"Good decision makers spend a great deal of time thinking through alternatives."
"A decision to which there is no alternative is always a bad one."

Peter Drucker

A Brief History of Decision Support Systems

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1. Executive Summary

Information Technology researchers and technologists have built and investigated Decision Support Systems (DSS) for more than 35 years. This paper chronicles and explores the developments in DSS beginning with building model-oriented DSS in the late 1960s, theory developments in the 1970s, and the implementation of financial planning systems and Group DSS in the early and mid 80s. Then it documents the origins of Executive Information Systems, OLAP and Business Intelligence. Finally, the discussion ends with the implementation of Web-based DSS in the mid-1990s.

2. Introduction

Decision Support Systems evolved early in the era of distributed computing. The history of such systems begins in about 1965 and it is important to start formalizing a record of the ideas, people, systems and technologies involved in this important area of applied information technology. Today it is still possible to reconstruct the history of Decision Support Systems from first-hand accounts and unpublished materials as well as published articles.

This paper is a starting point in documenting the origins of the various technology threads that are converging at the start of the 21st Century to provide integrated support for managers working alone, in teams and in organization hierarchies to manage organizations and make more rational decisions. History is both a guide to future activity in this field and a record of the ideas and actions of those who have helped advance our thinking and practice. In a technology field as diverse as DSS, history is not neat and linear. Different people have perceived the field from various vantage points and so they report different accounts of what happened and what was important. Some of this can be sorted out, but more data gathering is necessary. This paper is a starting point in collecting more first hand accounts and in building a more complete mosaic of what was occurring in universities, software companies and in organizations to build and use DSS.

The next few sections move from about 1965 to the mid-1990s. The DSS threads related to model-oriented DSS, expert systems, multidimensional analysis, query and reporting tools, OLAP, Business Intelligence, Group DSS, and Executive Information Systems are traced and interwoven as they appear to converge and diverge over the years.

3. The Early Years

Prior to 1965, it was very expensive to build large-scale information systems. At about this time, the development of the IBM System 360 and other more powerful mainframe systems made it more practical and cost-effective to develop Management Information Systems (MIS) in large companies (cf., Davis, 1974). MIS focused on providing managers with structured, periodic reports. Much of the information was from accounting and transaction systems.

In the late 1960s, a new type of information system became practical – model-oriented DSS or management decision systems. Two DSS pioneers, Peter Keen and Charles Stabell, claim the concept of decision support evolved from "the theoretical studies of organizational decisionmaking done at the Carnegie Institute of Technology during the late 1950s and early '60s and the technical work on interactive computer systems, mainly carried out at the Massachusetts Institute of Technology in the 1960s. (Keen and Scott Morton, 1978 preface)" Some historical information about the MIT project on interactive computer systems (Project MAC) is at multicians.org.

According to Sprague and Watson (1979), around 1970 business journals started to publish articles on management decision systems, strategic planning systems and decision support systems. For example, Scott Morton and colleagues published a number of decision support articles in 1968. In 1969, Ferguson and Jones discussed a computer aided decision system in the journal *Management Science*. In 1971, Michael S. Scott Morton's ground breaking book **Management Decision Systems: Computer-Based Support for Decision Making** was published. In 1966-67 Scott Morton had studied how computers and analytical models could help managers make a key decision. He conducted an experiment in which managers actually used a Management Decision System (MDS). Marketing and production managers used an MDS to coordinate

production planning for laundry equipment. MDS ran on an IDI 21 inch CRT with a light pen connected using a 2400 bps modem to a pair of Univac 494 systems. Scott Morton's (1967) dissertation research was a pioneering implementation, definition and research test of a model-driven decision support system.

T.P. Gerrity, Jr. focused on Decision Support Systems design issues in his 1971 **Sloan Management Review** article titled "The Design of Man-Machine Decision Systems: An Application to Portfolio Management". His system was designed to support investment managers in their daily administration of a clients' stock portfolio. DSS for portfolio management have become very sophisticated since Gerrity began his research.

In 1974, Gordon Davis, a Professor at the University of Minnesota, published his influential text on Management Information Systems. He defined a Management Information System as "an integrated, man/machine system for providing information to support the operations, management, and decision-making functions in an organization. (p. 5)." Davis's Chapter 12 titled "Information System Support for Decision Making" and Chapter 13 titled "Information System Support for Planning and Control" created the setting for the development of a broad foundation for DSS research and practice.

