

DECISION SUPPORT SYSTEMS: CONCEPTS, DEFINITIONS AND TYPOLOGIES

ROZALIA VERONICA RUS¹

ABSTRACT. There is no definition unanimously accepted for Decision Support System. First definitions were given around 1970 and were pretty broad. In this article we will analyse some of the most important decision support systems' definitions and we will overview the main characteristics of this type of information systems. The appearance of the new technologies supported the evolution and development of Decision Support Systems and researchers in this field tried to adapt these definitions to the new trends in technology. In the final part of the paper we will present the fundamental structure of a DSS application and main DSS typologies.

Key words: Decision Support Systems, unstructured problems, semi-structured problems, data, models.

In this paper we want to make a detailed analysis of some of the main Decision Support Systems' definitions and typologies. This material will use the analytical descriptive method based on a reach specialty bibliography, especially from North – American space. We will also use content analysis method and observation method in our scientific research.

According to D.J. Power Decision Support Systems research began in the late 1960². Decision Support Systems (DSS) appeared as a naturally necessity of the American corporations' management because it was obvious that the information products produced by Management Information Systems (MIS) were not meeting many of the decision-making needs of management. The major role for this new type of information systems was to provide ad hoc reports and interactive support for managerial end users. Nowadays, these systems are used on a large scale in United States of America and on a small scale in Occidental Europe being, unfortunately, almost absent in Romanian private and public organisations. For a better understanding of Decision Support System concept next we will present several definitions.

¹ Teaching assistant, Faculty of Business, Babeș-Bolyai University, Cluj-Napoca, Romania, vrus@tbs.ubbcluj.ro

² Power, D.J., *A Brief History of Decision Support Systems*. DSSResources.COM, World Wide Web, <http://DSSResources.COM/history/dsshistory.html> , version 2.8, May 31, 2003.

One of the earliest attempts to describe the concept of Decision Support Systems (DSS) was that of Gorry G. A. and Scott-Morton M. S. (1971). They described these new systems as "interactive computer-based systems which help decision makers utilize data and models to solve unstructured problems."³ In this definition appear the concepts of *data*, *model* and *unstructured problem*. To understand this definition we have to explain the *unstructured problem* concept. We will start by presenting Gorry and Scott-Morton's definition of structured problem: "a fully structured problem is one in which all three phases of any decision process – intelligence, design or choice – are structured. That is, we can specify algorithms, or decision rules, that will allow us to find the problem, design alternative solution, and select the best solution."⁴ Structured problems are repetitive and routine and require little judgment, evaluation, or insight. This kind of problems can be solved applying known formulas in which the values of the key variables are also known. In structured problems the decision making process can be easily automated with IT. Unstructured problems are novel and nonroutine and require considerable judgment, evaluation, and human creativity. Unstructured problems cannot be solved with formulas and values of some key variables are not known, so these problems are very difficult to automate with IT. Semi-structured problems contain the elements of both structured and unstructured problems and can be solved using both human judgment and computers. Gorry and Scott-Morton classified the information systems by the degree of structure involved in the processes. Most definitions from the beginning of '70s paid attention to the task structuredness and to the problem of distinguishing decision support systems from the other management support systems.

Another definition is the one given by T.P. Gerrity. He defined Decision Support Systems as: „an effective blend of human intelligence, information technology, and software, which interact closely to solve complex problems”⁵. This is a general definition, and the term “complex” can be interpreted in too many ways. Keen P. G. and Scott-Morton gave a similar definition in 1978: “Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision-makers who deal with semi-structured problems.”⁶ The key words in this definition are: *intellectual resources*, *quality of decisions* and *semi-structured problems*. Keen and Scott-Morton presented also in their book a definition which synthesised the definitions and ideas of Information System researchers in the 1970s: “Decision support implies the use of computers to:(1)

³ apud, Mora Manuel, Forgionne A. Guisseppi, Gupta N. D. Jatinder, *Decision Making Support Systems: Achievements, Trends and Challenges for the New Decade*, Idea Group Publishing, 2003, p. 102.

