

DECISION SUPPORT SYSTEM: APPROACH OF INFORMATION TECHNOLOGY IN MANAGEMENT INFORMATION SYSTEM

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Abstract

MIS provides limited support to the top-level management for interpretation & decision making, but the unstructured decisions have no pre-established decision. With such background, Decision support systems use computers to facilitate the decision-making process of unstructured decisions. This paper provides an overview of the importance of DSS in any organization. DSS, however, analyzes and interprets the data and provides the tools which help us in decision making.

Keywords: *DSS, Decision making, Interpretation. Planning, Management*

Introduction

There is a massive amount of transactional data, queries, feedback produced in any organization day by day. For future interpretation, it is necessary to analyze and compile comprehensive information that can be used to solve issues and help in decision making.

A properly designed DSS is an interactive software-based system intended to help decision-makers compile useful information from a combination of raw data, documents, personal knowledge, or business models to identify and solve problems and make decisions.

Typical information that a decision support application might gather and present are-

An inventory of all current information assets (including legacy and relational data sources, cubes, data warehouses, and data marts), comparative sales figures between one week and the next, projected revenue figures based on new product sales assumptions.

The DSS in any organization collects relevant data, analyzes them, and helps the management in taking decisions and making policies.

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This paper provides an overview of the importance of DSS in any organization. DSS, however, analyzes and interprets the data and provides the tools which help us in decision making.

Literature Review

According to Keen (1978), the concept of decision support has evolved from two main areas of research: The theoretical studies of organizational decision making done at the Carnegie Institute of Technology during the late 1950s and early 1960s, and the technical work on interactive computer systems, mainly carried out at the Massachusetts Institute of Technology in the 1960s. It is considered that the concept of DSS became an area of research of its own in the middle of the 1970s, before gaining in intensity during the 1980s. In the middle and late 1980s, executive information systems (EIS), group decision support systems (GDSS), and organizational decision support systems (ODSS) evolved from the single user and model-oriented DSS.

According to Sol (1987), the definition and scope of DSS have been migrating over the years. In the 1970s DSS was described as "a computer-based system to aid decision making". In the late 1970s, the DSS movement started focusing on "interactive computer-based systems which help decision-makers utilize databases and models to solve ill-structured problems". In the 1980s DSS should provide systems "using suitable and available technology to improve the effectiveness of managerial and professional activities", and end the 1980s DSS faced a new challenge towards the design of intelligent workstations.

In 1987 Texas Instruments completed the development of the Gate Assignment Display System (GADS) for United Airlines.

This decision support system is credited with significantly reducing travel delays by aiding the management of ground operations at various airports, beginning with O'Hare International Airport in Chicago and Stapleton Airport in Denver Colorado.

In the beginning of 1990, data warehousing and online analytical processing (OLAP) began broadening the realm of DSS. As the turn of the millennium approached, new Web-based analytical applications were introduced.

The advent of better and better reporting technologies has supported DSS start to emerge as a critical component of management design. It can be seen in the intense amount of discussion of DSS in the educational environment.

DSS also has a weak connection to the user interface paradigm of hypertext. Both the University of Vermont PROMIS system (for medical decision making) and the Carnegie Mellon ZOG/KMS system (for military and business decision making) were decision support systems that also were breakthroughs in user interface research. Furthermore, although hypertext researchers have generally been concerned with information overload, certain researchers, notably Douglas Engelbart, have been focused on decision-makers in particular.

Business Discipline Contributions to DSS

Accounting: Accounting research demonstrates how behavioral decision theory developed by cognitive scientists enriches the understanding of accounting problems with an ultimate goal of decision improvement through the improvement of the consistency of judgment. This line of research focuses on the examinations of the effects of heuristics on the accuracy of judgment using statistical decision theory, such as Bayes' theorem, as a criterion for evaluating intuitive or probabilistic judgments. These approaches provided a theoretical foundation for developing DSSs (including expert systems) to estimate the probability of bankruptcy, predict fraud, evaluate sample evidence and make a sample-size choice in audit settings, rank the importance of materiality factors, and make many other judgments of probability.

Economics: DSS researchers have referenced the economic theory of teams to explain various issues in designing and implementing group decision support systems. Especially notable, the theory of games is concerned with providing strategies for the games, both zero-sum and non-zero-sum, played by two or more persons with different interests and constrained by different rules of the game. On the other hand, the economic theory of teams is concerned with the case of several persons who have common interests in making decisions.

