CONSIDERATIONS REGARDING THE FLEXIBILITY OF INFORMATION SYSTEMS FOR DECISIONAL SUPPORT

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ABSTRACT: This paper presents an original model of an information system for decision making, able to provide reliable management solutions in various fields. There are presented some generalities of the proposed decision support system and then there are revealed three cases where it has been successfully applied: two applications in university management and one in urban planning. The results obtained using the proposed information system in the three cases presented in the paper show its high flexibility and the undeniable usefulness of information systems for management.

KEY WORDS: web-based decision support system, decision support technology, information systems for management.

1. INTRODUCTION

Decision support systems (DSS) are computer technology solutions that can be used to support complex decision making and problem solving. DSS have evolved from two main areas of research—the theoretical studies of organizational decision making (Simon, Cyert, March, and others) conducted at the Carnegie Institute of Technology during the late 1950s and early 1960s and the technical work (Gerrity, Ness, and others) carried out at MIT in the 1960s [11].

DSS have evolved significantly since their early development in the 1970s. Over the past three decades, DSS have taken on both a narrower or broader definition, while other systems have emerged to assist specific types of decision-makers faced with specific kinds of problems. Research in this area has typically focused on how information technology can improve the efficiency with which a user makes a decision, and can improve the effectiveness of that decision [14]. Modern decision support systems (DSS) provide their users with a broad range of capabilities.

Current DSS facilitate a wide variety of decision tasks including information gathering and analysis, model building, sensitivity analysis, collaboration, alternative evaluation, and decision implementation. Often, DSS are built and used for ad hoc analyses, but increasingly, decision support is integrated into business processes and information systems. In the past few years, the World Wide Web [3] has facilitated, nurtured, and promoted a broad resurgence in the use of decision technologies to support decision-making tasks. The global Internet and the World Wide Web are now the primary enabling technologies for delivering computerized decision support. Due to the growing interest in the Web, there are many on-going efforts to develop and implement Web-based DSS in various areas, such as health care, private companies, government, and education [5].

2. THE DSS CONCEPT

Decision support research began in the 1960s. Scott Morton [16] demonstrated that managers benefited from using a computer-based management decision system.
The original DSS concept was most clearly defined by Gorry and Scott Morton [6], who integrated Anthony's [1] categories of management activity and Simon's [18] description of decision types. Gorry and Scott Morton combined Anthony's management activities and Simon's description of decisions, using the terms structured, unstructured, and semi-structured, rather than programmed and nonprogrammed [17].
A DSS was defined as a computer system that dealt with a problem where at least some stage was semi-structured or unstructured. A computer system could be developed to deal with the structured portion of a DSS problem, but the judgment of the decision-maker was brought to bear on the unstructured part, hence constituting a human–machine, problem-solving system [17].
Shim et al [17] describe what probably came to be a more customarily used model of the decision-making process in a DSS environment. Here, the emphasis came to be on model development and problem analysis. Once the problem is recognized, it is defined in terms that facilitate the creation of models. Alternative solutions are created, and models are then developed to analyze the various alternatives. The choice is then made and implemented consistent with Simon's description

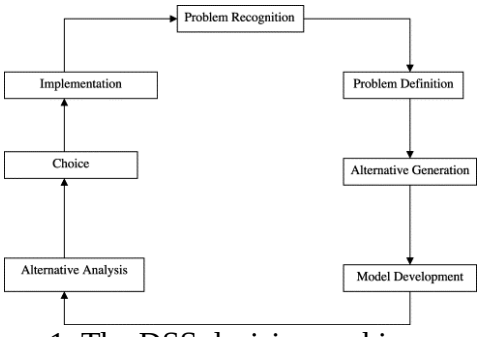

Figure 1. The DSS decision-making process (source: Shim et al, 2002)

The decision-making processes take place in a structure consisting of the following elements:

- the system under consideration representing reality;
- the problem which requires a decision, i.e., the disparity between the desired state and the existing state of the system; and
- the decision-maker, the entity required to decide upon the action or a set of actions undertaken to achieve certain objectives and realize the desired state.

The decision-making process aims to reduce or eliminate the gap between existing and desired states, and thus solve the problem. Objectives are provided by those to whom the decision-maker is responsible. Most methodologies assume an individual decision-maker. Political and social developments taking place in various countries in the world cause the notion of a single "decision-maker" to lose meaning. Complex economic, social and political structures require the decisions to be made in a framework of sophisticated processes involving many stakeholders, who more or less directly participate in the decision-making process [15].
What connects the above-mentioned elements of the structure underlying the decision-making process is information, which is continuously gathered, exchanged, processed, enhanced, evaluated and used during the decision-making processes.

