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Real-World Decision Support Systems

Case Studies

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To the Euro Working Group on Decision Support Systems coordination board and members, for their continuous and inspiring commitment on the promotion of the discipline

Foreword

Decision support systems (DSSs) appeared in the literature by the beginning of the 1970s. The first developed DSS was developed for executive managers using personal computers and was called executive information systems. Since this period, DSS evolved in several directions. The first proposed architecture of these systems was composed by a database management system, a model base management system, and a man-machine interaction module. The first step in the evolution of DSS was based on the introduction of knowledge in the architecture. A new module was added called the knowledge-based management system as well as an inference engine. From then on, due to a huge amount of data, the database management system evolved in line with research on data warehouses, for which the main concern is to find suitable data for the decision-maker. For the model base management system, a lot of research has been conducted including several kinds of models of real decision problems. These models are formulated in different ways like linear or constraint programming, decision rules, decision trees, etc. Nowadays, researchers on DSS are still very active and dynamic, and we can notice an evolution of the name; DSSs are also called in a more general way decision-making support systems (DMSSs). The number of international journals and international conferences on this topic is progressing every day. Recently, a new such journal, the *International Journal of Decision Support System Technologies* was created, published by IGI Global. This journal publishes selected papers organized in one volume per year including four issues composed of four papers. We can also mention the International Conference on Decision Support System Technologies organized annually by the Euro Working Group on Decision Support Systems. The conference attracts every year an international group of researchers, academics, and practitioners working on decision support systems. Topics covered by both the journal and the conference are, among others, context awareness, modeling, and management for DMSS; data capture, storage, and retrieval; DMSS feedback control mechanisms; function integration strategies and mechanisms; DMSS network strategies and mechanisms; DMSS software algorithms; DMSS system and user dialog methods; system design, development, testing, and implementation;

DMSS technology evaluation; and finally DMSS technology organization and management.

Nevertheless, this research would be without any actual interest if applications would not be developed and tested in real-life situations. The applications of DSS or cases of DSS are also very important and allow researchers to implement their architectures, models, and methodologies in real situations. These implementations are very valuable for the improvement of the DSS field. Indeed, the idea of this book, *Real-World Decision Support Systems – Case Studies*, including the application domains of the environment, agriculture and forestry, business and finance, engineering, food industry, health, production and supply chain management, and urban planning, is an excellent initiative. Research on the DSS discipline is still very promising and will be exciting for several decades to come.

Toulouse, France
June 2016

Pascale Zaraté

Preface

The number of papers regarding decision support systems (DSSs) has soared during the recent years, especially with the advent of new technologies. Indeed, if someone considers DSS as an umbrella term [1], the plurality of research areas covered is striking: from computer science and artificial intelligence to mathematics and psychology [3]. It is in this context that the editors of this book felt that there is a gap in the overall fabric; it was felt that too much attention has been given to theoretical aspects and individual module design and development. In addition, there have been many failures in information systems development; poor initial requirements analysis and design has many times led to a notable lack of success. Indeed, it seems that the DSS discipline is rather prone to this, tagging the development of such projects as risky affairs [2].

Moreover, decisions today have to be made in a very complex, dynamic, and highly unpredictable international environment with various stakeholders, each with his own separate and sometimes hidden agenda. Right into the center of the whole decision process is the decision-maker; he has the responsibility for the final decision and he will most probably bear the consequences. As there is no model that can integrate all the possible variables that influence the final outcome and the DSS results have to be combined with the decision-maker's insights, background, and experience, the system must facilitate the process at each stage rendering the user experience concept of great significance.

Bearing the above in mind, the rationale behind this edition is to provide the reader with a set of cases of real-world DSS, as the book title suggests. The editors were interested in real applications that have been running for some time and as such tested in actual situations. And not only that; unsuccessful cases were targeted as well, systems that at some point of their life cycle were deemed as failures for one reason or another. If the systems failed, what were the (both implicit and explicit) reasons for that? How can they be recorded and avoided again? The lessons learned in both successful and unsuccessful cases are considered invaluable, especially if one considers the investment size of such projects [4]. The overall and primary goal in each case is to point out the best practices in each stage of the system life cycle, from the initial requirements analysis and design phases to the final stages of the project. The cases aim to stimulate the decision-makers and provide firsthand experiences, recommendations, and lessons learned so that failures can be avoided and successes can be repeated.

