gain competitive edge. This urges us to consider a learning ability in the DeInCon method that enables decision makers to place more information in EIS.

3.2 Theoretic Foundations for the Research

One of the approaches adopted in most EIS development is prototyping (Watson, et al., 1989). This is because of the difficulty of specifying in advance what information is needed and how it should be presented (Runge, 1988). Delivering prototypes quickly and getting executive users feedback, more information can be placed in the EIS. This approach iterates EIS software by involving executive users and technical staff. Problems can result from executives having no time to do so, or executives needing information that cannot be provided immediately, because there is no requirements available in the EIS.

A purpose of EIS is to serve information that supports business objectives of organisation. The approach of strategic business objectives (SBO) takes an enterprise-wide perspective based on the critical business processes to provide information for decision-making support.

In our research, the method for configuration of information space from the decision question also adopts the SBO approach . To be more precise, a combined approach of SBO, soft systems methodology (SSM) (Checkland, 1981) and knowledge-based approach is to be used.

Strategic Business Objectives (SBO)

The SBO is to provide EIS to support the competitive advantage, in a way that align the EIS with the organisation's strategic plan. The information provided for this purpose will show how well the strategic business objectives are being met. This is also important for developing the DeInCon method.

The SBO is used as a scientific basis for the method design. The decision questions are often associated with understanding and monitoring current status of operations from management perspectives. An overview of the business performance can be obtained from tracing the business processes and analysing the processes at different levels and functional areas. Therefore the critical business processes that accomplish the business objectives strategically must be identified in order to articulate the decision questions in the business sense.

The information about the critical business processes will be defined in configuring the information space.

Soft Systems Methodology (SSM)

SSM focuses on understanding the problems rather than providing solutions. Often the problems that present themselves are ill-defined or 'soft'. SSM uses *rich picture* to define problems and conveys the process, interactions and sources of conflict. A *root definition* reflects a concise description of a human activity. A *conceptual model* is constructed from the root definitions enabling the user to understand the problem situation. Change for improvement of the conceptual model will be done by giving a feasible action from a comparison of views.

The SSM approach is used to organise the captured critical business processes in a management concept and draw interrelations between the processes. These processes can be decomposed into sub-processes according to business principles, for example, marketing is a process. Sales, pricing, costing and etc. are the sub-processes which partially reflect marketing performance. The sub-processes are structured at lower levels. Thereby a conceptual model of the decision-making activities with supported critical business process is constructed.

These processes or sub-processes may be across business functional areas, and related to other processes. Different processes may share the same information. For example, information about a product is concerned with production managers more in production schedules, or in purchasing; marketing managers are interested in products from product-availability and sales perspectives.

A precise information space should be configured to meet this kind of requirement. If users express their question in a not clear way, the articulation process provides them with an interactive way to emphasis their particular needs.

Knowledge-based approach

Two types of knowledge will be organised in a knowledge-base to support the process of determination of information requirements and decision-making: declarative and procedural knowledge. Declarative knowledge includes the business concepts and relationships. They are used to define business principles and operations. Procedural knowledge tells the processes decomposition of decision questions and also tells how the information spaces can be configured.

Knowledge represented in the DeInCon method will facilitate the articulation and configuration process and the result of learning from the processes will be added into the knowledge-base. This approach will combine the executive decision-making ability of humans with EIS techniques:

- to improve users' knowledge of the organisation,
- to enhance learning capability of EIS,
- to speed up the configuration of information space by learning from the examples,
- to learn the implications of key performance indicators which concern them most with an explanation facility.

3.3 Building the DeInCon Method

Having positioned this research project on the theoretical grounds and studied the current EIS practice, we have conceived the DeInCon method which is virtually a process of decision question articulation and a process of information space configuration, plus a set of rules. Figure 1. illustrates the method with an example.

An application of the method starts from core business functional areas, for example, production and marketing. Management activities around these areas can be structured at different levels.

The top-down process is for *problem articulation*. A decision question which is general and vague can be decomposed into structured and specific business processes. Each business process has the necessary information defined. A higher level process is the definition for the lower ones. When the decision question is located precisely in the decision space, it means that the *problem articulation* reaches the destination. Then the bottom-up - *information space configuration* - process starts from there to aggregate the information dimensions, and configure the information space. This process needs a set of configuration rules to filter out less important ones. The articulation of decision questions starts from as low a level as possible. For example, sales is one of the most important processes in marketing and sales performance can be evaluated by the sub-processes at its lower level, such as distribution, sales territory, market share, etc.