By 1975, J. D. C. Little was expanding the frontiers of computer-supported modeling. Little's DSS called Brandaid was designed to support product, promotion, pricing and advertising decisions. Also, Little (1970) in an earlier article identified criteria for designing models and systems to support management decision--making. His four criteria included: robustness, ease of control, simplicity, and completeness of relevant detail. All four criteria remain relevant in evaluating modern Decision Support Systems.

Klein and Methlie (1995) note "A study of the origin of DSS has still to be written. It seems that the first DSS papers were published by PhD students or professors in business schools, who had access to the first time-sharing computer system: Project MAC at the Sloan School, the Dartmouth Time Sharing Systems at the Tuck School. In France, HEC was the first French business school to have a time-sharing system (installed in 1967), and the first DSS papers were published by professors of the School in 1970. The term SIAD ('Systèmes Interactif d'Aide à la Décision' the French term DSS) and the concept of DSS were developed independently in France, in several articles by professors of the HEC working on the SCARABEE project which started in 1969 and ended in 1974."

4. Developing Theory

In the late 1970s, both practice and theory issues related to DSS were discussed at academic conferences including the American Institute for Decision Sciences meetings and the ACM SIGBDP Conference on Decision Support Systems in San Jose, CA in January 1977. The first International Conference on Decision Support Systems was held in Atlanta, Georgia in 1981. Academic conferences provided forums for idea sharing, theory discussions and information exchange. MIT researchers including Peter Keen and Michael Scott Morton were especially influential. Keen and Scott Morton’s DSS

textbook (1978) provided a broad behavioral orientation to Decision Support System analysis, design, implementation, evaluation and development.

In 1980, Steven Alter published his MIT doctoral dissertation results in an influential book titled **Decision Support Systems: Current Practice and Continuing Challenge**. Alter's research and papers (1975; 1977) expanded the framework for our thinking about management DSS. Also, his case studies provided a firm descriptive foundation of Decision Support System examples. A number of other MIT dissertations completed in the mid- and late 1970s also dealt with issues related to using models for decision support.

In 1979, John Rockart of the Harvard Business School published a ground breaking article in the Harvard Business Review that led to the development of executive information systems (EISs) or executive support systems (ESS).

Bonczek, Holsapple, and Whinston (1981) created a theoretical framework for understanding the issues associated with designing knowledge-oriented Decision Support Systems. Their book showed how Artificial Intelligence and Expert Systems technologies were relevant to developing DSS.

Ralph Sprague and Eric Carlson's (1982) book **Building Effective Decision Support Systems** was an important milestone. It further explained the Sprague (1980) DSS framework of data base, model base and dialog generation and management software. Also, it provided a practical, understandable overview of how organizations could and should build DSS. Although their book probably created some unrealistic expectations, the problems stemmed more from the limits of the existing technologies for building DSS rather than the limits of the concepts discussed by Sprague and Carlson.

5. Expanding the Framework

By the late 1970s, a number of researchers and companies had developed interactive information systems that used data and models to help managers analyze semi-structured problems. These diverse systems were all called Decision Support Systems. From those early days, it was recognized that DSS could be designed to support decision-makers at any level in an organization. DSS could support operations, financial management and strategic decision-making. DSS could use spatial data in a system like Geodata Analysis and Display System (GADS) (cf., Grace, 1976), structured multidimensional data and unstructured documents (cf., Swanson and Culnan, 1978). A variety of models were used in DSS including optimization and simulation. Also, statistical packages were recognized as tools for building DSS. Artificial Intelligence researchers began work on management and business expert systems in the early 1980s.

Financial planning systems became popular decision support tools. The idea was to create a "language" that would "allow executives to build models without intermediaries (Gray, 1987, p. 3)". A popular financial planning systems called IFPS, an acronym for

interactive financial planning system, was originally developed in the late 1970's by Gerald R. Wagner and his students at the University of Texas. Wagner's company, EXECUCOM Systems, marketed IFPS until the mid 1990s. One major advantage that a planning language has over a spreadsheet is that the model is written using natural language and the model can be separated from the data. In the early 80s, spreadsheets were also used for building model-driven DSS (see Power, D., "A Brief History of Spreadsheets"). In a 1988 paper, Sharda, Barr, and McDonnell reviewed the first 15 years of DSS research. Research related to using models and financial planning systems for decision support was encouraging but certainly not uniformly positive.