The authors of the chapters of this book were requested to provide information on a number of issues. They were asked to follow a certain chapter structure, and their work was rigorously peer-reviewed by the editors and selected reviewers from the DSS community. The cases are also presented in a constructive, coherent, and deductive manner, in order to act as showcases for instructive purposes, especially considering their high complexity. This book consists of one introductory chapter presenting the main concepts of a decision support system and 12 chapters that present real-world decision support systems from several domains. The first chapter by Daniel Power reviews frameworks for classifying and categorizing decision support systems, while it also addresses the need and usefulness of decision support system case studies.

Chapter 2 by Malik Al Qassas, Daniela Fogli, Massimiliano Giacomin, and Giovanni Guida presents the design, development, and experimentation of a knowledge-driven decision support system, which supports decision-making processes that occur during clinical discussions.

Chapter 3 by Anna Arigliano, Pierpaolo Caricato, Antonio Grieco, and Emanuela Guerriero proposes a method to integrate decision analysis techniques in high-throughput clinical analyzers. The proposed method is integrated into a clinical laboratory information system in order to demonstrate the benefits that it achieves.

Chapter 4 by Andrea Bettinelli, Angelo Gordini, Alessandra Laghi, Tiziano Parriani, Matteo Pozzi, and Daniele Vigo is about a suite of two decision support systems for tackling network design problems and energy-production management problems.

Chapter 5 by Pierpaolo Caricato, Doriana Gianfreda, and Antonio Grieco analyzes a model-driven decision support system to solve a variant of the cutting stock problem on a company that produces high-tech fabrics.

Chapter 6 by Mats Danielson, Love Ekenberg, Mattias Göthe, and Aron Larsson introduces a procurement decision support system implementing algorithms targeted for decision evaluation with imprecise data that it can be used as an instrument for a more meaningful procurement process.

Chapter 7 by António J. Falcão, Rita A. Ribeiro, Javad Jassbi, Samantha Lavender, Enguerran Boissier, and Fabrice Brito presents a model-driven evaluation support system for open competitions within Earth observation topics.

Chapter 8 by Narain Gupta and Goutam Dutta presents the design, development, and implementation of a model-based decision support system for strategic planning in process industries.

Chapter 9 by Andreja Jonoski and Abdulkarim H. Seid explains the experiences in developing and applying a model-driven decision support system in a transboundary river basin context, taking the Nile Basin decision support system as a case.

Chapter 10 by Manfred J. Lexer and Harald Vacik presents a data-driven decision support system for forest management that can support all phases of the decision-making process.

Chapters 11 and 12 by Mário Simões-Marques examine in detail a decision support system for emergency management. Chapter 11 describes the problem context, the system requirements and architecture, the knowledge management process, and the spiral development approach, while Chap. 12 presents the main features implemented in the proposed decision support system.

Finally, Chap. 13 by Mette Sønderskov, Per Rydahl, Ole M. Bøjer, Jens Erik Jensen, and Per Kudsk presents a knowledge-driven decision support system for weed control that offers herbicide dose suggestions based on a large database of the existing knowledge of herbicides and herbicide efficacies.

We are very delighted to have included in this book a set of high-quality and interesting pieces of research, authored by researchers and industrial partners coming from different research institutions, universities, and companies across different continents. We are grateful to all reviewers and authors for the collaboration and work they have put into this book. We especially want to thank Daniel Power for writing the introductory chapter that introduces the main concepts that define a decision support system and prepares the readers for the remaining chapters of this book.

We hope that you will also enjoy reading the book, and we hope the presented "good" and "bad" practices on developing and using a decision support system can be useful for your research.