3. WEB-BASED DECISION SUPPORT SYSTEMS

The difficulties in communication and exchange of information between practitioners (decision-makers) and scientists can be attributed to the fact that most scientists seldom meet with policy makers. Consequently, scientists have limited knowledge and experience regarding policy makers' perceptions or the costs of inadequate information. Regular and structured contacts between policy makers and representatives of the public opinion are even less frequent. To enable constructive and efficient dialogue,

both policy makers and the public need a solid, robust and accessible knowledge base [15].

Beginning in the early 1990s, four powerful tools emerged for building DSS. The first new tool for decision support was the data warehouse. The two new tools that emerged following the introduction of data warehouses were on-line analytical processing (OLAP) and data mining. The fourth new tool set is the technology associated with the World Wide Web [17]. Knowledge-driven DSS can suggest or recommend actions to managers. The Web helps deliver this type of DSS to a much broader audience of decision makers.

A useful framework for thinking about ways in which decision support can exploit the Web is the twin perspectives of "Web as media" and "Web as computer" [4].

The Web can be conceptualized as a vast, distributing computing capability. The "Web as computer" decision support capabilities fit in three broad categories: digital product demonstrations, previewing a decision support product using online interactive examples, and on-line, Web-based Decision Support Systems.

The proposed decision support system falls under the third category, of web-based DSS, helping decision makers to take action based on a complex mathematic algorithm, without the use of advanced mathematical skills

4. TYPES OF DECISIONAL SUPPORT PROGRAMS

Knowledge management (KM) can have great efficiency, on an individual and organizational level, when it is implemented correctly thru decision support systems. This is because KM is closely integrated with information and communication technologies [12], which play a key role in enabling and supporting its practice [2] and because of its capability of reducing bias in the strategies formulated by a decision maker. In this respect decision support systems are a key tool in KM, because they act like an expertise locator for the individual or organization, which is trying to ascertain a correct path of action.

Decision support systems come in a varied array of shapes and sizes. They vary based on the way organizational and individual knowledge is located, extracted, organized and ultimately presented to the decision maker. We identify two types of support system: the "Black Box" and "White Box" systems and propose a third type the "Grey Box".

The "Black Box" DSS (BBDSS) is centered on automating knowledge by applying systems that tend to solve problems in the place of individuals [19]. These have the propriety of reasoning in a limited and narrow field [2]. They are useful when applied to routine activities and in the case of rule based or case based reasoning. There are some drawbacks in the utilization of BBDSS. They tend to become cumbersome, unwieldy and error prone when the number of rules applied in a system increases, or when these cannot be specified precisely.

The "White Box" DSS (WBDSS) takes the diametrically opposite approach. It is focused on guiding the decision maker by presenting relevant knowledge, thus enhancing their interpretation of it and facilitating problem solving [13]. Sometimes though this system can overload the individual with information and create confusion and unnecessary time depletion in the process.

This paper presents a "Grey Box" Decisional Support System (GBDSS) as a tool in the KM arsenal that combines characteristics of the "Black Box" and "White Box" systems. It facilitates and explicates an individual's decisions based on a set of personal, programmable criteria (BBDSS) and it presents recommendation and guidance (WBDSS) solely based on them. As a result the vast amount of information available is synthesized into knowledge based report on which the decision maker can ascertain the best course of action in a shortened time span. The presented GBDSS can be used in various situations by business administrators, doctors, architects [8], engineers, but also by

academics who have managing positions and are faced with daily challenges[7, 10].

5. OVERVIEW OF THE PROPOSED DSS

The proposed decision support system allows the decision maker to choose the best alternative out of a set of possible interventions, based on a group of custom-defined criteria.
The system allows the use of an indefinite number of alternatives and criteria. Underlying the DSS is an innovative approach that combines two well-known algorithms: the hierarchic-analytic process, used mainly in operations management, and the advanced multi-criteria analysis based on the FRISCO formula. A detailed description of this combined algorithm may be found in the work of Grecu and Denes (2012).
The developed algorithm requires good mathematical abilities from the user, and this can therefore limit the real-life applicability of the proposed decision support system. In order to make it easier to use the DSS and increase the number of potential users, the DSS was implemented online with a user-friendly interface. For this purpose, an extension for the content management system Joomla! 1.5 was developed. It can be easily integrated into any website created with Joomla! 1.5 [9]. The purpose of our approach is to offer a finite tool to decision makers by leaving the computational part to the server. We are thus allowing users to concentrate on planning issues rather than having to understand the formulas that lie behind the algorithm.