Management Science: Management science models have been essential elements of DSSs. Forecasting and statistical models, simulation, integer programming, linear programming, and network models have been powerful tools that have been increasingly embedded in DSSs. Advances in algorithms such as large-scale primal transshipment algorithms developed by management scientists make it possible for unsophisticated users to obtain readily understandable outputs. Advanced implementations of algorithms such as simplex methods, the new interior point, branch-and-bound algorithms, and so forth have been incorporated in commercially available software tools for DSS development (e.g., Excel).

Strategic Management: Porter's work on techniques for analyzing industries and competitors and creating/sustaining superior performance have provided an impetus and theoretical basis for developing DSSs that analyze an organization's external environment, its industry's trends, mergers and acquisitions, product/market position, facilitate strategic planning at various levels (corporate, division, department) and with various functions.

Contributions to the DSS Field from Other Disciplines

Computer Science: Relational database management theories, from the discipline of computer science, have substantially influenced decision support system foundations, architectures, and implementations since the early days of the DSS field. Ongoing innovations in database management, such as multi-dimensional data models, data warehousing, data marts, high-level query languages, and distributed databases continue to be important to DSS progress.

Database management has also impacted the DSS specialty area of model management. The structured modeling approach is an extension of the entity-relationship data model and advocates a set of model manipulation operators. In addition to database management, computer scientists have influenced the development of research in the subspecialty of DSS user interface design and evaluation.

Infrastructure: DSS takes place in a context within an organization that has a particular technology infrastructure. That infrastructure has several levels that influence what can be done from a DSS perspective, and different organizations have different capabilities. Some basic infrastructure environment considerations include the following. First, what is the computing environment, e.g., is the DSS embedded in a personal computing, mobile computing, etc. environment. Second, what is the networking environment? Is the system part of a broader system integrated into a peer computing environment, is the system linked to the Internet, etc. Third, what is the information environment? For example, is there a large transaction processing capability, such as an enterprise resource planning system (e.g., O'Leary 2000) showing information into the system, or is information captured specifically for the particular system, and to what extent is the DSS integrated with the conventional systems? Fourth, what kind of security is in place? Is there sharing of information?

Developmental Frameworks

DSS systems are not entirely different from other systems and require a structured approach. Such a framework includes people, technology, and the development approach. DSS technology levels (of hardware and software) may include:

1. The actual application that will be used by the user. This is the part of the application that allows the decision-maker to make decisions in a particular problem area. The user can act upon that particular problem.
2. The generator contains a Hardware/software environment that allows people to easily develop specific DSS applications. This level makes use of case tools or systems such as Crystal, AIMMS and iThink.
3. Tools include lower-level hardware/software. DSS generators including special languages, function libraries, and linking modules

An iterative developmental approach allows for the DSS to be changed and redesigned at various intervals. Once the system is designed, it will need to be tested and revised for the desired outcome.

Classifying DSS

There are several ways to classify DSS applications. Not every DSS fits neatly into one category, but a mix of two or more architecture in one.

Holsapple and Whinston classified DSS into the following six frameworks: Text-oriented DSS, Database-oriented DSS, Spreadsheet-oriented DSS, Solver-oriented DSS, Rule-oriented DSS, and Compound DSS.

A compound DSS is the most popular classification for a DSS. It is a hybrid system that includes two or more of the five basic structures described by Holsapple and Whinston.

The support given by DSS can be separated into three distinct, interrelated categories: Personal Support, Group Support, and Organizational Support.

DSS components may be classified as:

1. **Inputs:** Factors, numbers, and characteristics to analyze
2. **User Knowledge and Expertise:** Inputs requiring manual analysis by the user

3. **Outputs:** Transformed data from which DSS "decisions" are generated
4. **Decisions:** Results generated by the DSS based on user criteria

DSSs which perform selected cognitive decision-making functions and are based on artificial intelligence or intelligent agent technologies are called Intelligent Decision Support Systems (IDSS). The nascent field of Decision engineering treats the decision itself as an engineered object and applies engineering principles such as Design and Quality assurance to an explicit representation of the elements that make up a decision.

Applications

As mentioned above, there are theoretical possibilities for building such systems in any knowledge domain.

DSS is extensively used in business and management. Executive dashboard and other business performance software allow faster decision making, identification of negative trends, and better allocation of business resources.

A growing area of DSS application, concepts, principles, and techniques is in agricultural production, marketing for sustainable development. For example, the DSSAT4 package, developed through the financial support of USAID during the 80's and 90's, has allowed rapid assessment of several agricultural production systems around the world to facilitate decision-making at the farm and policy levels. There are, however, many constraints to the successful adoption of DSS in agriculture.