Thessaloniki, Greece — Jason Papathanasiou
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The editors of this book wish to acknowledge their gratitude for the prompt and highly constructive reviews received from the researchers above in the various phases of this book's reviewing process.

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Chapter 1
Computerized Decision Support Case Study Research: Concepts and Suggestions

Daniel J. Power

Abstract Supporting decision making is an important and potentially transformative research topic that is challenging for academic researchers to study. Anecdotal evidence suggests that computerized decision support systems (DSS) can improve decision quality and change the structure and functioning of organizations. To make progress in our understanding of this phenomenon there is an ongoing need for more decision support case study field research that includes documenting decision support impacts. Research case studies help understand the use and consequences associated with building and using computerized decision support. More descriptive and technical information about specific DSS will be helpful in explaining the variability of these technology artifacts. Current theory related to computerized decision support is inadequate and research case studies can potentially assist in theory building. The possibilities for improving and increasing decision support continue to evolve rapidly and research case studies can help define this expanding, changing field of study. More "good" case studies and more details about each specific case is useful, helpful, and a significant contribution to understanding how computing technologies can improve human decision making.

1.1 Introduction

A variety of tools and aids have been used by people to help make decisions for thousands of years. For example, people have kept ledgers and records of historical information, have used checklists and have built physical scale models. Now managers use these tools and more sophisticated computerized tools for decision support. Computerized decision support systems and analytics can serve many new purposes and are and will be built using many differing technologies. The domain of computerized decision support continues to get more diverse and more sophisticated.

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Decision support capabilities should have a targeted user group and a purpose. A decision support system is a technology artifact crafted from hardware and software linked by networks and accessed by interface devices like smart phones and personal computers. Documenting the expanding application domain is a major reason to prepare research case studies. DSS builders must remember that providing computerized decision support does not guarantee that better decisions will be made. Understanding and documenting Decision Support Systems (DSS) can potentially improve the design and usefulness of DSS. This chapter focuses on using case study research to understand computerized decision support. This chapter reviews the ongoing need for case study field research and documenting UML use cases related to decision support. Section 1.2 reviews frameworks for classifying and categorizing computerized DSS. Section 1.3 reviews the case study method in general and then discusses applying the method to documenting a specific DSS artifact or to examining a DSS in its context of application and use. Section 1.4 reviews classical DSS case studies. Section 1.5 addresses the usefulness of DSS case studies. Section 1.6 summarizes major conclusions from this methodology overview and some recommendations for using a case study to study computerized decision support.

1.2 Understanding Decision Support Systems

At the website DSSResources.com, a decision support system (DSS) is defined as "an interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to identify and solve problems, complete decision process tasks, and make decisions. Decision support system is a general term for any computer application that enhances a person or group's ability to make decisions. In general, decision support systems are a class of computerized information systems that support decision-making activities."

Decision support is a broad concept that describes tools and capabilities to assist individuals, groups, teams and organizations during decision making processes. Computerized decision support systems built since the 1950s can be categorized in a number of ways, cf. [24]. The four major taxonomies or frameworks in the literature were proposed by Alter [1], Arnott and Pervan [2], Holsapple and Whinston [9], and Power [20–22, 28]. There are commonalities among them and the schemes are not contradictory. All of the frameworks attempt to organize observations and literature about the variety of DSS that have been built and used over the years. This review focuses on Power's [20, 21] expanded DSS framework that builds upon Alter's [1] categories.

There are five DSS types in the expanded framework defined based upon the dominant technology component. The initial DSS category in the expanded framework is model-based or model-driven DSS. Many early DSS derived their functionality from quantitative models and limited amounts of data. Scott-Morton's

[33] production planning management decision system was the first widely discussed model-driven DSS. Early case studies of other model-driven systems were about MEDIAC [15], SPRINTER [40] and BRAND AID [14]. A model-driven DSS emphasizes access to and manipulation of financial, optimization and/or simulation models. Simple quantitative models provide the most elementary level of functionality. Model-driven DSS generally use small to medium-sized data sets, and parameters are often provided by decision makers. These systems aid decision makers in analyzing a situation and evaluating sensitivity issues, but in general large, gigabyte or terabyte data bases are not needed for model-driven DSS, cf. [21].

