

MATHEMATICAL MODELLING: THEORY AND APPLICATIONS

# MODEL-BASED DECISION SUPPORT METHODOLOGY WITH ENVIRONMENTAL APPLICATIONS

Andrzej P. Wierzbicki, Marek Makowski  
and Jaap Weessels (Eds.)



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# Model Based Decision Support Methodology With Environmental Applications

**Yasuo Narukawa**



## **Model Based Decision Support Methodology With Environmental Applications:**

Model-Based Decision Support Methodology with Environmental Applications Andrzej P. Wierzbicki, Marek Makowski, Jaap Wessels, 2000-05-31 The complexity of issues requiring rational decision making grows and thus such decisions are becoming more and more difficult despite advances in methodology and tools for decision support and in other areas of research Globalization interlinks between environmental industrial social and political issues and rapid speed of change all contribute to the increase of this complexity Specialized knowledge about decision making processes and their support is increasing but a large spectrum of approaches presented in the literature is typically illustrated only by simple examples Moreover the integration of model based decision support methodologies and tools with specialized model based knowledge developed for handling real problems in environmental engineering industrial economical social and political activities is often not satisfactory Therefore there is a need to present the state of art of methodology and tools for development of model based decision support systems and illustrate this state by applications to various complex real world decision problems The monograph reports many years of experience of many researchers who have not only contributed to the developments in operations research but also succeeded to integrate knowledge and craft of various disciplines into several modern decision support systems which have been applied to actual complex decision making processes in various fields of policy making The experience presented in this book will be of value to researchers and practitioners in various fields The issues discussed in this book gain in importance with the development of the new era of the information society where information knowledge and ways of processing them become a decisive part of human activities The examples presented in this book illustrate how various methods and tools of model based decision support can actually be used for helping modern decision makers that face complex problems Overview of the contents The first part of this three part book presents the methodological background and characteristics of modern decision making environment and the value of model based decision support thus addressing current challenges of decision support It also provides the methodology of building and analyzing mathematical models that represent underlying physical and economic processes and that are useful for modern decision makers at various stages of decision making These methods support not only the analysis of Pareto efficient solutions that correspond best to decision maker preferences but also allow the use of other modeling concepts like soft constraints soft simulation or inverse simulation The second part describes various types of tools that are used for the development of decision support systems These include tools for modeling simulation optimization tools supporting choice and user interfaces The described tools are both standard commercially available and nonstandard public domain or shareware software which are robust enough to be used also for complex applications All four environmental applications regional water quality management land use planning cost effective policies aimed at improving the European air quality energy planning with environmental implications presented in the third part of the book rely on many years of cooperation

between the authors of the book with several IIASA's projects and with many researchers from the wide IIASA network of collaborating institutions. All these applications are characterized by an intensive use of model-based decision support. Finally, the appendix contains a short description of some of the tools described in the book that are available from IIASA free of charge for research and educational purposes. The experiences reported in this book indicate that the development of DSSs for strategic environmental decision making should be a joint effort involving experts in the subject area, modelers, and decision support experts. For the other experiences discussed in this book, the authors stress the importance of good data bases and good libraries of tools. One of the most important requirements is a modular structure of a DSS that enhances the reusability of system modules. In such modular structures, user interfaces play an important role. The book shows how modern achievements in mathematical programming and computer sciences may be exploited for supporting decision making, especially about strategic environmental problems. It presents the methodological background of various methods for model-based decision support and reviews methods and tools for model development and analysis. The methods and tools are amply illustrated with extensive applications. Audience: This book will be of interest to researchers and practitioners in the fields of model development and analysis, model-based decision analysis and support, particularly in the environment, economics, agriculture, engineering, and negotiations areas, and mathematical programming. For understanding of some parts of the text, a background in mathematics and operational research is required, but several chapters of the book will be of value also for readers without such a background. The monograph is also suitable for use as a text book for courses on advanced Master and Ph.D. levels for programs on Operations Research, decision analysis, decision support, and various environmental studies, depending on the program, different parts of the book may be emphasized.

