"It is impossible for ideas to compete in the marketplace if no forum for their presentation is provided or available." Thomas Mann, 1896

Decision Support Solutions (DSS) Overview

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White Paper - December 2006

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1. DSS

Decision Support Solutions (DSS) are an important asset of enterprise information systems. They are computer-based information systems that supply interactive and informative support for managers and senior executives during the decision proces. [1]

Origins

The concept of DSSes was born in the early 1970s and prospered through the 1970s and 1980s. It developed at the intersection of two trends. The first was the growing belief that existing information systems, despite their success in automating operating tasks in organizations, had failed to assist management in many higher level tasks. The second was a continuing improvement in computer hardware and software that made it possible to place meaningful computing power (powerful, usable, etc.) directly in the hands of managers and executives. DSS systems were meant to be decision focused, supportive of higher levels of management, adaptive, and user initiated and controlled [2]. Two seminal articles in the early 1970s defined DSS and have had a major influence on the field ever since. The first of the articles**, "Models and Managers: The Concept of a Decision Calculus**" [Little, 1970], had its roots in management science. It opened with

the observation that "the big problem with management science models is that managers practically never use them". Little pointed out the difficulty of developing effective computer implementations of management science models and stressed the importance of the model interface. He described the concept of a "decision calculus" as a "model-based set of procedures for processing data and judgment to assist a manager in his decision-making." The requirements for such a system to be successful were that it be simple, robust, easy to control, adaptive, complete on important issues, and easy to communicate with. [Little, 1970, p.B470].

Little was right in this matter. DSS systems are built to assist the human being. They are designed so human beings can use them easily. These requirements have been a recurring issue in the DSS field and will always be.

The second of these articles**, "A framework for Management Information Systems**" by Gorry and Scott Morton, defined the term "decision support system" and has been widely recognized as the foundation paper for the field. Gorry and Scott Morton were motivated by the failure of management information systems (MIS) practitioners to understand the range of possible applications of computers in organizations. In particular, they argued that a greater proportion of MIS resources should be devoted to the development of systems to support "decision processes" in organization. They felt that much greater payoffs were possible in this field, because the technology was sufficient and the process of how human beings solve problems was understood enough to capture aspects of the human decision process in models. The Gorry and Scott Morton framework (figure 2) maps potential computer support for management activities on two dimensions. The horizontal axis consist of Anthony's three levels of managerial activities**:**

a) operational control,
b) management control and
c) strategic planning [Anthony, 1965].

Figure 1: The Anthony Management Triangle

This classification has been widely accepted since its inception. The vertical axis contains three classes of decision situations:

1) structured: corresponds roughly to programmed decisions. (standard procedures)
2) unstructured: correspond roughly to unprogrammed decisions
3) semi-structured: there isn't a cut-and-dried method for handling the problem

Programmable decisions can be fully automated; in unprogrammable situations, the system must fall back on "whatever general capacity it has for intelligent, adaptive, problem-orientated action" [Simon, 1960]. Gorry and Scott Morton define the semi-structured case as one in which one or more of the three phases of decision making according to Simon: intelligence- (scanning environment), design- (develop alternative courses), and choice stages (selection of alternative) are unstructured. [2]

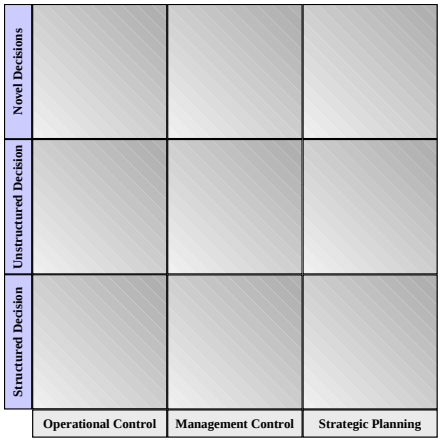

Figure 2: Morton Framework

2. Components of DSS

Decision Support Solutions usually consists of

1. **Hardware**: PC-workstations, alone or connected through a network to other systems, for access to other DSS software-, models-, Data Warehouses or Data Marts and datahelp-sources.