In the early 1980s, academic researchers developed a new category of software to support group decision-making (cf., Gray, 1981; Huber, 1982; Turoff and Hiltz, 1982). Mindsight from Execucom Systems, GroupSystems developed at the University of Arizona and the SAMM system developed by University of Minnesota researchers were early Group DSS. Dickson, Poole and DeSanctis (1992) report that Brent Gallup, a Ph.D. student at Minnesota, decided in 1984 "to program his own small GDSS system in BASIC and run it on his university's VAX computer". That system was the start of the Minnesota GDSS studies.

Jay Nunamaker, Jr. and his colleagues wrote in 1992 that "The underlying concept for GroupSystems had its beginning in 1965 with the development of Problem Statement Language/Problem Statement Analyzer (PSL/PSA) as part of the ISDOS (Information System Design and Optimization System) project at Case Institute of Technology (p. 144)". In 1984, a system called PLEXSYS was completed and a computer-assisted group meeting facility was constructed at the University of Arizona. The first facility, called the PlexCenter, housed a large U-shaped conference table with 16 computer workstations. PLEXSYS provided the foundation for the development of the University of Arizona GroupSystems software. Since the mid-80s, many research studies have examined the impacts and consequences of Group DSS. Also, a number of companies have commercialized Group DSS and groupware. Click here to see a group decision support room.

Executive Information Systems (EIS) evolved from single user model-driven Decision Support systems and improved relational database products. The first EIS used pre-defined information screens and were maintained by analysts for senior executives. For example, in fall of 1978, development of an EIS called Management Information and Decision Support (MIDS) system began at Lockheed-Georgia (cf., Houdeshel and Watson, 1987). Beginning in about 1990, data warehousing and On-Line Analytical Processing (OLAP) began broadening the realm of EIS and defined a broader category of Data-Driven DSS (cf., Dhar and Stein, 1997). Nigel Pendse (1997) claims the first Executive Information System product was Pilot Software's Command Center. He notes both multidimensional analysis and OLAP had origins in the APL programming language and in systems like Express and Comshare's System W. Nigel Pendse of the OLAPReport.com has written and updates a much more detailed history of the origins of OLAP products (you can read the local copy).

Nylund (1999) traces the developments associated with Business Intelligence (BI) to Procter & Gamble's efforts in 1985 to build a DSS that linked sales information and retail scanner data. Metaphor Computer Systems, a spinoff of researchers from Xerox's Palo Alto Research Center (PARC), built the early P&G DSS. Metaphor alumni latter founded many of the BI vendors: Richard Tanler founded Information Advantage and Katherine Glassey co-founded Brio Technologies. The term BI is a popularized, umbrella term supposedly introduced by Howard Dresner of the Gartner Group in 1989. BI describes a set of concepts and methods to improve business decision making by using fact-based support systems. BI is sometimes used interchangeably with briefing books, report and query tools and executive information systems. Business Intelligence systems are data-driven DSS.

6. A Technology Shift

Beginning in about 1990, Bill Inmon and Ralph Kimball actively promoted DSS built using relational database technologies. For many MIS practioners, DSS built using Oracle or DB2 were the only decision support systems they were exposed to in the popular computing literature. Model-driven DSS were in the domain of operations research and were not part of Information Systems. Ralph Kimball was "The Doctor of DSS" and Bill Inmon was the "father of the data warehouse". Inmon defined decision support system (DSS) as "a system used to support managerial decisions. Usually DSS involves the analysis of many units of data in a heuristic fashion. As a rule, DSS processing does not involve the update of data (cf., billinmon.com)." Inmon and Kimball focused on building data-driven DSS.

In the early 1990s, a major technology shift occurred from mainframe-based DSS to client/server-based DSS. Some desktop OLAP tools were introduced during this time period. In 1992-93, some vendors started recommending object-oriented technology for building "re-usable" decision support capabilities. In 1994, many companies started to upgrade their network infrastructures. DBMS vendors "recognized that decision support was different from OLTP and started implementing real OLAP capabilities into their databases" (Powell, 2001). Paul Gray asserts that around 1993 the data warehouse and the EIS people found one another and the two niche technologies have been converging. In 1995, data warehousing and the World Wide Web began to impact practitioners and academics interested in decision support technologies. Web-based and web-enabled DSS became feasible in about 1995 (cf., Power, 2000; Bhargava and Power, 2001).

