

BOOK REVIEW

Decision Support Systems: A Knowledge-based Approach

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Decision Support System (DSS) is the name of a specific discipline and of a movement which have, over the last 25 years, captured the attention of many researchers from academia, of system developers, and users from the public sector and private industries. To better define the scope of DSS discipline one should turn to the scope of the Working Group (WG) 8.3 on Decision Support Systems of the IFIP Technical Committee 8 (Information Systems). This was formally established in 1981. Its mission was set to cover "the development of approaches for applying information systems technology to increase the effectiveness of decision makers in situations where the computer system can support and enhance human judgement in the performance of tasks that have elements that cannot be specified in advance".

Many journal articles, textbooks, readings and conference proceedings have since been published to contribute to building and disseminating a body of knowledge in the DSS domain (see for example <http://dssresources.com/books/dssbooks.html>). A remarkable contribution to this movement is made by the book of C.W. Holsapple and A.B. Whinston, two of the mostly acknowledged scientific authorities in the DSS field.

This book proposes a quite original perspective to describe the decision making and the computerised decision supporting. The essence of the authors' approach lies in their view of a decision making as a process of manufacturing new knowledge. The knowledge-based perspective adopted in this book draws from many innovative papers and books produced by the authors and their colleagues since the mid60ies.

The main body of the book is divided into **five Parts**. Each Part starts with a keynote quotation and a short preview, and ends with a case study meant for class discussion on the topics addressed in the Chapters of the respective Part. The five Parts include 18 Chapters.

Part One (Chapters 1-4), entitled "*Decision Making and Knowledge*" sets the stage for the material to be presented in the corpus. It addresses, from a knowledge-based viewpoint, the setting for understanding the DSS concepts such as the content of managerial work, the decision making characteristic features and processes and the definition and usage of knowledge in decision making.

Chapter 1, *Managing to excel*, highlights the role of managers in structuring the resources of the organisation. It reviews the traditional managerial functions (planning, organising, commanding, coordinating and controlling) as well as the interrelated managerial roles (interpersonal, informational and decisional) proposed by Minzberg. A several-point profile of the managerial work is drawn with a view to emphasise the knowledge handling (acquisition, storing, using and maintaining) as a major activity and a basis for communication and decision making activities.

Chapter 2, *Decisions, decisions, decisions*, establishes a working perspective by introducing the authors' original view on decision making as a knowledge-intensive activity to manufacture new knowledge with a view at upgrading the state of knowledge within an organisation. Several context factors, such as management level, situation maturity, decision concurrency and organisational design are presented to highlight their impact on decision. The Chapter concludes with the presentation of some extra features helping classify decisions such as: functional area, structuredness, and negotiation. Each such case shows the influence of the feature on decision support.

Chapter 3, *Decision makers and processes*, identifies several types of entities (humans or computers) that make decisions such as individual or multiparticipant decision makers (teams, groups or

organisations). H. Simon's classical three-phase (intelligence, design and choice) process view of decision making is connected with the description of flows of problem recognition and solution activities. Several strategies guiding organisation of the decision making process such as optimization, satisficing, elimination by aspects, incrementalism, etc., are reviewed. The Chapter describes the need for computerised decision support systems as determined by the perceived cognitive, economic and time limits of human decision makers. The Chapter concludes with a set of seven decision supporting functions that might be offered by a DSS: alerting on decision opportunity, problem recognition and solving, facilitating and enhancing user's ability to process knowledge, offering advice, evaluating and designing solutions, stimulating user's creativity, and co-ordinating interactions among participants in decision-making process.

Chapter 4, *Knowledge matters*, final Chapter of Part One, contains several key concepts and the authors' original findings, the solutions presented are based on. First, a knowledge-based view of decision making is looked upon as a process to manufacture new knowledge. Several necessary abilities to modify and use the content of a "knowledge storehouse" such as: accepting and issuing messages, assimilating new knowledge, acknowledging the need for a decision and manufacturing the decision, are presented. The DSS is viewed as a supporting participant in a team. Its mission is to support the cognitive abilities of the human decision maker(s) by manipulating the knowledge inventory. Three views of knowledge-representation, transition from one state to another and production (based on knowledge acquisition and derivation) respectively, are further presented. Then a review of knowledge sources and quality aspects is made. A fundamental classification (based on previous works of the authors and of their co-workers) of knowledge types (descriptive, procedural, reasoning, linguistic, assimilative and presentation) is given in the final part of Chapter 4.