DSS is also prevalent in forest management where the long planning timeframe demands specific requirements. All aspects of Forest management, from log transportation, harvest scheduling to sustainability and ecosystem protection have been addressed by modern DSSs. A comprehensive list and discussion of all available systems in forest management is being compiled under the COST action Forsys.

A specific example concerns the Canadian National Railway system, which tests its equipment regularly using a decision support system. A problem faced by any railroad is worn-out or defective rails, which can result in hundreds of derailments per year. Under a DSS, CN managed to decrease the incidence of derailments at the same time other companies were experiencing an increase.

DSS has many applications that have already been spoken about. However, it can be used in any field where an organization is necessary. Additionally, a DSS can be designed to help make decisions on the stock market, or deciding which area or segment to market a product toward.

Are computerized decision aids decision support systems?

The term computerized decision aid refers to a very diverse set of tools based on a variety of techniques. Some are complex and sophisticated and hence should be classified as decision support systems. Other so-called computerized decision aids are simple and unsophisticated, i.e., a web page with information or a simple web-based checklist, and hence is not DSS.

The phrase decision aid has a much longer history in the academic literature than the term decision support system and the decision aid term is used broadly. A decision aid assists or helps for reaching a conclusion and making a choice among alternatives. In English, the verb "aid" means to give support or assistance and hence the overlap and sometimes confusion with the concept decision support system. At Google, a search for decision aid returns 127,000,000 results and a decision support system returns 365,000,000. I could sample only a small fraction of the results. One definition on the Web of a "decision aid" is "an object used to assist a person in deriving optimal decisions, such as a particular medical diagnosis, when to change a component on an aircraft, or which site to investigate on a scouting mission in a time of war. Decision aids are computer-based, i.e., algorithms, software and/or hardware."

Christophe David suggested that a decision aid is all about "helping people to make choices between several options (actions), based on several aspects (criteria), taking into account the individual preferences, means helping people to find their preference, considering their perception of the world." The website Request for Proposal templates (rfp-templates.com) notes "Broadly speaking, a decision-support system (DSS) is simply a computer system that helps in decision by leveraging the multi-criteria decision-making model. DSS provides a means for decision-makers to make decisions based on more complete information and analysis. Among the major advantages of the use of DSS are the following:

- 1) Increased number of alternatives examined.
- 2) A better understanding of the business.
- 3) Fast response to unexpected situations.

- 4) Improved communication.
- 5) Cost savings.
- 6) Better decisions.
- 7) More effective teamwork.
- 8) Time savings.
- 9) Better use of data resources.

Decision AID project was a computerized collection of heuristics and a multi-criteria model (Power, 1998). Most decision aids focus on the convergent phase of the decision process and help a specific decision maker come closer to making a decision or choice among alternatives. Decision aids range from a simple heuristic like mark-up pricing to a very complex tool based upon a multi-criteria model, algebraic model, or even a complex genetic algorithm. The heuristics used in computerized decision aids are rules of thumb, generally based on expert experience or common sense. When mathematical models are incorporated in decision aids they become more complex and more sophisticated.

Computerized decision aids are also sometimes called recommender systems. According to Wietsma and Ricci, "recommender systems provide decision aid and information filtering functions ... (and are) exploited in e-Commerce web sites to suggest products and provide to consumers information for facilitating the decision process."

Advantages and Disadvantages of Computerized Decision Support System

A good opportunity to summarize the advantages and disadvantages of DSS areas follows-

Advantages:

- 1) **Time savings.** For all categories of decision support systems, research has demonstrated and substantiated reduced decision cycle time, increased employee productivity, and more timely information for decision making. The time savings that have been documented from using computerized decision support are often substantial. Researchers have not however always demonstrated that decision quality remained the same or improved.

- 2) **Enhance effectiveness.** The second category of advantage that has been widely discussed and examined is improved decision-making effectiveness and better decisions. Decision quality and decision-making effectiveness are however hard to document and measure. Most research has examined soft measures like perceived decision quality rather than objective measures. For example, Hogue and Watson (1983) reported the most important reason managers cited for using a DSS was to obtain accurate information. Studies of model-driven DSS have examined this outcome more than research on other types of DSS (cf., Sharda, Barr, and McDonnell, 1988). Advocates of building data warehouses identify the possibility of more and better analyses that can improve decision-making.
- 3) **Improve interpersonal communication.** DSS can improve communication and collaboration among decision-makers. In appropriate circumstances, communications-driven, and group DSS have had this impact. Model-driven DSS provides a means for sharing facts and assumptions. Data-driven DSS make "one version of the truth" about company operations available to managers and hence can encourage fact-based decision making. Improved data accessibility is often a major motivation for building a data-driven DSS. This advantage has not been adequately demonstrated for most types of DSS.
- 4) **Competitive advantage.** Vendors frequently cite this advantage for business intelligence systems, performance management systems, and web-based DSS. Although it is possible to gain a competitive advantage from computerized decision support, this is not a likely outcome. Vendors routinely sell the same product to competitors and even help with the installation. Organizations are most likely to gain this advantage from novel, high-risk, enterprise-wide, inward-facing decision support systems. Measuring this is and will continue to be difficult. For more discussion of this issue read Ask Dan! (Vol. 6, No. 17, July 31, 2005).
- 5) **Cost reduction.** Some research and especially case studies have documented DSS cost saving from labor savings in making decisions and from lower infrastructure or technology costs. This is not always a goal of building DSS.
- 6) **Increase decision-maker satisfaction.** The novelty of using computers has and may continue to confound analysis of this outcome. DSS may reduce the frustrations of decision-makers, create perceptions that better information is being used, and/or create perceptions that the individual is a "better" decision-maker. Satisfaction is a complex