2. **Software**: DSS generators contain modules for database-, models-, graphical delivery software and dialog screen control. The software varies from complete DSS-generators to simple spreedsheet packages either as stand-alone or integrated packages. The software has to at least support control of dialog screens. This provides the “friendly” user interface. This interface is important for the interactive analytical modeling. User input is supported by commands, menus, questions, icons, etc. Output is provided by prompts, answers, reports and graphic images. Model-management supports development, revision and control of models in a DSS-model environment. It also connects models to integrated models and supports analytical modeling for the decision process. The current trend is the “multi-dimensional” spreadsheet approach to DSS modeling. Data warehouse management supports the making, using, and maintenance of a DSS-database. It helps define the structure of data records and relations within the database, saving and retrieval of data, updating the database and monitoring the integrity of the database.

3. **Data**: A DSS-data warehouse or data mart contains data and information from the organization’s enterprise database, external databases, and the personal database of the manager.

4. **Models**: The model archive contains a library of mathematical models and analytical techniques. These are stored in different program modules and -files. Parts of models can be combined into an integrated model supporting a specific decision.

5. **People**: A DSS is used by managers or their staff specialists for investigating alternative decisions. Often these systems are developed by the end-users but for more complex DSSes and software packages this is the job for information system specialists.

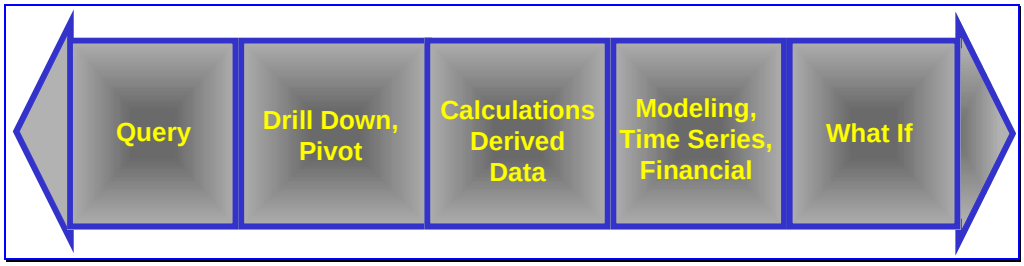

Figure 3: Decision Support Analysis Continuum

DSSes use (1) **analytical models**, (2) **specialized databases**, (3) **the insight** and **judgment capability of the user** and (4) **an interactive, automated modeling** processes supporting structured and unstructured decisions residing somewhere on the Decision Support Analysis Continuum (Figure 3). They are designed as ad hoc quick response systems, used and controlled by managers. Because of this, DSSes can directly support the different forms of decisions, personal decision making styles and wishes of individual managers.[1]

3. Types of DSS systems

There are two kinds of DSSes: institutional and ad-hoc. An institutional DSS is used for large or complex problem solving in companies facing problems constantly. For example a DSS that is used for strategic planning within a company. An ad-hoc DSS is used for small- or less complex, sometimes "onetime", problem solving. For example a DSS that is used in a reorganization of a company. The most important goal of a DSS is the supply of information and decision support techniques needed for solving specific problems or taking advantage of certain opportunities. Because of this, a number of DSSes are designed to support a type of decision that is common in a certain industry (i.e. banking: MAPP), or function area (i.e. marketing: BRANDAID). I found on internet an agricultural DSS called: Parkland Agriculture Research Initiative (PARI) DSS. The study of a medical DSS, called QMR, concluded that the use of QMR early in the hospital course by an experienced physician-user would lead to reduced net charges and early diagnosis in diagnostically challenging cases.

GDSS

In practice, decisions often are made by groups of persons. This type of decision-making has its own specific requirements. There are a number of different software packages for group Decision Support Solutions (GDDS) on the market. For instance, there are

extensive electronic meeting systems (EMS) with several program modules for support of the different group activities that can take place in the group decision process, such as the development of ideas, the research of certain subjects and voting.[1]

Why do we need these systems? A US consultancy firm estimates that the average US Executive spends 800 hours each year in meetings, 30% of total work hours, with 24% of those hours considered to be wasted. Cognitive feedback in group decision making is information that provides decision makers with a better understanding of their own decision processes and that of the other group members. It appears to be an effective aid in group decision making. Research indicates that (1) developers should include cognitive feedback as an integral part of the GDSS at every level, and (2) they should design the human-computer interaction so there is an intuitive and effective transition across the components of feedback at all levels. Finally, researchers trying to enhance the capabilities of GDSS should continue examining how to take advantage of the differences between individual, interpersonal, and collective decision making.[3] There are also software packages for groups (so called group-ware) in support of the activities of the members of a work-group. Those members must have access to workstations that are connected to each other by a LAN. These packages are designed for computer-based systems for cooperative work (CSCW) or for collaborative work support systems (CWSS). They support the group decision making, the preparation of documents, communication and the other work group activities. They make it possible, for instance, to do a joint “what-if'-analyses” of a spreadsheet, to work together on a document with a task editor, or to use E-mail.[1]