Part Two, entitled: "*Foundations of Decision Support Systems*", includes many of the key concepts and original conceptual findings that the authors based on in the remaining part of the book.

Chapter 5, *Decision Support Systems overview*, starts with describing the "raison d'être" of a DSS, namely to "increase the productivity of the decision maker" through implementing his/her abilities to manipulate knowledge, by facilitating problem-solving, and providing an aid for nonstructured problems. The concept of DSS is presented in contrast to other information systems such as the ancestor EDP (electronic data processing) and MIS (management information systems), or the relatively new solution EIS (executive information systems), or the broader concept of TSS (task support systems). Five characteristic features are identifiable in qualifying an information system as a DSS, namely: a) it contains a body of appropriate knowledge, b) it has the ability to acquire and maintain the knowledge, c) it can present the knowledge in a required customised way, d) it is able to select the necessary subset of knowledge for deriving new knowledge or for presentation to the user, and e) it can directly interact with the participant(s) in decision making process in a flexible and natural way. The metaphor of a human DSS (HDSS) is presented in the final part of the Chapter, to be invoked in the next Chapters of the book. Four behavioural categories of the HDSS have been chosen to be described in more detail. They are: accepting requests made by the decision maker, preparing answers, possessing and processing knowledge.

Chapter 6, *Decision Support Systems architecture*, contains several working concepts used from this Chapter on. It presents the authors' original DSS framework that includes four essential subsystems (language system-LS, presentation system-PS, knowledge system-KS, and problem processing system-PPS) that correspond to the four traits of the HDSS introduced at Chapter 5. While the first three subsystems serve to represent the six types of knowledge described at Chapter 4, the fourth subsystem is the "DSS software engine" that supports activities such as problem recognition and solving. The main abilities of PPS are knowledge acquisition, selection/derivation and presentation. In accordance with the main knowledge management technique a DSS makes use of, several specialised frameworks are identified and described, say: text-oriented DSS, database-oriented DSS, spreadsheet-oriented DSS, solver-oriented DSS and rule-oriented DSS.

Chapter 7, *Building Decision Support Systems*, describes the main phases of the DSS development process and concisely refer Sprague's and Carlson's two well-known methods such as ROMC (during the analysis phase) and incremental design respectively.

Chapter 8, *DSS development tools*, the last one of Part Two, logically follows. It investigates aspects which the system developer ought to consider when he/she selects one or several tools to implement particular DSS. The roles of "intrinsic" and "extrinsic" tools and several characteristic features (user-

friendliness, styles adopted to implement the language and presentation possibilities) are discussed. Also multi-technique integration of tools is reviewed, such as knowledge conversion, clipboard, nesting and synergistic integration.

Part Three, entitled : "*Knowledge Management Techniques for Decision Support*", analyses 3 knowledge management techniques. The presentation reveals both knowledge *representation* facilities and knowledge *processing* methods, without insisting on the implementation of specific tools. The order of presentation is in accordance with the increasing complexity of the techniques.

Chapter 9, *Expression, text, hypertext, and database management*, covers those techniques which are frequently used for representation and processing of descriptive knowledge.

Chapter 10, *Solver, spreadsheet, program, and menu management*, deals with the techniques which are especially useful in representing and processing procedural knowledge. Menu management is appropriate for managing linguistic knowledge.

Chapter 11, *Forms, report, graphics, rule and message management*, describes four techniques that are suitable for managing presentation knowledge, and one technique (rule management), that is adequate for managing reasoning knowledge. All through this Part of the book the presentation of various techniques is accompanied with scant reference to implementation details of tools existing on the market. The technique-oriented approach of the authors is justified by the fact that while the fundamentals of techniques are rather time invariant and well-defined, the actual tools may cover -to various extents- more than one technique and their popularity and the set of facilities available may vary in time.

Part Four, entitled : "*Artificially Intelligent Decision Support Systems*", extends the presentation of rule management done in Chapter 11, and gives a good coverage of the domain of rule-based expert systems utilised in managerial applications.

Chapter 12, *Overview of artificially intelligent decision support*, reviews the history and the scope of artificial intelligence and highlights potential benefits of expert systems in managerial applications. An application of setting quotas in book distribution business is introduced in Section 12.4 with a view at being used as a vehicle to illustrate many of the concepts this Part of the book brings in.