Alter [1] identified data-oriented DSS as fundamentally different than DSS deriving functionality more from quantitative models than from data. Data sets were growing, but analytical tools were limited. Bonczek, Holsapple and Whinston [4] termed these systems retrieval-only DSS. Data-driven DSS emphasize access to and manipulation of large data sets. Simple online file systems accessed by query and retrieval tools provide the most elementary level of functionality. Data warehouse and Business Intelligence systems that provide for the manipulation of data by computerized tools provide additional functionality.

Beginning in the mid-1970s the developments in Artificial Intelligence led to creating knowledge-driven DSS. These systems suggest or recommend actions. Alter [1] termed them suggestion DSS and Klein and Methlie [13] used the term knowledge-based DSS. These knowledge-driven DSS are person-computer systems with specialized problem-solving expertise.

Two remaining categories in the expanded DSS framework [19, 21] are communications-driven and document-driven DSS. Communications-driven DSS "use network and communications technologies to facilitate decision-relevant collaboration and communication. In these systems, communication technologies are the dominant architectural component. Tools used include groupware, video conferencing and computer-based bulletin boards" [21]. A document-driven DSS "uses computer storage and processing technologies to provide document retrieval and analysis. Large document databases may include scanned documents, hypertext documents, images, sounds and video. Examples of documents that might be accessed by a document-driven DSS are policies and procedures, product specifications, catalogs, and corporate historical documents, including minutes of meetings and correspondence. A search engine is a primary decision-aiding tool associated with a document-driven DSS" [21]. Table 1.1 provides examples of the dimensions in the expanded framework.

The expanded framework identifies the primary dimension for categorizing DSS is the dominant architecture technology component or driver that provides decision support. The three secondary dimensions are the targeted users, the specific purpose of the system and the primary deployment or enabling technology. Five generic DSS types are identified and defined based upon the dominant technology component. This framework is the conceptualization used at DSSResources.COM to organize what we have learned about decision support systems, cf. [19, 23]. Table 1.2 provides a general checklist for categorizing the five broad types of decision support systems.

Table 1.1 Expanded DSS framework [25]

DSS type	Dominant DSS component	Targeted users (examples)	Purpose (examples)	Enabling technology (examples)
Communications-driven DSS	Communications	Internal teams	Conduct a meeting	Bulletin board
		Supply chain partners	Help users collaborate	Videoconferencing
Data-driven DSS	Database	Managers and staff, now suppliers	Query a data warehouse	Relational databases
				Multidimensional databases
Document-driven DSS	Document storage and management	Specialists and user group is expanding	Search Web pages	Search engines, HTML
Knowledge-driven DSS	Knowledge base, AI	Internal users, new customers	Management advice	Expert Systems
Model-driven DSS	Quantitative models	Managers and staff, new customers	Scheduling	Linear Programming, Excel
			Forecasting	

Table 1.2 Check list for categorizing decision support systems

DSS check list
1. What is the dominant component of the architecture that provides functionality?
2. Who are the targeted users?
3. What is the purpose of the DSS?
4. What enabling technology is used to deploy the DSS?

1.3 Decision Support Case Studies

A case study is one type of qualitative research method. A case study researcher often uses both observation and systematic investigation to gather data and then the case write-up documents and summarizes what was found. Ideally a researcher needs access to observe the decision support capability in use, access to documents, and also access to ask questions of both developers and users.

Case studies help us understand computerized decision support. Both teaching and research case studies serve a useful purpose in advancing the field. A good teaching case can share challenges faced in design, implementation, and use. A good research case study can generate hypotheses for further testing and document "best practices" and use cases. Even short case study examples and vendor reported case studies enrich our courses and help explain the breadth of the decision support phenomenon.