ODSS

ODSS stands for organizational Decision Support Solutions. This is a relatively new research field. There are two interpretations of ODSS. The first is that ODSS are a subset of DSS designed to support decisions that are of an organization-wide importance. In this view, ODSS consists of a communication structure together with DSS, GDSS, and EIS systems designed to support top management. A broader view that ODSS is a natural extension of research focus from individuals (traditional DSS), to groups (GDSS), to the organization as a whole. [2]

4. Analytical models

Working with a DSS is an interactive analytical modeling process. A manager or staff specialist uses a DSS-software package on his workstation. This enables the manager to ask questions, reply and give instructions with a keyboard, a mouse, a touch screen or by voice-input. Output is directed to a display, printer or a storage medium. Working with a Decision Support Solutions means dealing with four elementary kinds of analytical modeling activities:

(1) 'what-if'-analyses,
(2) sensitivity analyses,
(3) goal searching analyses and
(4) optimization analyses.

'What-if' analyses is looking at how changes in selected variables influences other variables. (e.g. What are the consequences for the sale if we spend 10 percent less on advertisement?)

Sensitivity analyses is looking at how repeated changes in one variable influence other variables. (e.g. Decrease the advertisement budget each time by 200 dollar to discover a relation between advertisement spending and sales.)

Goal searching analyses is changing selected variables repeatedly till a specific variable reaches a target value (e.g. Raise the advertising budget till the sales are $1 million.)

Optimization analyses is searching for an optimal value for a selected variable subject to certain constraints. (e.g. What is the optimum amount of advertisement, given the current budget and choice of medium?)

5. EIS, IRS & DSS

A EIS (executive information system) differs from a DSS because EISs are information delivery systems only. They focus on the need for strategic information of the top management. Certainly a DSS application will contribute significantly to the pool of information available to the EIS. The IRS (information reporting system) provides management with targeted reports generated from either the DSS or the corporate repository. Because managers don't ask for specified information in advance, IRSs can be voluminous. A DSS helps interactively with the retrieval of the information needed for a decision greatly reducing the volume of paper reports. This is the essence of the idea of a Decision Support Solutions.[1]

6. DSS and artificial intelligence.

The aspirations of artificial intelligence (AI) has a unique relationship with DSSes. The guiding objective of AI is to emulate intelligence. For example, in the subfield of AI known as expert systems, the objective is to understand human expertise in some fashion and codify it in a computer program. The fact that many expert systems support rather then replace decision-makers is a fact of life explained by the complexity of the problem and the limited system capabilities in building such systems. On the other hand, from its inception, DSS has recognized the need to decision making in unstructured domains. It seeks to provide a helpful environment for exploration of a problem domain but allows the users to draw their own conclusions. Thus, an expert system may use concepts from DSS, and a DSS might contain an expert system component or two. [2]

Models in conventional Decision Support Solutions (DSS) are best suited for problem solutions in domains with well defined/structured (mathematical) or partially defined/semi-structured (heuristic) environments. Non-conservative/unstructured domains are those that either lack a known model or have a poorly defined domain model. Neural networks (NNs) represent an alternative modeling technique that can be useful in such domains. NNs autonomously learn the underlying domain model from

examples and have the ability to generalize, i.e., use the learned model to respond correctly to previously unseen inputs. Research has been done to explore the use of NNs for providing decision support by generalization in non-conservative/unstructured domains. The results of this research indicates that NNs have the potential to provide adequate decision support in non-conservative/unstructured domains.[4] Another important contribution of AI to DSS is that it provides sophisticated tools and concepts for building advanced software systems. AI approaches are extensively used in the field of model management (managing decision models). [2]

7. User interfaces

Continuing developments in the technology of computer interfaces -such as windowing software, interactive graphics, voice recognition, multimedia systems- have a major impact on the acceptance and effectiveness of DSS applications. A subfield of computer science, human factors, is concerned with the effective design of computer interfaces for a broad range of computer systems including DSS. A vast array of studies have been done to determine the effectiveness of graphical versus tabular displays of information. These studies concluded that graphical or tabular displays are more effective than textual displays. The success of Windows and other GUIs (graphical user interfaces) shows that most users prefer graphics over plain text. Finally, the emerging area of visual interactive modeling (VIM) is where users interact with a graphic image of their problem and immediately see the result of their decisions on the computer screen. Turban and Carlson provides an overview and presents the results of a survey showing that VIM greatly enhances managerial involvement and understanding of the modeling process [Turban and Carlson, 1988].