**Handbook of Operations Research in Natural Resources** Andres Weintraub, Carlos Romero, Trond Bjørndal, Rafael Epstein, 2007-09-19. Handbook of Operations Research in Natural Resources will be the first systematic handbook treatment of quantitative modeling, natural resource problems, their allocated efficient use, and societal and economic impact. Andr s Weintraub is the very top person in Natural Resource research. Moreover, he has an international reputation in OR and a former president of the International Federation of Operational Research Societies (IFORS). He has selected co-editors who are at the top of the sub-fields in natural resources: agriculture, fisheries, forestry, and mining. The book will cover these areas in terms of contributions from researchers on modeling natural resource problems, quantifying data, developing algorithms, and discussing the benefits of research implementations. The handbook will include tutorial contributions when necessary. Throughout the book, technological advances and algorithmic developments that have been driven by natural resource problems will be called out and discussed.

**Environmental Information Management and Decision Support System** Booz, Allen & Hamilton, National Cooperative Highway Research Program, 2003. Introduction: Get started and achieve buy-in. Understand requirements for the EIM DSS. Absorb the vision for the EIM DSS. Assess existing capabilities. Assess the evolution of technology. Identify

alternative migration paths Develop phased implementation plan Implement each phase using software development lifecycle methodology Acronyms and abbreviations Bibliography **Environmental Systems - Volume III** Achim Sydow,2010-09-27

Environmental Systems is a component of Encyclopedia of Environmental and Ecological Sciences Engineering and Technology Resources in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias Environmental Systems is something about data handling modeling and decision making in the field of environmental systems It includes related basic knowledge on measurement techniques modeling techniques and models and their applications for decisions making Environmental engineering research are based on measurement techniques and related knowledge of natural and life sciences Developed mathematical and numerical simulation models are tools and strictly purpose oriented that means suitable for decision making The three volumes on Environmental Systems are aimed at the following five major target audiences University and College students Educators Professional practitioners Research personnel and Policy analysts managers and decision makers and NGOs **Vector Calculus in Regional**

**Development Analysis** Kesra Nermend,2009-04-29 Methods used for regional development analysis are employed mainly to make forecasts and comparisons Forecasting models of various types e g econometric models are usually used for forecasting Recently vector autoregressive models VAR have become popular These models were proposed by Sims in 1980 On the contrary taxonomic methods that are in the center of attention as far as the present publication is concerned are most often employed to make comparisons Linear ordering methods including standard methods are the most popular among taxonomic methods They are based on different distance and similarity measures which leads to the fact that they do not always provide reliable information When for example one construes the standard for a base year and then compares it with data for other years it may turn out that the measure determined will have worse values than the standard for a real object region micro region although this object is better from the standard Hence one must look for new methods employed in regional development analysis or improve hitherto existing ones in such a way so that information obtained reflects the reality to a larger extent The main aim of the present publication is to work out methodological basis for regional development analysis based on vector calculus together with assumptions about computer system supporting the implementation of the method suggested Applied Decision Support with Soft Computing Xinghuo Yu,2012-12-06 Soft computing has provided

sophisticated methodologies for the development of intelligent decision support systems Fast advances in soft computing technologies such as fuzzy logic and systems artificial neural networks and evolutionary computation have made available powerful problem representation and modelling paradigms and learning and optimisation mechanisms for addressing modern decision making issues This book provides a comprehensive coverage of up to date conceptual frameworks in broadly perceived decision support systems and successful applications Different from other existing books this volume predominately focuses on applied decision support with soft computing Areas covered include planning management finance