In general, a research case study presents a systematic description, explanation and analysis of a specific instance of a category or sub-category of objects or artifacts. Decision support artifacts are especially important to study. Software systems can vary greatly, and each specific artifact we investigate informs our understanding of what is possible, what has worked and been effective, and what might work in a different context.

Schell [32] argues “As a form of research, the case study is unparalleled for its ability to consider a single or complex research question within an environment rich with contextual variables”. He defines three characteristics of an empirical or research case study: (1) investigates a contemporary phenomenon within its real-life context; (2) the boundaries between phenomenon and context are not clearly evident; and (3) multiple sources of evidence are used, cf. [44].

Wikipedia.com notes “A case study involves an up-close, in-depth, and detailed examination of a subject (the case), as well as its related contextual conditions.” (cf. https://en.wikipedia.org/wiki/Case_study). In general, decision support case studies should be “key” cases that are chosen because of the inherent interest of the case or the circumstances surrounding it.

WhatIs.com defines a case study in a business context as “a report of an organization’s implementation of something, such as a practice, a product, a system or a service. The case study can be thought of as a real-world test of how the implementation works, and how well it works” [42].

Case studies are a form of qualitative descriptive research. An ongoing concern are the issues of validity, reliability, and generalizability, cf. [7]. In most situations it is desirable to use several methods of data collection including observing people using the system, structured feedback from users, review of technical documentation, etc. Case studies based on multiple sources of information are often perceived as more valid and reliable.

A Google search on the key words “decision support case study” in quotations suggests the case study is a reasonably popular research method for this decision support phenomenon. The actual search in November 2015 returned 2330 results. Without using quotations around the phrase the search returned about 43 million results. Cases studies were identified that reported systems serving many diverse purposes including: clinical decision support (CDS), risk management, capacity planning, flood forecasting, technology selection, veterinary decision support, investments, land use planning, and scheduling to name a few of them.

Can we generalize from an individual case study or even 2330 case studies? Generalization can result from examining specific case studies, but the credibility of the generalization increases as more cases are examined. Decision support case studies provide a description of a software artifact and its context of use, and an implementation case study can identify what did not work and sometimes reasons why failure occurred. A case study can also help identify design patterns and best practices in terms of design methods, implementation processes, and deployment and ongoing use of a decision support capability. Also, case studies of the same or different systems at various stages in the software life cycle can help piece together the longitudinal interaction of software systems and decision makers. So we may be able to develop useful generalizations from case study findings.

Decision support case studies are important because "good" ones provide detailed information about how software/hardware systems are impacting decision making in an actual organization. The decision support phenomenon becomes more concrete and the rich context can be shared along with technical details and observational notes.

1.4 Examples of DSS Case Studies

DSS case studies published in journals and books have contributed significantly to our understanding. Websites like DSSResources.com and vendor websites also include case examples. To document his framework, Alter [1] explained eight major case examples, Connoisseur Foods, Great Eastern Bank OPM, Gotaas-Larse Shipping Corporate Planning System, Equitable Life Computer-Assisted Underwriting System, a media decision support system, Great Northern Bank budgeting, planning and control system, Cost of Living Council DSS, and AAIMS, an analytical information system.

A common motivation for adopting or building information systems and decision support systems is that the organization will gain a competitive advantage. There is some case study evidence to support that claim. For example, in a literature review, Kettinger, Grover, Guha, and Segars [11] identified a number of companies that had gained an advantage from information systems and some of those systems were decision support systems. They identified nine case studies of DSS including:

1. Air Products—vehicle scheduling system
2. Cigna—health risk assessment system
3. DEC—expert system for computer configuration
4. First National Bank—asset management system
5. IBM—marketing management system
6. McGraw Hill—marketing system
7. Merrill Lynch—cash management accounts
8. Owens-Corning—materials selection system
9. Proctor & Gamble—customer response system

Power [21] explored the question of gaining competitive advantage from DSS by reviewing examples of decision support systems that provided a competitive advantage including systems at Frito-Lay, L.L. Bean, Lockheed-Georgia, Wal-Mart and Mrs. Field's Cookies. A major lesson learned from reviewing case studies is that a company needs to continually invest in a Strategic DSS to maintain any advantage.