8. Human information processing and decision aids

Cognitive research asserts that DSS design should reflect individual differences in the way that decision-makers gather and process information [Benbasat and Taylor, 1978]. For example, a DSS might provide only summary information to a person with a cognitive style that involves "perceptive" information gathering (Looking at the big picture rather than messing with details). Unfortunately, research seeking to show an advantage in matching DSS features to users' cognitive styles has not provided strong prescriptions for DSS design [Huber, 1983]. Although DSS is concerned with supporting the decision maker, there has been relatively little research by DSS researchers on the decision process of individuals and the social interaction that takes place as groups make decision. DSS designers have generally accepted the Simon phases of decision making (intelligence, design, and choice) as providing an adequate model for decision making. However, there has been a realization that cognitive science and behavior decision theory, in particular, have important implications for DSS design and use. Generic decision aids (sometimes called cognitive aids) are aimed at improving the decision-making process itself, independent of any particular decision situation. Such decision aids can move the boundary between what is structured and unstructured by helping users discover and understand various components of their decision problem, suggest a

sequence of human information processing steps that should be performed, help users manipulate intuitive and judgmental relationships, and extend human memory and conceptual capabilities.

Multiple-criteria decision-making techniques are examples of cognitive aids for situations in that the choice phase of decision making is unstructured, because choices have to be made on the basis of conflicting criteria [Saaty, 1980]. Please refer to Johansen discussion of cognitive support for groups [Johansen, 1989] .

9. Conclusion

The traditional assumption in the Decision Support Solutions (DSS) literature is that if decision makers are provided with expanded processing capabilities they will use them to analyze problems in more depth and, as a result, make better decisions. Empirical studies investigating the relationship between DSS and decision quality have not borne this out. The explanation for such outcomes could be found in behavioral decision-making theories. The literature on behavioral decision-making indicates that the conservation of effort may be more important than increased decision quality. If this is so, then the use of a decision aid may result in effort savings but not improved decision performance. The results of two studies indicate that subjects with a decision aid did not use more information than those without one. Overall, subjects behaved as if effort minimization was “the most” important consideration.[5] If this is so, the effort we must make in developing DSS environments is to meet the challenges of KISS. They must be easy to use. They must have rapid access to corporate information. They must present the material in the format acceptable to the decision maker.

Although DSS systems do not increase the decision quality, they have earned there existence. Because of DSS, research has been done on how people make decisions, how AI can help with decision making process, etc. So the secondary benefits are quite large and important. Finally, DSSes have proven that they can reduce the effort allowing the decision makers more time to gather more information regarding the decision. As is always the case, it is up to the decision maker to determine the trade-off between information overload and making the right decision. The DSSes primary responsibility is, simply, to ***deliver the right information to the right person at the right time in the right format.***

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11. Glossary

API (Application Programming Interface) Interface that allows programs from multiple vendors to be integrated.

Client Single user computer which is connected via a network to, and works in conjunction with, one or more shared computers (servers), with data storage and processing distributed between them.

Cube (or Data Cube) Physical and/ or metaphorical data structure used to hold and manipulate multidimensional data.

Data Mart Data repository easily accessed by end users which contains information pertaining to a single functional area or subject within a company.

Data Mart Suite Integrated package for implementing a data mart quickly and easily. Includes Oracle Data Mart Designer, Oracle Data Mart Builder, Oracle7 Enterprise Server, Oracle Web Application Server 2.1, Oracle Discoverer, with appropriate documentation and training. Also available is the Sales & Marketing Edition, which is the same bundle, but also includes Express Server with RAM/ RAA.

Data Mining Process of using statistical techniques to discover subtle relationships between data items, and the construction of predictive models based on them.

Data Warehouse Data repository easily accessed by end users which contains information used by multiple functional areas within a company.

DBA (Database Administrator) Person responsible for configuring, customizing, and maintaining a database so that users can access data effectively.

Dimension Dimensions help organize data by categorizing it. Each dimension represents a series or group of physical objects, events or processes for which there are one or more pieces of data. Example: Time could be a dimension whose values would be the months of the year.

Discoverer Intuitive ad hoc query and reporting tool that provides business users with immediate access to critical information from relational data warehouses, data marts, or OLTP systems.

