

Chapter 1 – Introduction

The goal of knowledge acquisition is to construct an accurate and efficient formal representation of an expert's knowledge (Turban 1995). The knowledge engineer usually elicits the knowledge from the expert, conceptualises it and represents it in the knowledge base via a variety of interactive techniques. In general, expressing knowledge and transferring the knowledge to either a machine or a person is difficult. The expert is often unaware of the detailed process or rules he uses to arrive at a conclusion. The indirect transfer of knowledge between the domain expert and the knowledge base via a knowledge engineer may lead to a long and inefficient knowledge acquisition process. Transferring this knowledge to a machine requires knowledge in a detailed and organised manner.

1.1 Background and the state of existing knowledge

The actuality of the Web has turned the focus of modern Decision Support Systems (DSS) to opportunities that the World Wide Web (Web) offers DSS. The Web extends the capabilities of DSS to a large number of geographically dispersed users at a relatively low cost (Shim et al 2002). The Web's impact ensures a more efficient decision making process that is more widely used. The latest advances in DSS include tools such as data warehouses, on-line analytical processing (OLAP), data mining, Web-based DSS, collaborative support systems, virtual teams, knowledge management, optimisation-based DSS and active decision support (Shim et al 2002).

Several expert system development software packages such as EXSYS, Level5 and VP Expert simplified the syntax of production rules to make them easier to create and understand. Ideally, a natural language processor used to represent knowledge in a specific representation structure would support the domain expert best (Turban 1995).

Expert System knowledge can be transferred over the Web not only to human users but also to other computerised systems including DSS, robotics and databases. Expert Systems (ES) can even be constructed using the Internet. Intranet-based GroupWare can facilitate the process of collaborating builders, experts and knowledge engineers. Knowledge maintenance can also facilitate the use of the Web, which is useful to users (Turban et al 2001). The Web can support the spread of multimedia-based ES. These systems, also called *Intelimedia systems*, support the integration of extensive multimedia applications and ES.

According to Shim et al (2002), ES technology is now being replaced by Intelligent Systems (IS) to fulfil two key functions:

- Screening, sifting and filtering of a growing overflow of data, information and knowledge, and
- The support of effective and productive use of Executive Information Systems (EIS)

1.2 Motivation

Because of the ambiguity of natural language, it is difficult to represent knowledge that is free from any structure. Recent research in this area has been towards evaluating text for keywords used in a domain and identifying relations between these keywords to parse a meaningful framework of valid concepts about the system when specifying the system's requirements (Gervasi and Nuseibeh 2002).

Shim et al (2002) recommends that DSS researchers and developers:

- Identify areas where tools are needed to transform uncertain and incomplete data into useful knowledge alongside qualitative insights
- Be more prescriptive about effective decision making by using intelligent systems and methods
- Exploit advancing software tools to improve the productivity of working and decision making time, and
- Assist and guide DSS practitioners in improving their core knowledge of effective decision support

They state that this process will be enhanced by continued development in Web-enabled tools, wireless protocols and group support systems, which will expand the interactivity and pervasiveness of decision support technologies. This study aims to investigate the possibility that a domain expert can maintain a frequently updated knowledge base resulting in a productive and effective support of a web-based intelligent decision support system.

1.3 Problem definition

This study investigates the possibility of a web-based intelligent DSS model where domain experts could maintain a decentralised knowledge base in an easy and domain-expert-friendly way without the assistance of a knowledge engineer.

An intelligent DSS has an expert system component that emulates a human expert's skill in a specific problem domain. The skill of the human expert is codified in the knowledge base component of the ES. When presented with input, the inference engine component of the expert system uses this knowledge base to derive a solution. The decision support system then presents a knowledge worker or decision-maker with all the skills (the ES component with explanation facility) to make a well-informed decision. This study focuses on a set of similar problem domains in which the knowledge contained in knowledge bases is changed periodically. Codifying the knowledge presented in a knowledge base usually involves a complex procedure where the expert and codifier share the responsibility of the codified result.

It would be valuable if the expert himself could define and maintain the knowledge in the frequently updated knowledge base. The definition and maintenance of this knowledge base should be easy and

domain-expert-friendly. In Figure 1-1, Turban (1995) presents a conceptual model of DSS. In Figure 1-2 a modified version of his conceptual DSS model is presented to emphasise the focus of this study.