Power [26, 27] identified classic Decision Support Systems described in case studies. A classic decision support system is an early and lasting example of using technology to support decision making. Ten DSS related to business and organization decision-making are among the classics: AAIMS, Advanced Scout, CATD, DELTA, Flagstar LIVE, GADS, GroupSystems, OPM, PMS and PROJECTOR.

The classic DSS help document what was possible even though the purpose of the systems may have been implemented using new technologies.

AAIMS, An Analytical Information Management System, was implemented by American Airlines in the mid-1970s. It was developed in APL and was used for data analysis. AAIMS included a database and functions for data retrieval, manipulation and report generation. The database included sales, price and employee data. Klass and Weiss developed the system internally at American Airlines. The system was used for ad hoc reporting and to create a report of corporate performance indicators, cf. [1, 12, 39].

Advanced Scout was developed by IBM and the software used data mining to help National Basketball Association (NBA) coaches and league officials organize and interpret data collected at every game. In the 1995–1996 season, 16 of 29 teams used the DSS. A coach can quickly review countless statistics: shots attempted, shots blocked, assists made, personal fouls. But Advanced Scout can also detect patterns in these statistics that a coach may not have identified. Patterns found through data mining are linked to the video of the game. This lets a coach look at just those video clips that make up the interesting pattern, cf. [3].

CATD or Computer Aided Train Dispatching was developed by the Southern Railway Co. from 1975 to 1982. It was initially built as a mini-computer based simulator and was installed and tested on the North Alabama track system in January 1980. The system was placed in production for that system on September 15, 1980. Gradually additional track systems were converted to CATD. The system provides decision support to aid train dispatchers in centralized traffic control. The system significantly reduced delays and reduced train meetings in the system, cf. [31].

DELTA, Diesel-Electric Locomotive Troubleshooting Aid, helped maintenance personnel to identify and correct malfunctions in diesel electric locomotives by applying diagnostic strategies for locomotive maintenance. The system can lead the user through a repair procedure. It was a rule-based system developed in a general-purpose representation language written in LISP. DELTA accesses its rules through both forward and backward chaining and uses certainty factors to handle uncertain rule premises. Although the system was prototyped in LISP, it was later reimplemented in FORTH for installation on microprocessor-based systems. The General Electric Company developed this system at their research and development center in Schenectady, New York. Current status unknown, but it was field tested, cf. [41].

Flagstar Bank, FSB (Nasdaq:FLGS) won the 1997 Computerworld Smithsonian Award for it's use of information technology in the Finance, Insurance, and Real Estate category. Flagstar Banks Lenders' Interactive Video Exchange (LIVE) merged Intel ProShare conferencing systems with automated underwriting technologies to allow the home buyer and loan underwriter to meet face to face and get loans approved quickly, regardless of where the loan originated. Usually this process takes weeks and the prospective home owner has no contact with the person who actually makes the decision, cf. [6].

GADS was an interactive system also known as Geodata Analysis and Display System. The goal in developing GADS was to enable nonprogrammers to solve unstructured problems more effectively by applying their job-specific experience and their own heuristics. It had a strong graphic display and "user-friendly" characteristics that enabled non-computer users to access, display, and analyze data that have geographic content and meaning. The system was used initially by police officers to analyze data on "calls for service". By 1982, 17 specific DSS had been developed using GADS, cf. [37].

In early 1987, IBM combined efforts with the University of Arizona to implement a group decision support system (GDSS) called GroupSystems. GroupSystems was the result of a research and prototype development project by the MIS department. GroupSystems utilized a set of flexible software tools within a local area network to facilitate problem-solving techniques including brainstorming, idea organization, alternative generation, and alternative selection. The GroupSystems hardware, software and methodologies are combined in specially developed group facilities called decision support centers (DSC). These rooms were 26 feet by 30 feet and contained 11 PCs connected by a LAN to a large screen projector. The PC workstations were placed in a U-shape around the screen, cf. [16].

