



# MULTI-CRITERIA DECISION ANALYSIS

ENVIRONMENTAL APPLICATIONS  
AND CASE STUDIES

Igor Linkov  
Emily Moberg



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# Multi Criteria Decision Analysis Environmental Applications And Case Studies Environmental Assessment And Management

**Igor Linkov, Emily Moberg**



## **Multi Criteria Decision Analysis Environmental Applications And Case Studies Environmental Assessment And Management:**

**Multi-Criteria Decision Analysis** Igor Linkov, Emily Moberg, 2017-03-29 Environmental management is often complicated and multidisciplinary and the issues that arise can be difficult to solve analytically. Often decision makers take ad hoc approaches which may result in the ignoring of important stakeholder opinions or decision criteria. Multi criteria decision analysis MCDA provides a framework by which these types of decisions can be made but despite being used effectively in many fields it is not often used in environmental management. Given the novelty and inherent applicability of this decision making framework to the environmental field there is a need for more teaching tools for MCDA. In particular there is a need for a case study based approach to help readers navigate the many MCDA methods and decide how to apply them to a specific case. Through a collection of case studies *Multi Criteria Decision Analysis Environmental Applications and Case Studies* gives readers the tools to apply cutting edge MCDA methods to their own environmental projects. It offers an overview of the types of MCDA available and a conceptual framework of how it is applied with the focus on its applicability for environmental science. Taking an in depth look at the case of sediment management the book introduces different steps of MCDA processes from problem formulation and model development to criteria weighing and alternative scoring. The authors then explore the case using various MCDA methods which allows readers to see clearly how the methodologies differ and gain a better understanding of the mechanistic operation of the analysis. A series of case studies in nanotechnology collectively demonstrate the application of MCDA in situations of high variability and uncertainty that require the integration of technical information and expert judgment an area where MCDA clearly shines. The authors describe multiple decisions from risk classification to value of information analysis to the assessment of potential research and funding investments that readers may face in dealing with emerging environmental threats. Demonstrating the broad applicability of MCDA methods for different types of cases the book presents a series of case studies ranging from oyster restoration to oil spill response. In conjunction with these cases the book also provides corresponding decision models that are implemented by the DECERNS software and allow users to examine the same case using multiple MCDA tools. The DECERNS software and models are available for download at [www.crcpress.com](http://www.crcpress.com). Intended both as a research and teaching tool this book inspires creative thinking when applying MCDA to complicated environmental issues.

*Multi-Criteria Decision Analysis* Igor Linkov, Emily Moberg, Benjamin D. Trump, Boris Yatsalo, Jeffrey M. Keisler, 2020-09-14 Decision analysis has become widely recognized as an important process for translating science into management actions. With climate change and other systemic threats as driving forces in creating environmental and engineering problems there is a great need for understanding decision making frameworks through a case study based approach. Management of environmental and engineering projects is often complicated and multidisciplinary in scope and nature thus issues that arise can be difficult to solve analytically. Multi

Criteria Decision Analysis Case Studies in Engineering and the Environment provides detailed description of MCDA methods and tools and illustrates their applications through case studies focused on sustainability and system engineering applications New in the Second Edition Addresses current and emerging environmental and engineering problems Includes seven new case studies to illustrate different management situations applicable at the international level Builds on real case studies from recent and relevant environmental and engineering management experience Describes advanced MCDA techniques and extensions used by practitioners Provides corresponding decision models implemented using the DECERNS software package Gives a more holistic approach to teaching MCDA methodology with a focus on sustainable solutions and adoption of new technologies including nanotechnology and synthetic biology Given the novelty and inherent applicability of this decision making framework to the environmental and engineering fields a greater number of teaching tools for this topic need to be made available This book provides those teaching tools covering the breadth of the applications of MCDA methodologies with clear explanations of the MCDA process The case studies are implemented in the DECERNS software package allowing readers to experiment and explore and to understand the full process by which environmental managers assess these problems This book is a great resource for professionals and students seeking to learn decision analysis techniques and apply similar frameworks to environmental and engineering projects

**Multicriteria Analysis for Environmental Decision-Making** Davide Geneletti, 2019-05-30 Multicriteria analysis or MCA has been increasingly used in environmental decision making to support the identification of suitable courses of action by integrating factual information with value based information collected through stakeholder engagement Multicriteria Analysis for Environmental Decision Making provides an introduction to the key concepts of MCA and includes a series of case studies that illustrate the application of MCA to a variety of environmental decision making problems ranging from protected area zoning to landfill siting and from forest restoration to environmental impact assessment of tourism infrastructures A compact reference that can be used by researchers practitioners and planners decision makers Multicriteria Analysis for Environmental Decision Making can also serve as a textbook for undergraduate and postgraduate courses in a broad range of curricula

**Multi-Criteria Decision Analysis** Igor Linkov, Emily Moberg, 2011-10-24 Environmental management is often complicated and multidisciplinary and the issues that arise can be difficult to solve analytically Often decision makers take ad hoc approaches which may result in the ignoring of important stakeholder opinions or decision criteria Multi criteria decision analysis MCDA provides a framework by which these types of decisions can be made but despite being used effectively in many fields it is not often used in environmental management Given the novelty and inherent applicability of this decision making framework to the environmental field there is a need for more teaching tools for MCDA In particular there is a need for a case study based approach to help readers navigate the many MCDA methods and decide how to apply them to a specific case Through a collection of case studies Multi Criteria Decision Analysis Environmental Applications and Case