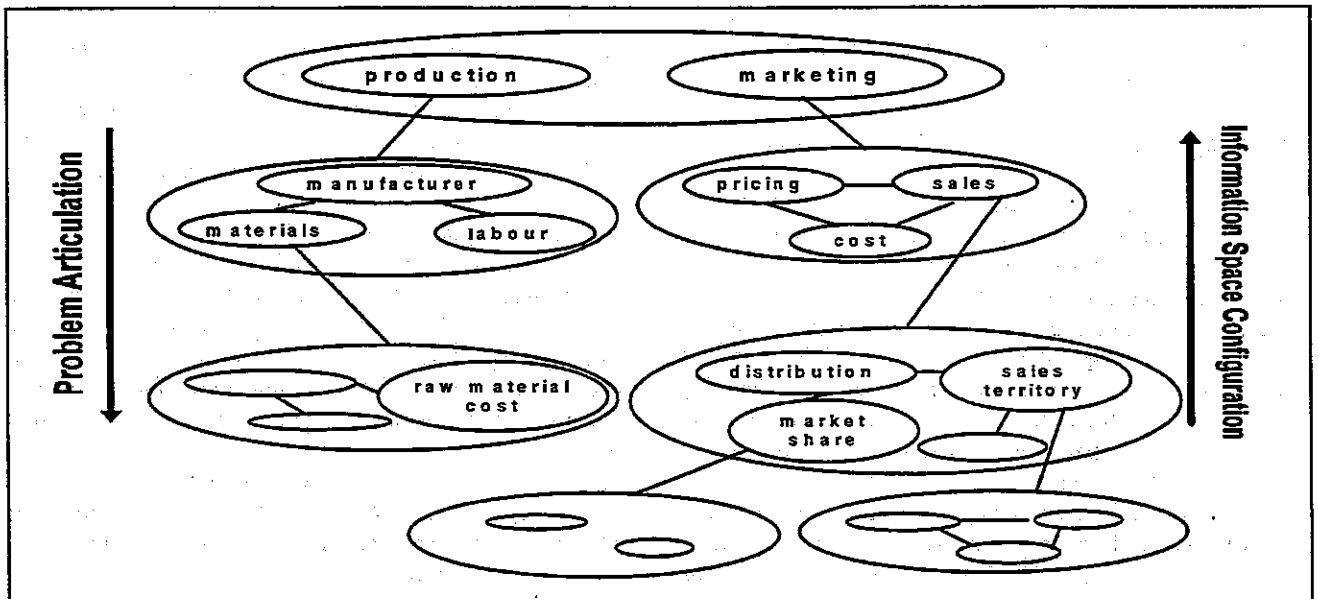

Figure 1. An example of the DeInCon method.

4. Integrating the Decision Assistant Module into EIS

The Decision Assistant (DA) is a software module that can be embedded into an EIS environment (see Figure 2.). This module will be designed based on the method discussed in section 3.3. EIS users can start from this module to express their decision questions. The appropriate information for the questions will be provided by the existing EIS functions. However for the users who are certain about what information they look for and

technically familiar with the EIS can work without using the DA module.

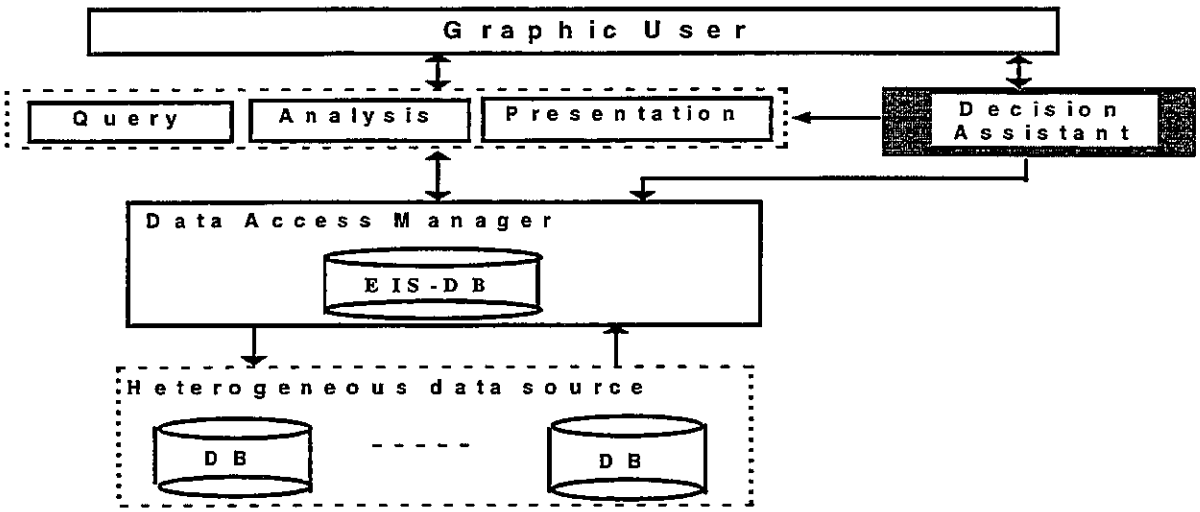

Figure 2. Integrate the Decision Assistant module in EIS.

The DA module has interrelations with EIS through three channels. Through a link between the GUI and the DA, users' decision questions can be articulated interactively with users' control. The output of this process is the information space which can be transferred into Data Access Manager of EIS for information retrieval. This information space is also used to generate presentation format.

5. Issues for Future Research

This paper has discussed the usefulness of EIS in strategic management, as well as some limitations of this technology due to the characteristics of decision-making at strategic levels. To enhance EIS technology, a method has been outlined as to assist EIS users to articulate their decision questions and to determine the information required from EIS.

Some issues will have to be placed on the research agenda. The first one is to detail the DeInCon method, specifically to elicit the business and management knowledge in the declarative and procedural forms, so that the method can be operationalised. The method will be then verified by applying it to various case studies. Moreover, the method will be implemented in a software module which will possibly be incorporated into EIS to improve the effectiveness and efficiency of the existing technology.

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