OPM, On-line Portfolio Management System, was described in a case study written by Alter [1] based on research done by Ginzberg. "OPM had four purposes: investment decision making, account reviews, administration and client relations, and training (p. 29)". OPM included 8 functions: directory, scan, groups, table, histogram, scatter, summary and issue.

PMS, Portfolio Management System, was developed by T.P. Gerrity and it was implemented in four banks beginning in 1974. The purpose of the DSS was to help manage security portfolios and manage risk and return, cf. [10].

Finally, PROJECTOR was developed in 1970 by C.L. Meador and D.N. Ness to support financial planning. The system included forecasting and optimization models. It was used in 1974 by a New England manufacturing company to investigate the acquisition of a new subsidiary, cf. [17].

Based upon available descriptions the classic DSS can be classified as follows: AAIMS, OPM and PMS are data-driven DSS. GADS is a data-driven, spatial DSS. CATD is a model-driven DSS. DELTA is a knowledge-driven DSS. GroupSystems is a model-driven, group DSS.

At DSSResources.com, there are 54 case studies posted primarily between 2001 and 2007. There are examples of each of the five categories of decision support systems. The Decision Support Case Studies web page.is at URL http://dssresources.com/cases/index.html. The page preface notes: This DSSResources.com page indexes case examples of various types of computerized Decision Support Systems, decision automation systems and special decision support studies that use computerized analyses. Some of the cases are based upon field research, but many have been provided by software vendors. We have tried to confirm and verify the information in vendor supplied cases. The following examples from the case studies index are grouped into the five categories in the expanded framework.

Data-driven DSS. The Databeacon East of England Observatory case is a web-based system. The MySQL Cox Communications case describes an open source data-driven DSS for real-time operational support and management control. Stevens describes implementing the Redland Genstar Data Mart. Power and Roth describe Ertl's Decision Support Journey. Power documents GE Real Estate's Innovative Data-driven Decision Support.

Model-driven DSS. Stottler Henke Associates described PADAL a DSS that helps US Navy aircraft land aboard carriers. Procter & Gamble used @RISK and PrecisionTree. TechComm Associates documented how estimating software yielded higher profits at Liberty Brass. ProModel reported how MeritCare Health System used simulation to optimize integration of service areas into a new day unit.

Knowledge-driven DSS. Biss wrote about how Dynasty Triage Advisor enabled Medical Decision Support. Pontz and Power describe building an Expert Assistance System for Examiners (EASE) at the Pennsylvania Department of Labor and Industry. EXSYS reported how IAP Systems is using Exsys CORVID expert system software to support corporate families on overseas assignments.

Communications-driven DSS. eRoom staff documented how Naval Medicine CIOs used a collaboration and knowledge-sharing decision support application.

Document-driven DSS. Documentum Staff explained how BFGoodrich (BFG) Aerospace was improving Aircraft Maintenance Operations decision making using a document-driven work flow system. Stellent Staff reported how University of Alberta increased access to policies and procedures.

Some systems have multiple decision support subsystems. For example, Tully explains E-Docs Asset GIS, a web-based spatial DSS with both data and document-driven decision support.

1.5 How Useful Are DSS Case Studies

Decision Support Systems (DSS) encompass a broad array of software artifacts intended to support decision making. The broad purpose is the same for all DSS, but the narrower more specific uses and purposes vary. The targeted users of the systems also differ. More fundamentally the architecture, technologies and source of primary functionality can differ in significant ways. To better understand the wide range of systems categorized broadly as Decision Support Systems researchers can and should investigate exemplar systems and document them to demonstrate changes as DSS are built using new technologies and to document innovation and best practices.