Drill-down The ability to expand or collapse a list of information based on its hierarchy.

DSS (- Solutions) General term used to describe applications for analyzing large quantities of data and performing a wide variety of calculations and projections. Sub-categories include OLAP and query & reporting tools.

EIS (Executive Information System) Category of applications for presenting and analyzing corporate and external data for management purposes. Ease- of- use and fast performance is expected, but analytical functionality is usually limited.

Express Family of market- leading OLAP technology products. Includes Express Server, Personal Express, OFA, OSA, OEO, and OEA.

Express Server A server that is based on a multidimensional data model and optimized for the calculation, query and analysis of corporate data such as sales, marketing, financial, manufacturing, or human resource data.

Hierarchy A hierarchy exists when values within a dimension are aggregated into levels, with values at lower levels contributing to the aggregate values of higher levels. Example: If months comprise the lowest level of values for the time dimension, hierarchy levels above months may include quarters and years.

MDDB (Multidimensional Database) Product that can store and process multidimensional data.

Metadata Data about data that describes how the structures and calculation rules are stored and provides additional information on data sources, user privileges, etc.

Model Multidimensional structure used to define rules (i. e., equations) for manipulating data.

NCA (Network Computing Architecture) Multi- tiered computing paradigm which moves complex system management and administrative tasks off the desktop and into a network where systems can be centrally, expertly, and efficiently maintained. NCA's purpose is to make computers easy to use, with low maintenance and low cost.

OADW (Oracle Applications Data Warehouse) Tool that supports the design, construction, and administration of a data warehouse. Initially developed for use with Oracle Applications, the OADW is now being expanded to support all sources of data.

OEA (Express Analyzer) General- purpose, object- oriented tool for end user reporting and analysis. OEA can be integrated with OEO so that applications and objects can easily be shared.

OEO (Express Objects) Premier visual object- oriented development environment for creating client/ server OLAP applications. OEO offers traditional Express graphical modeling and what- if analysis, and is also open to third-party controls.

OEWA (Express Web Agent) Web- enabling component of Express Server. Provides a Developer's Toolkit that enables IS professionals to build custom OLAP applications for the Web.

OEWP (Express Web Publisher) End- user tool that is a component OEO/ OEA. Enables knowledge workers to build secure, dynamic, data driven OLAP Web sites in a matter of minutes.

OFA (Financial Analyzer) Distributed multidimensional application for financial reporting, analysis, budgeting and planning.

OLAP (On- Line Analytical Processing) Category of applications and technologies for collecting, managing, processing and presenting data for analysis and management purposes. Occasionally referred to as MOLAP (Multidimensional On- Line Analytical Processing).

OLTP (On- Line Transaction Processing) The operational systems used to collect and manage the base data of an organization.

Oracle Express Administrator A utility that provides a convenient graphical user interface for creating Express databases and configuring them for use with Express Client products.

Oracle Warehouse Tool-kits A family of products designed specifically to support the extraction of data from major third- party ERP applications (SAP, PeopleSoft, etc.) and the loading of this data into an Oracle Warehouse.

OSA (Sales Analyzer) Distributed multidimensional application for analyzing sales, marketing, or similar data.

Personal Express Single- user version of Express Server, which runs locally on a PC or laptop. Personal Express allows end users to perform OLAP tasks while disconnected from their enterprise network.

RAM/ RAA (Relational Access Manager/ Relational Access Administrator) Components that allow Express applications to read data from a data warehouse stored in a relational database.

RDBMS (Relational Database Management System) Used to store, process and manage data arranged in relational tables. Often used for transaction processing and data warehouses.

ROLAP (Relational OLAP) Architecture that enables multidimensional analysis of data stored in an RDBMS. The multidimensional processing may be done within the RDBMS, on a mid- tier server, or on the client.

Server Computer servicing a number of users. It will usually hold and process data. An application server may not necessarily store data and a file server may not necessarily do any processing.

Slice Subset of an OLAP database that contains selected dimension values, document definitions, and data cubes.

SQL (Structured Query Language) Standard data structuring and access language used by relational databases.

Thick Client Form of client/ server architecture in which a significant amount of data storage, manipulation, and processing occurs on the client machine, usually a PC.

Thin Client Form of client/ server architecture in which no data is stored and little processing occurs on the client machine, which may be a Network Computer (NC).

WAN (Wide Area Network) Usually, two or more geographically dispersed LANs connected by lower speed links. Can cause problems with client/ server applications that transmit large quantities of data between servers and clients.