⁴ apud, Gray, Paul (editor), *Decision Support And Executive Information Systems*, Prentice Hall International, Inc., New Jersey, 1994, p.10.

⁵ apud, Kroenke, David, Hatch, Richard, *Management Information Systems*, third edition, Mitchell McGraw-Hill, United States of America, 1994, p. 688.

⁶ Zaharie, Dorin, Albescu, Felicia, Bojan, Irina, Ivancenco, Veronica, Vasilescu, Corina, *Sisteme informatice pentru asistarea deciziei*, DualTech, 2001, p. 18.

assist managers in their decision process for semi-structured tasks, (2) support rather than replace managerial judgement and (3) improve the effectiveness of decision making rather than its efficiency.”⁷ In these later definitions, the area of suitable problem types is broadened to include semi-structured problems, and greater importance is given to the role of the intellectual resources of individuals. We also see a shift from solving problems to assisting and supporting managers in decision making process and improving the quality of decisions. Some researchers sustained that DSS is useful only for the structured parts of decision problems, but humans must solve the unstructured parts.

As a synthesis of these definitions we consider that Decision Support Systems are a major category of information systems which represent an integrated act between human intellectual resources and computers capability having as main objectives to support and improve decision-making process. The quality of the decision depends, in a large measure, of the manager’s experience, knowledge, intuition and judgment. The system gives certain solutions but the final decision and the implementation of the decision belongs to the manager. Besides coherence and exactness, Decision Support Systems offer another extraordinary parameter represented by the reduction of the necessary time to make a decision. The main characteristics of DSS are:

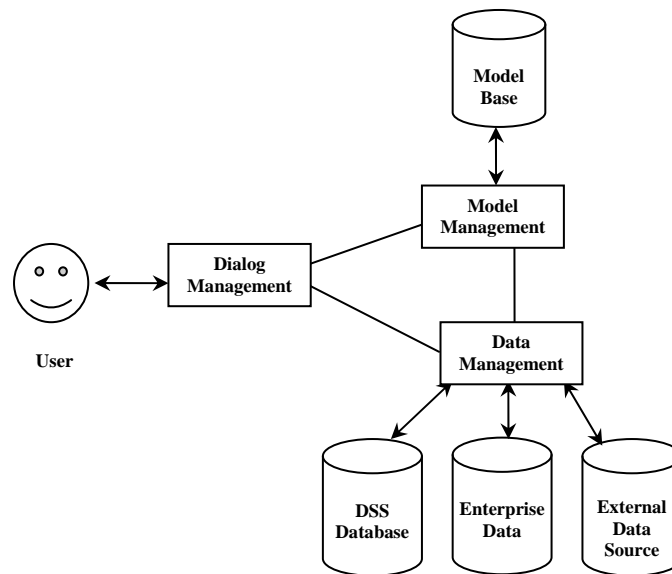
- DSS support decisions;
- are interactive computer-based information systems;
- are easy to use;
- are designed to support semistructured and unstructured problem analysis;
- provide support for all stages of decision making process: intelligence, design, choice and implementation;
- are used by managers at different levels: senior managers, middle managers, managers at operational level;
- contain broad databases;
- contain modeling and analytic capabilities;
- provide support for group decisions.

The benefits of DSS vary because of the complex situational nature of tasks they support and because of their personalized users. We will overview some of the Decision Support Systems’ advantages:

- increased productivity;
- increased problems understanding;
- increased speed;
- increased flexibility;
- reduced problem complexity;
- reduced cost.

⁷ apud, Mora Manuel, Forgionne A. Guiseppe, Gupta N. D. Jatinder, *Decision Making Support Systems: Achievements, Trends and Challenges for the New Decade*, Idea Group Publishing, 2003, p. 51.