and administration in both the private and public sectors

**Trust and Fairness in Open, Distributed Systems** Adam Wierzbicki, 2010-05-26 This book is an attempt to bring closer the greater vision of the development of Social Informatics. Social Informatics can be defined as a discipline of informatics that studies how information systems can realize social goals, use social concepts or become sources of information about social phenomena. All of these research directions are present in this book. Fairness is a social goal, trust is a social concept, and much of this book is based on the study of traces of Internet auctions used also to drive social simulations that are a rich source of information about social phenomena. The book has been written for an audience of graduate students working in the area of informatics and the social sciences in an attempt to bridge the gap between the two disciplines. Because of this, the book avoids the use of excessive mathematical formalism, especially in Chapter 2 that attempts to summarize the theoretical basis of the two disciplines of trust and fairness management. Readers are usually directed to quoted literature for the purpose of studying mathematical proofs of the cited theorems.

**Algorithms in Decision Support Systems** Vicente García-Díaz, 2021-03-19 This book aims to provide a new vision of how algorithms are the core of decision support systems (DSSs) which are increasingly important information systems that help to make decisions related to unstructured and semi-structured decision problems that do not have a simple solution from a human point of view. It begins with a discussion of how DSSs will be vital to improving the health of the population. The following article deals with how DSSs can be applied to improve the performance of people doing a specific task like playing tennis. It continues with a work in which authors apply DSSs to insect pest management together with an interactive platform for fitting data and carrying out spatial visualization. The next article improves how to reschedule trains whenever disturbances occur together with an evaluation framework. The final works focus on different relevant areas of DSSs: 1 a comparison of ensemble and dimensionality reduction models based on an entropy criterion; 2 a radar emitter identification method based on semi-supervised and transfer learning; 3 design limitations, errors and hazards in creating very large scale DSSs; and 4 efficient rule generation for associative classification. We hope you enjoy all the contents in the book.

**Ecosystems and Sustainable Development VI** Enzo Tiezzi, 2007 Containing papers presented at the Sixth International Conference on Ecosystems and Sustainable Development, this book presents research related to different aspects of ecosystems and sustainable development including physical sciences and modelling. A wide list of topics include Thermodynamics and Ecology, Sustainability indicators, Mathematical and system modelling, Biodiversity, Sustainability development studies, Conservation and Management of Ecological Areas, Socio-Economic Factors, Energy Conservation and Generation, Environmental and Ecological Policies, Environmental Management, Environmental Risk, Natural Resources Management, Recovery of Damaged Areas, Biological Aspects, Complexity, Remote Sensing, Landscapes and Forestation Issues, Soil and agricultural issues, Water Resources, Sustainable Waste Management, Air pollution and its Effects on Ecosystems.

*Recent Advances in Information Systems and Technologies* Álvaro Rocha, Ana Maria Correia, Hojjat Adeli, Luís Paulo

Reis, Sandra Costanzo, 2017-03-27 This book presents a selection of papers from the 2017 World Conference on Information Systems and Technologies WorldCIST 17 held between the 11st and 13th of April 2017 at Porto Santo Island Madeira Portugal WorldCIST is a global forum for researchers and practitioners to present and discuss recent results and innovations current trends professional experiences and challenges involved in modern Information Systems and Technologies research together with technological developments and applications The main topics covered are Information and Knowledge Management Organizational Models and Information Systems Software and Systems Modeling Software Systems Architectures Applications and Tools Multimedia Systems and Applications Computer Networks Mobility and Pervasive Systems Intelligent and Decision Support Systems Big Data Analytics and Applications Human Computer Interaction Ethics Computers Health Informatics Information Technologies in Education and Information Technologies in Radiocommunications

Computational Intelligence in Decision and Control Da Ruan, Javier Montero, 2008 FLINS originally an acronym for Fuzzy Logic and Intelligent Technologies in Nuclear Science is now extended to Computational Intelligence for applied research The contributions to the eighth edition in the series of FLINS conferences cover state of the art research development and technology for computational intelligence systems in general and for intelligent decision and control in particular