measure and often researchers measure satisfaction with the DSS rather than satisfaction with using a DSS in decision making. Some studies have compared satisfaction with and without computerized decision aids. Those studies suggest the complexity and "love/hate" tension of using computers for decision support.

- 7) **Promote learning.** Learning can occur as a by-product of the initial and ongoing use of a DSS. Two types of learning seem to occur: learning of new concepts and the development of a better factual understanding of the business and decision-making environment. Some DSS serve as "de facto" training tools for new employees. This potential advantage has not been adequately examined.

Disadvantages:

- 1) **Overemphasize decision-making.** The focus of those of us interested in computerized decision support is on decisions and decision making. Implementing DSS may reinforce the rational perspective and overemphasize decision processes and decision-making. It is important to educate managers about the broader context of decision-making and the social, political, and emotional factors that impact organizational success. It is especially important to continue examining when and under what circumstances DSS should be built and used. We must continue to ask if the decision situation is appropriate for using any type of DSS and if a specific DSS is or remains appropriate to use for making or informing a specific decision.

- 2) **Assumption of relevance.** According to Winograd and Flores (1986), "Once a computer system has been installed, it is difficult to avoid the assumption that the things it can deal with are the most relevant things for the manager's concern." The danger is that once DSS becomes common in organizations, that managers will use them inappropriately. There is limited evidence that this occurs. Again training is the only way to avoid this potential problem.

- 3) **Transfer of Power** - Building DSS, especially knowledge-driven DSS, may be perceived as transferring decision authority to a software program. This is more a concern with decision automation systems (check DecisionAutomation.com) than with DSS. I advocate building computerized decision support systems because I want to improve

decision-making while keeping a human decision-maker in the "decision loop". In general, I value the "need for human discretion and innovation" in the decision-making process.

4) Unanticipated Effects - Implementing decision support technologies may have unanticipated consequences. It is conceivable and it has been demonstrated that some DSS reduce the skill needed to perform a decision task. Some DSS overload decision-makers with information and reduce decision-making effectiveness. I'm sure other such unintended consequences have been documented. Nevertheless, most of the examples seem correctable, avoidable, or subject to remedy if and when they occur.

5) Obscuring responsibility - The computer doesn't make a "bad" decision, people do. Unfortunately, some people may deflect personal responsibility to a DSS. Managers need to be continually reminded that the computerized decision support system is an intermediary between the people who built the system and the people who use the system. The entire responsibility associated with making a decision using a DSS resides with people who built and use the system.

6) False- belief in Objectivity - Managers who use DSS may or may not be more objective in their decision-making. Computer software can encourage more rational action, but managers can also use decision support technologies to rationalize their actions. It is an overstatement to suggest that people using a DSS are more objective and rational than managers who are not using computerized decision support.

7) Status Reduction - Some managers argue using a DSS will diminish their status and force them to do clerical work. This perceptual problem can be a disadvantage of implementing a DSS. Managers and IS staff who advocate building and using computerized decision support need to deal with any status issues that may arise.

Conclusion

It is evident that DSS be extremely beneficial in overall performances of the organization, however, DSS can also be the cause of great confusion, misperception, and even inaccurate analysis. These systems are not designed to eliminate "bad" decisions.

DSS facilitates a manager in making operational decisions, but the ultimate burden of responsibility lies with the manager. Managers can sometimes be over-optimistic in their

expectations of a DSS and develop an unrealistic reliance on the system (Power, C.J; *Caveat Emperor*). Thus, it may be concluded that a class of information with computerized systems supports the both business as well as organization. A proper designed data support system would certainly help decision-makers to compile more useful information in near future.

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