The specific DSS in a specific context is the "case" being studied and researchers need to exercise care to insure their investigation does not bias the data collection or the analysis. A researcher collecting data about the design, functioning and effectiveness of a specific decision support system may and often is biased toward the expanded use of computerized decision support. Yin [44] defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context (cf. p. 23). Prospective DSS case study researchers should consult sources like Soy [36], who suggests steps for preparing a case study for technology artifacts. He based his prescriptions on [35, 38, 44].

According to Yin [44–46], case studies are appropriate when your research addresses either a descriptive question like ‘What is happening or has happened?’ or an explanatory question like ‘How or why did something happen?’ Eisenhardt [5] concludes theory-building case study methods are appropriate for new areas of research as well as “research areas for which existing theory seems inadequate” (p. 549).

Some decision support case studies are longitudinal involving repeated observation and data collection over time while others involve a cross-sectional snapshot of the system. Both approaches have advantage and can potentially provide differing insights and different types of evidence. Selecting a specific DSS to study is most often based upon opportunity, cooperation of the “owner” of the DSS, and interest of the researcher or research team.

A systematic, research case study is in many ways the most useful research method for understanding the what, how, why and how much benefit questions important in an applied scientific field like computerized decision support. Reporting the implementation of a novel DSS is also useful, but some third party validation is desirable.

More case studies of Decision Support Systems in use are needed to improve our understanding and to document what is occurring. More longitudinal case studies that report design, development, installation, use, and maintenance would also be useful. Case studies provide rich, detailed information. DSS case study research is not often theory driven, it is not hypothesis testing, and a single case study does not result in generalizations, but it is useful. DSS case study research at its best leads to informed descriptions and interpretive theory development. Peskin [18] notes good description provides a foundation for all research. He also states “Interpretation not only engenders new concepts but also elaborates existing ones (p. 24).”

1.6 Conclusions and Recommendations

The value of a decision support case study depends upon many factors. Only some of them are controllable by the researchers. The following suggestions should increase the value of a DSS research case study and help to expand our collective body of decision support knowledge:

1. Try to identify novel DSS implementations where permission to publish the findings is granted.
2. Identify installations/sites where you receive good cooperation from both users and technical staff.
3. Be systematic in gathering information; think about what you want to know and what has been reported in other DSS case studies.
4. Try to use the actual decision support system. If possible, do more than observe its use.

5. Identify multiple informants and information sources, including system documentation.
6. Take notes, lots of notes.
7. Follow up a site visit or online meeting/demonstration with emails to get more details and to confirm what you heard and observed.
8. Say thank you often. Maintain positive relationships so you can get feedback on the draft of the case study. Make sure managers recognize the value of documenting the DSS, and of its development and use.

Yin [44] notes "The detective role offers some rich insights into case study field research (p. 58)." Like a detective, the case study researcher must know the purpose of the investigation, collect descriptive and factual data systematically, interpret the data, summarize what was found, and draw reasonable conclusions. Simon [34] briefly discussed the case study as an example of descriptive research. He admonishes the case study researcher to "work objectively. Describe what is really out in the world and what could be seen by another observer. Avoid filtering what you see through the subjective lenses of your own personality (pp. 276–277)."

Case study research is a legitimate tool for expanding our understanding of computerized decision support [8, 43]. No research methodology answers all of our questions conclusively. Qualitative DSS case study research brings an information systems researcher in direct contact with the technology artifact. The benefit to the researcher from that direct contact is enhanced by spending the time and effort to systematically collect data, organize and interpret the findings, and then share the case study with other researchers. Decision support researchers need to study in the field the decision support systems that they teach about, find interesting, and perhaps wonder about. Decision support systems are varied, complex, changing and consequential, some are more enduring than others. More research case studies and more details about each specific case will be useful, helpful, and a contribution to our understanding how computing and software can improve individual, group and organization decision making.

Note

This chapter incorporates material from Ask Dan! columns written by D. Power that have appeared in Decision Support News. Check [23, 29, 30] in the archive of Ask Dan! columns at http://dssresources.com. Thanks to Professor Dale Cyphert and the editors for suggestions.

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