**Computational Intelligence In Decision And Control - Proceedings Of The 8th International Flins Conference**

Da Ruan, Javier Montero, Jie Lu, Luis Martinez, Pierre D'hondt, Etienne E Kerre, 2008-08-08 FLINS originally an acronym for Fuzzy Logic and Intelligent Technologies in Nuclear Science is now extended to Computational Intelligence for applied research The contributions to the eighth edition in the series of FLINS conferences cover state of the art research development and technology for computational intelligence systems in general and for intelligent decision and control in particular

**Modeling Decisions for Artificial Intelligence** Yasuo Narukawa, 2008-11-05 This book constitutes the refereed proceedings of the 5th International Conference on Modeling Decisions for Artificial Intelligence MDAI 2008 held in Sabadell Spain in October 2008 The 19 revised full papers presented together with 2 invited lectures were thoroughly reviewed and selected from 43 submissions they are devoted to theory and tools for modeling decisions as well as applications that encompass decision making processes and information fusion techniques The papers are organized in topical sections on aggregation operators decision making clustering and similarity computational intelligence and optimization as well as data privacy

*Web Engineering and Peer-to-Peer Computing* Enrico Gregori, Ludmila Cherkasova, Gianpaolo Cugola, Fabio Panzieri, Gian P. Picco, 2003-06-30 This book constitutes the refereed proceedings of the two thematic workshops held jointly with Networking 2002 WEB Engineering and Peer to Peer Computing Networking 2002 was organized by the Italian National Research Council CNR and was sponsored by the IFIP working groups WG 6.2 Network and Intern work Architectures WG 6.3 Performance of Communication Systems and WG 6.8 Wireless Communications The program of the conference covered five days and included the main conference three days two tutorial days and one day of

thematic workshops The International Workshop on Web Engineering was dedicated to the discussion of the principal issues that emerge in the design and implementation of large scale complex Web based systems Scalability issues pose a number of challenging problems to solve for both applications and the underlying web network infrastructure On one hand web services and internet applications must take into account network performance and transport protocol design to achieve acceptable performance and robustness On the other hand emerging network and Web technologies are determined by the requirements of these applications Fifteen papers were presented that illustrated the current state of the art in this area In addition to the authors of these papers the Workshop on Web Engineering was attended by about thirty participants who contributed to the workshop by stimulating fruitful discussions at the end of each presentation Thus this workshop provided an excellent opportunity for researchers from both industry and academia to gather exchange ideas and discuss recent results in the development of Web based systems and emerging Internet applications

#### **Integrated Water Management P.**

Meire, 2008 Integrated Water Management IWM deals with the planning and management of water resources by integrating the different issues involved including ecological economic technical legislative and transboundary This book offers a general framework for IWM It includes both the different environmental problems that affect the very different ecosystems and the main methodologies able to face the problem of IWM

#### **Knowledge Synthesis**

Yoshiteru Nakamori, 2015-11-26 This book provides readers the idea of systemically synthesizing various kind of knowledge which needs to combine analytical thinking and synthetic thinking Systems science is expected to help in solving contemporary complex problems utilizing interdisciplinary knowledge effectively and combining analytical thinking and synthetic thinking efficiently However traditional systems science has been divided into two schools one seeks a systematic procedure to give a correct objective answer the other develops an emergent systemic process so that the user can continue exploratory learning It is not an exaggeration to say that analytical thinking and synthetic thinking have been developed independently in different schools This book integrates approaches developed in these two schools using ideas in knowledge science that have been emerging recently under the influence of Eastern thinking It emphasizes the importance of utilizing intuition in systems approaches whereas other books usually try to solve problems rationally and objectively rejecting subjectivity This book never denies rationality and objectivity however complex problems of today do not always yield to complete analysis The novelty of this present volume is that it takes in the ideas of synthetic thinking in knowledge science to develop systems science further The chapter contributors who are experienced systems scientists with a profound understanding of knowledge management discuss knowledge synthesis from the Western and Eastern cultural perspectives The book introduces a theory on systemic knowledge synthesis in an odd chapter and then presents an application of the theory in the next chapter in order to contribute to developing translational systems science