DSSs are not only theoretical concepts but also have a large practical application. DSSs vary in application and complexity but they all share specific features. In general, decision support systems applications are made up of three components: model management, data management, and dialog management (user interface management). The fundamental structure of a DSS application is represented in the next figure ⁸ (Ariav Gad, M. J. Ginzberg):



The Model Management component: consist of both the DSS models and the DSS model management system. A model is a simplified representation of some event, fact or situation. DSS use statistical models, analytical models, accounting and financial models, representational models, optimization models, etc. The model management system stores and maintains the DSS's models. Its function of managing models is similar to that of a database management system.

The Data Management component: performs the function of storing and maintaining the information that are used by DSS. Consist of both the DSS information (data) and DSS database management system. The information used by DSS can come from: organizational database, external sources and enterprise data.

The Dialog Management component: consist of the user interface and the user interface management system. The user interface is an important component because is the part of the system users see, trough it they enter information, commands, and models.

⁸ Apud, Kroenke, David, Hatch, Richard, *Management Information Systems*, third edition, Mitchell McGraw-Hill, United States of America, 1994, P. 689

More and more DSS include also a *Knowledge Management component* which provides the necessary expertise and knowledge for resolving difficult and complex problems.

Some DSS focus on data, some on models, some on knowledge and some on facilitating communications and collaboration. We can classify DSS applications in many ways. One of the classifications is based on the dominant components of DSS application. Power (2003) identified five specialized types of DSS:

1. *Data-driven DSS*: use databases from different applications and support decision-making process by providing summarized information to managers. Usually, data are stored in a data warehouse and are analysed with OLAP (Online analytical processing) tools and data mining tools. Business intelligence systems linked to a data warehouse are examples of data-driven DSS.

2. *Model-driven DSS*: include systems that use accounting and financial models, representational models and optimization models. Model-driven DSS emphasize access to and manipulation of a model. The first DSS were model-driven and were separated from other information systems.

3. *Knowledge-driven DSS*: are based on Artificial Intelligence technology and contain specialized problem-solving expertise which consists of knowledge about a particular domain, understanding of problems, and skill at solving those problems. Comparing with the other DSS, these systems can suggest or recommend actions to managers.

4. *Document-driven DSS*: integrate a variety of storage and processing technologies to provide complete document retrieval and analysis. The components of these systems are the document base and the search tools that create text summaries and rate document relevance. Some of the technologies used in *document-driven DSS* systems are hypertext, intelligent agents and web.

5. *Communications-driven DSS*: systems built using communication, collaboration and decision support technologies.

Decision support systems are gaining an increased popularity in various domains, including business, engineering, the military, and medicine. Modern DSS provide managers a wide range of capabilities. It can aid human cognitive deficiencies by integrating various sources of information, providing intelligent access to relevant knowledge and aiding the process of structuring decisions. Proper application of decision-making tools increases productivity, efficiency, and effectiveness, and gives many businesses a comparative advantage over their competitors, allowing them to make optimal choices for technological processes and their parameters, planning business operations, logistics, or investments.

At the early 70's there were a lot of articles on DSS which tried to define this new term. In the following years the accent was put on defining structured and unstructured problems and on distinguishing Decision Support Systems from Management Information Systems and Transaction Processing Systems. Finally, the conclusion was that the degree of problem structuredness is not so relevant in

the definition of DSS because a problem become more structured as we know more about it and about the way of solving it. In time any unstructured problem may become structured. DSS are perceived in different ways by managers, IT specialist and users. For a manager the definitions and classifications of DSS are not so important, they have some expectations from these systems such as: timeless information, easiness of usage, accuracy and format of results, etc. In the last ten years there were not major contributions in DSS field, although the implementation of the new technologies and tools like client-server, web, OLAP (Online analytical processing), artificial intelligence, data warehouse and data mining have supported the evolution of DSS.

More and more frequent, DSS are integrated in larger software systems such as ERP (Enterprise Resource Planning), systems that cover all domains of activities in an organization, from operational level to strategic level. ERP are produced by specialized companies and are customized for business users. An example is the product of SAP-AG Germany, Sap-R3. These systems have multiple components for decision support from production control to strategic management. Another important trend is to include the DSS in Business Intelligence Systems.

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