The history of Decision Support Systems covers a relatively brief span of years, and the concepts and technologies are still evolving. Today it is still possible to reconstruct the history of Decision Support Systems (DSS) from retrospective accounts from key participants as well as from published and unpublished materials. Many of the early innovators and early developers are retiring but their insights and actions can be captured to guide future innovation in this field. It is hoped this paper leads to email and retrospective accounts that can help us understand the "real" history of DSS. The Internet and Web have speeded-up developments in decision support and have provided a new

means of capturing and documenting the development of knowledge in this research area. Decision support pioneers include many academic researchers from programs at MIT, University of Arizona, University of Hawaii, University of Minnesota and Purdue University. The DSS pioneers created particular and distinct streams of technology development and research that serve as the foundation for much of today's work in DSS.

7. DSS Time Line (under construction)

Year	Milestone
1964	Beginnings of Michael Scott Morton research -- see email from Andrew McCosh
1967	Michael Scott Morton research completed on the impact of computer-driven visual display devices on the management decision-making process
1968	Scott Morton and McCosh paper; Scott Morton and Stephens paper
1975	Steve Alter completed his M.I.T. Ph.D. dissertation titled "A Study of Computer Aided Decision Making in Organizations"
1978	DSS system developed for San Diego Gas and Electric. This became the prototype example for public utility executive reporting.
1978	development began on an EIS called Management Information and Decision Support (MIDS) system at Lockheed-Georgia
1981	first International Conference on Decision Support Systems, Atlanta, Georgia
1982	founding of Metaphor Computer Systems
1984	Teradata Database Computer (DBC/1012) was shipped to Wells Fargo, AT&T and Chrysler with a relational database management system (RDBMS) on a proprietary platform.
1986	1986 DSS Conference in Washington, DC declares the end of Decision Support. Peter Keene, in his keynote speech, declares that there is no need for further development in DSS – "all has been completed that needs to be completed."

8. Selected Bibliography

Alter, S., "A Study of Computer Aided Decision Making in Organizations," Ph.D. dissertation, M.I.T., 1975.

Alter, S.L., "Why Is Man-Computer Interaction Important for Decision Support Systems?", *Interfaces*, Vol.7, No.2, Feb. 1977, pp.109-115.

Alter, S.L., "A Taxonomy of Decision Support Systems", *Sloan Management Review*, Vol.19, No.1, Fall 1977, pp. 39-56.

Alter, S.L., *Decision Support Systems: Current Practice and Continuing Challenge*. Reading, MA: Addison-Wesley, 1980.

Bhargava, H., and D. J. Power. Decision Support Systems and Web Technologies: A Status Report. Proceedings of the 2001 Americas Conference on Information Systems, Boston, MA, August 3 - 5, 2001.

Bonczek, R. H., C. W. Holsapple, and A. Whinston. *Foundations of Decision Support Systems*. Academic Press, 1981.

Corbató, F. J., M. M. Daggett, and R. C. Daley, "An Experimental Time-Sharing System," SJCC paper, May 3, 1962 at URL larch-www.lcs.mit.edu:8001/~corbato/sjcc62/.

Davis, G., *Management Information Systems: Conceptual Foundations, Structure, and Development*, New York: McGraw-Hill, 1974.

DBMS interview, "The Doctor of DSS," *DBMS magazine*, July 1994.

Dhar, V. & Stein, R., *Intelligent Decision Support Methods: The Science of Knowledge*. Upper Saddle River, NJ: Prentice-Hall, 1997.

Dickson, G. W., M. S. Poole, and G. DeSanctis. "An Overview of the GDSS Research Project and the SAMM System", in Bosttrom, R. P., R. T. Watson, and S. T. Kinney, *Computer Augmented Teamwork: A Guided Tour*, New York: Van Nostrand Reinhold, 1992, pps. 163-179.

Ferguson, R. L. and C. H. Jones, "A Computer Aided Decsion System", *Management Science*, June 1969, pp. B550-B561.

Gerrity, T. P., Jr. "The Design of Man-Machine Decision Systems", *Sloan Management Review*, vol. 12, no. 2, pp. 59-75, Winter 1971.

Grace, B. F. "Training Users of a Decision Support System", *IBM Research Report RJ1790*, IBM Thomas J. Watson Research Laboratory, May 31, 1976.

Gray, P., "The SMU decision room project", Transactions of the Ist International Conference on Decision Support Systems (Atlanta, Ga.), 1981, pp. 122-129.

Gray, P., *Guide to IFPS* (In*teractive Financial Planning System*), New York: McGraw-Hill Book Company, 1987.

9. 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.