Chapter 13, *Rule management*, covers the classical subjects of rule-based knowledge representation and inference mechanisms (forward and backward reasoning). Interaction with the user and links with external sources of knowledge such as databases, spreadsheets and solvers, are reviewed.

Chapter 14, *Developing an artificially intelligent DSS*, covers the seven phases of the development cycle of a rule-based expert system.

Chapter 15, *Advanced reasoning tools*, addresses several finer aspects such as reasoning rigour, rule selection order, premise evaluation strategy.

Methods of dealing with uncertain and unclear information are in-depth discussed.

Part Five, entitled: "*Multiparticipant and Executive Decision Support Systems*", extends the concepts presented in Part Two by several solutions for multiparticipant decision makers (introduced in Chapter 3) and for top executives.

Chapter 16, *Organisational computing for decision support*, introduces the concepts of "organisational infrastructure" and [computer-based] "technological infrastructure", and identifies four organisational DSS, namely: corporate planning systems (CPS), functional DSS (FDSS), executive information systems (EIS), local DSS (LDSS). Several forms of organisational computing (OC) subjects are surveyed : groupware, computer mediated communication, computer-supported cooperative work and coordinating technology.

Chapter 17, *Multiparticipant Decision Support Systems*, extends the DSS framework for individual decision maker, introduced at Chapter 6. The destination and commonalities of multiparticipant DSS (MDSS) are examined and a common architecture of MDSS is given by building up on the generic

framework introduced at Chapter 6 for the single decision maker. Three types of MDSS such as group DSS (GDSS), organisational DSS (ODSS) and negotiation support systems, are taken into consideration.

Chapter 18, *Executive information systems*, highlights the specific characteristics of EIS and describes the developing process and possible causes for EIS failure.

Chapter 19, *Knowledge-based organisation*, outlines several aspects of the knowledge-based society as they had been revealed at the time this book was written.

The main body of the book is followed by 8 Appendices. Appendices A through D offer complementary material on various knowledge (expression, text, data and program) management techniques. The subjects of "AI knowledge representation" (through frames and semantic networks) and "Machine learning" (genetic algorithms and artificial neural networks) are addressed in Appendices E and F.

The book inserts a rich Glossary, an Index and a Directory of publications in the field of DSS.

The book was meant by the authors as a text for students in management and business schools. It can also be used by the students in information systems schools and by managers and consultants. It contains several learning aids in each chapter such as: an opening description of an application DSS, special interest boxes, items from newspapers (in the body of the Chapter), a summary of main ideas covered, a list of important terms, a set of exercises, review questions and discussion topics (at the end of the Chapter).

The book is supported by a remarkable Internet site (<http://www.uky.edu/BusinessEconomics/dssakba/welcome.html>) meant "to help teachers and researchers who choose to adopt a knowledge management perspective in the field of DSS". The site has several chapters such as: "Instructional materials", "In the News", "Selected periodicals", "Selected references", "Announcements", "Related sites", "The DSS student discussion forum", "The knowledge management exchange", and "Degrees and careers in business computing".

This book distinguishes by several features. This is the first text to adopt a knowledge-based perspective on DSS that allows an unified understanding of important concepts.

The book covers most of the classic and modern topics, essential to understanding the DSS concepts. Of course, several other techniques such as data warehousing, data mining and web-based cooperative work, that are considered important at present, received only little attention in Chapter 18 and Chapter 19 respectively of a book written in 1996. Nevertheless the reader or the teacher can easily find an adequate place for these techniques and for others that will possibly show up in the years to come. This is because the presentation is independent of particular products on the market. Only few are the references made to actual information tools such as IFPS, Visicalc, Lotus. I think the authors have made a right decision as concepts and techniques have a longer life than particular implementation solutions of commercial products and applications. This is proved by the fact that the conceptual DSS framework that Bonczek, Holsapple and Whinston proposed in a famous book (*Foundations of Decision Support Systems*, Academic Press, 1982) two decades ago, which Chapter 6 of the book presents in an updated form, is still valid in its main lines.

The concepts are gradually introduced in a natural sequence, and the writing style is lively and clear and it is consistent across Chapters.

The concepts which Holsapple, Whinston and their colleagues introduced over the last two decades influenced a large number of researchers (including this reviewer) and practitioners. Also this book has been adopted by many instructors since its publication in 1996. I think this remarkable book is up to turn into a new "classic" and I warmly recommend it to all those who have not adopted it yet.

At present the book has become a product of Course Technology MA.

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