#### **Systems-of-Systems Perspectives and Applications**

Tien M. Nguyen, 2021-07-07 This professional technical book presents complex topics on System of System SoS and Systems of



Systems SOS engineering SOS enterprise architecture SOSEA design and analysis and implementation of SOSEA framework along with the modeling simulation and analysis MS namely a primary and secondary category The primary category includes system engineers SOS architects and mathematicians The secondary category includes scientists and researchers in space airborne systems wireless communications medicine and mathematics who would benefit from several chapters that contain open problems and technical relevance Innovative Location Optimization for Rescue and Emergency Medical Services

Adapting to a Dynamic Environment Dirk Degel, 2015-07-15 Die effiziente und nachhaltige Ausgestaltung der rettungsdienstlichen Infrastruktur zur Sicherstellung einer hohen kommunalen Versorgungsqualität stellt eine komplexe Planungsaufgabe dar Insbesondere Fragestellungen der Standortplanung für Rettungswachen und Rettungsmittel z.B. RTWs sind in einem dynamischen und durch Unsicherheit geprägten Umfeld für die rechtzeitige Versorgung in Notfallsituationen von entscheidender Bedeutung In dieser Arbeit werden innovative Optimierungsmodelle vorgestellt die einerseits optimale Standortentscheidung für Rettungsmittel auf einer taktischen Ebene unter Berücksichtigung dynamischer Umwelteinflüsse und unsicherer Nachfrage bestimmen Andererseits wird die strategische Systemanpassung und Weiterentwicklung einer rettungsdienstlichen Infrastruktur unter Berücksichtigung unsicherer zukünftiger Entwicklungen bestimmt Hierzu wird auf Methoden des Operations Research und insbesondere der robusten Optimierung zurückgegriffen Die vorgestellten Modelle erlauben die Analyse komplexer Entscheidungssituationen sowie die Bestimmung optimaler Handlungsalternativen Hierdurch wird eine effektive Entscheidungsunterstützung zur Planung der kommunalen Notfallversorgung gegeben

Creative Environments Andrzej P. Wierzbicki, Yoshiteru Nakamori, 2007-06-02 Creative Environments is a follow up on the book Creative Space in the same series and by the same authors serving this time as editors of a broader book on computational intelligence and knowledge engineering tools for supporting knowledge creation This book contains four parts The first part presents a further development of models of knowledge creation presented already in Creative Space in particular the Triple Helix of normal academic knowledge creation and a new integrated model of normal academic and organizational knowledge creation called Nanatsudaki seven waterfalls Model The second part presents computational intelligence tools for knowledge acquisition by machine learning and data mining for debating brainstorming for roadmapping and for integrated support of academic creativity The third part presents the use of statistics for creativity support virtual laboratories gaming and role playing for creativity support methods of knowledge representation and multiple criteria aggregation distance and electronic learning The last part addresses knowledge management and philosophical issues and contains chapters on management of technology and knowledge management for academic R and D on knowledge management and creative holism or systems thinking in the knowledge age on technology and change or the role of technology in knowledge civilisation on the emergence of complex concepts in science and the final chapter on summary and conclusions including a proposal of an integrated episteme of constructive evolutionary objectivism necessary for the

knowledge civilization age      *Computational Collective Intelligence Technologies and Applications* Piotr Jedrzejowicz, Ngoc Thanh Nguyen, Kiem Hoang, 2011-09-13 The two volume set LNAI 6922 and LNAI 6923 constitutes the refereed proceedings of the Third International Conference on Computational Collective Intelligence ICCCI 2011 held in Gdynia Poland in September 2011 The 112 papers in this two volume set presented together with 3 keynote speeches were carefully reviewed and selected from 300 submissions The papers are organized in topical sections on knowledge management machine learning and applications autonomous and collective decision making collective computations and optimization Web services and semantic Web social networks and computational swarm intelligence and applications

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