6. THE WORKING PRINCIPLE OF THE DSS

For exemplification it is used a hypothetical situation for a decision in an urban planning situation, with five decision alternatives and five selection criteria. First, the user is requested to enter the number of criteria (figure 2A) and specify (figure 2B) the name of each criterion (C1 – C5). Then a quadratic matrix is generated and the user has to compare each criterion against the others. One can choose whether each criterion is more important, equally important or less important than other criteria (figure 2C). It is important to remember that the relationships between criteria are the choice of the decision maker. This choice can be based on sociological studies, public surveys, urban planning goals, academic literature reviews or other specific needs. This step basically establishes a hierarchy of the chosen criteria and each criterion is given a weight.

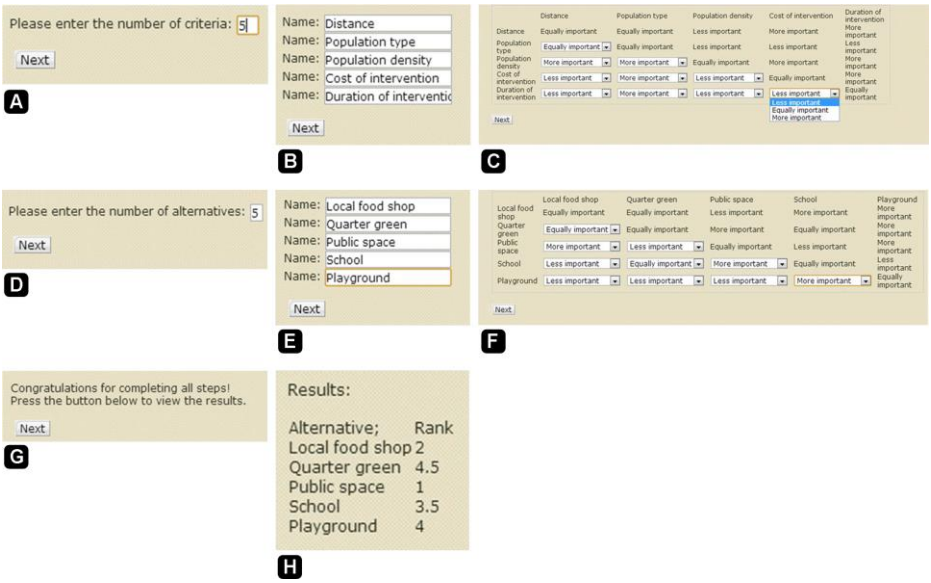

Figure 2. Functioning of the DSS (Source: Grecu and Morar, 2013)

Then, the user is asked to enter the number of decision alternatives (figure 2D), to define/name them (figure 2E) and then to compare each alternative against the others based on how they satisfy each criterion (figure 2F). For example, when the alternatives are compared considering the criterion "cost of intervention", the cheaper alternative is considered "more important".
The software then uses the encoded mathematical algorithm and returns the optimal solution, as shown in figure 2H. This allows the urban planner to make an informed decision, based on the specific needs of the community and the particularities of the neighborhood, rather than intuition.

7. CONCLUSIONS

The developments in the last decade will guide us in understanding the coming evolution of decision support technologies. Changes will occur in technologies and in the implementation environment—users are becoming more sophisticated and more demanding, organizations are becoming more complex yet more agile and flexible, and global regulatory and competitive factors rapidly change, affecting the design and use of these tools. The future will offer surprises, to be sure, but certain trends can be observed.
The practice of building Decision Support Systems can benefit in many ways from the increased availability and growing sophistication of Web technologies. These technologies provide platform-independent, remote, and distributed computation and the exchange of complex multimedia information. System maintenance is simplified and centralized, letting end users focus on problem analysis and decision making. While there is significant promise in the idea of Web-based Decision Support Systems, there are also some important challenges that must be overcome. We need to resolve technological, economic, and social and behavioral challenges to realize the benefits the Web can provide as a platform for building Decision Support Systems.
The proposed decision support system allows decision makers to choose the best alternative out of a set of possible ones, based on a group of custom-defined criteria. The system allows the use of an indefinite number of alternatives and criteria. However, in this paper there was presented a scenario with five possible decision alternatives and five selection criteria.
As the proposed DSS allows the decision maker to define his/her own set of decision alternatives and selection criteria, it has a virtually ubiquitous applicability, being adaptable for all decision scenarios where it is required to choose from a list of alternatives, based on a set of criteria. The proposed decision support system speeds up the decision making process and increases the quality of the management process.
Underlying the proposed DSS is an innovative approach that combines two well-known algorithms: the hierarchic-analytic process, used mainly in operations management, and the advanced multi-criteria analysis based on the FRISCO formula. The developed algorithm requires good mathematical abilities from the user, and this can therefore limit the real-life applicability of the proposed decision support system. In order to make it easier to use the DSS and increase the number of potential users, it was implemented online with a user-friendly interface.
Further research may mean creating a series of databases with recommendations based on knowledge, in order to guide the user when choosing the decision criteria and their importance for the project.

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