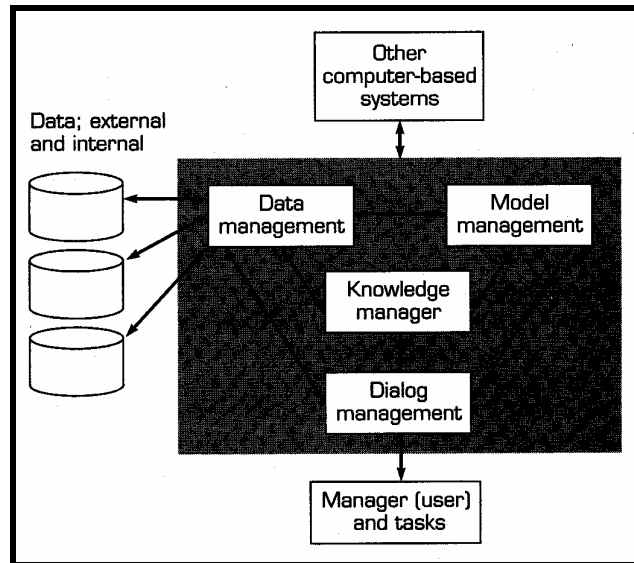


Figure 1-1 A conceptual model of Decision Support Systems (Turban 1995)

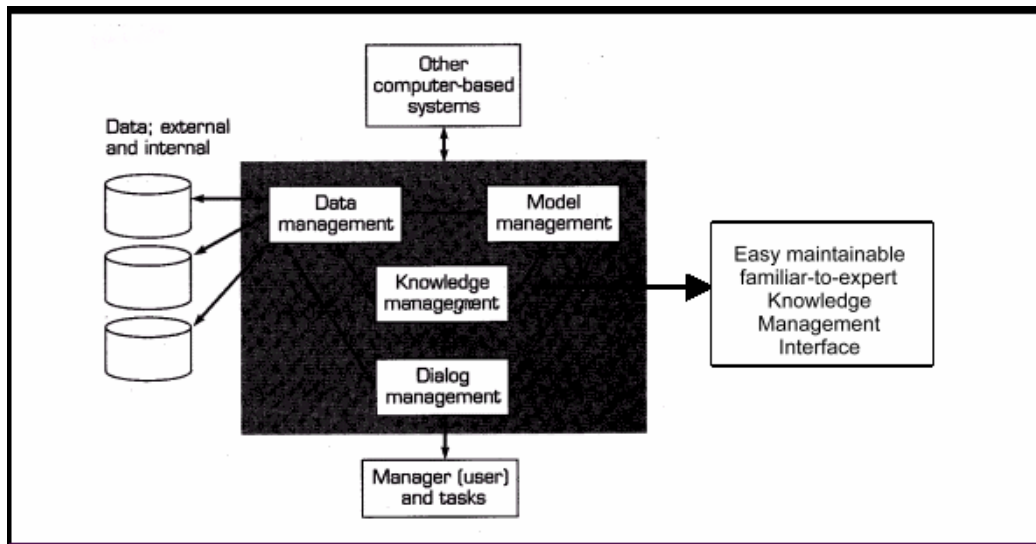


Figure 1-2 Turban's (1995) DSS model modified to include the focus of this study

In order to allow the expert to maintain his knowledge, a special kind of interface allowing the expert to express himself is necessary. The maintained knowledge serves as input to the Intelligent Decision Support System (IDSS). This study aims to investigate the possibility of such a system (See Figure 1-2).

1.4 Research hypothesis and objectives

It is possible to provide an interface to a knowledge base where course-skilled domain experts can develop and maintain their knowledge that serves as an input to the expert or intelligent component of an Intelligent Decision Support System.

Objectives of the research:

1. This study will describe an Intelligent Decision Support System (IDDS) model that includes the following features:
 - A knowledge base interface
 - That allows course-skilled experts to specify and maintain their knowledge
 - A decentralised knowledge base
 - Used by an Intelligent Decision Support Web-application
 - A specific DSS (model)
 - That provides the decision-maker with the knowledge from the knowledge base to reach a well-informed decision
 - A web-based DSS user interface that provides the user with
 - Alternatives to explore, and
 - Explanation of suggestions made to the user or knowledge worker; both contributing to the effectiveness of the decision support system
 - A data component
 - That provides information to the intelligent component and user interface, and
2. Maintenance of the knowledge in the knowledge base should not cause a new release of the IDDS application and thus ensure productivity

1.5 Structure of the thesis

The primary purpose of this thesis is to describe a web-based knowledge based decision support system (KB-DSS) model that involves a knowledge base interface that provides domain experts with a tool to maintain the knowledge used by the IDDS.

Chapter one describes the problem definition and hypothesis of the thesis. Chapter two presents a summarised literature study of Intelligent Decision Support Systems also known as Knowledge-Based Systems. Chapter three describes the construction process of Decision Support Systems and Expert Systems and the synergy they produce as Intelligent Decision Support Systems. Chapter four presents an Intelligent System case study describing and prototyping an easy-to-use decentralised knowledge base interface, as part of a web-based KB-DSS model.

Because of the decision support and expert capabilities of the intelligent system, an in-depth investigation is launched into both Decision Support Systems and Expert Systems in chapters five and six. Chapter seven presents evaluation models for DSS, ES and KB-DSS and describes how the

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student registration advice system prototyped in chapter four can be evaluated. Chapter eight concludes with final remarks and possible future research suggestions.

A final note: The acronyms used in the thesis are summarised as a List of acronyms on p. ix, and can represent the singular or the plural form.