Studies gives readers the tools to apply cutting edge MCDA methods to their own environmental projects It offers an overview of the types of MCDA available and a conceptual framework of how it is applied with the focus on its applicability for environmental science Taking an in depth look at the case of sediment management the book introduces different steps of MCDA processes from problem formulation and model development to criteria weighing and alternative scoring The authors then explore the case using various MCDA methods which allows readers to see clearly how the methodologies differ and gain a better understanding of the mechanistic operation of the analysis A series of case studies in nanotechnology collectively demonstrate the application of MCDA in situations of high variability and uncertainty that require the integration of technical information and expert judgment an area where MCDA clearly shines The authors describe multiple decisions from risk classification to value of information analysis to the assessment of potential research and funding investments that readers may face in dealing with emerging environmental threats Demonstrating the broad applicability of MCDA methods for different types of cases the book presents a series of case studies ranging from oyster restoration to oil spill response In conjunction with these cases the book also provides corresponding decision models that are implemented by the DECERNS software and allow users to examine the same case using multiple MCDA tools The DECERNS software and models are available for download at [www.crcpress.com](http://www.crcpress.com) Intended both as a research and teaching tool this book inspires creative thinking when applying MCDA to complicated environmental issues

*Futures Research and Environmental Sustainability*  
James K. Lein, 2016-12-08 This book explores the challenges of presenting sustainability as a more actionable or practical concept and identifying approaches that might offer useful assistance in addressing the temporal and spatial representation of sustainability The underlying premise of this book is that sustainability is a state realized in the future In that future there is a geographic arrangement of society and economy that agrees with its environmental setting This future perspective introduces a little examined subject area that can lend significant content to the sustainability challenge Futures Research

**Energy Systems Evaluation (Volume 1)** Jingzheng Ren, 2021-06-01 This book presents various methods for sustainability assessment of energy systems under various different conditions and scenarios It answers the questions of how to measure the sustainability of energy systems by adopting appropriate metrics and methods This book provides readers with a comprehensive view of the frontiers of sustainability assessment methods for energy system analysis It presents various methodologies allowing readers to understand the complete metrics for sustainability assessment life cycle thinking for sustainability assessment of energy systems and the advanced sustainability assessment methods for energy systems This book is of interest to researchers engineers decision makers and postgraduate students within the field of energy systems sustainability and decision analysis

*New Perspectives in Multiple Criteria Decision Making* Michalis Doumpos, José Rui Figueira, Salvatore Greco, Constantin Zopounidis, 2019-04-02 This book provides comprehensive coverage of the latest research on multiple criteria research analysis MCDA and related areas gathering a collection of high quality chapters

prepared by leading scholars in the field By covering the established streams in MCDA research and simultaneously exploring new and emerging areas of application it offers a unique reference resource for the future development of MCDA The book approaches MCDA as one of the most active areas in operations research and management science OR MS It presents not only the significant advances achieved to date but also the new opportunities and challenges arising for both the theory and practice of MCDA Among many others the book addresses behavioral and conceptual aspects of decision aiding and decision making problem structuring issues in the framework of new technological and socio economic advances methodological and algorithmic advances for analytical modeling and decision aiding as well as a number of new application areas in engineering business and the social sciences Resilience and Risk Igor Linkov, José Manuel

Palma-Oliveira, 2017-08-01 This volume addresses the challenges associated with methodology and application of risk and resilience science and practice to address emerging threats in environmental cyber infrastructure and other domains The book utilizes the collective expertise of scholars and experts in industry government and academia in the new and emerging field of resilience in order to provide a more comprehensive and universal understanding of how resilience methodology can be applied in various disciplines and applications This book advocates for a systems driven view of resilience in applications ranging from cyber security to ecology to social action and addresses resilience based management in infrastructure cyber social domains and methodology and tools Risk and Resilience has been written to open up a transparent dialog on resilience management for scientists and practitioners in all relevant academic disciplines and can be used as supplement in teaching risk assessment and management courses Shipping and the Environment Karin Andersson, Selma Brynolf, Fredrik

Lindgren, Magda Wilewska-Bien, 2016-02-23 This book focuses on the interaction between shipping and the natural environment and how shipping can strive to become more sustainable Readers are guided in marine environmental awareness environmental regulations and abatement technologies to assist in decisions on strategy policy and investments You will get familiar with possible paths to improve environmental performance and in the long term to a sustainable shipping sector based on an understanding of the sources and mechanisms of common impacts You will also gain knowledge on emissions and discharges from ships prevention measures environmental regulations and methods and tools for environmental assessment In addition the book includes a chapter on the background to regulating pollution from ships It is intended as a source of information for professionals connected to maritime activities as well as policy makers and interested public It is also intended as a textbook in higher education academic programmes *Water Studies* C. A.

Brebbia, 2018-03-27 Comprising specially selected papers this book presents trans disciplinary research on issues related to the nature of water and its use and exploitation by society The valuable research contained in this book demonstrates the need to bridge the gap between physical biological environmental and health sciences Water is essential for sustaining life on our planet nevertheless its unequal distribution is a source of permanent conflict It is predicted that population growth and

irregular rainfall due to climate change may lead to more restricted access to water in certain regions of the world This problem is made even more severe by human actions that can cause degradation to nature and the environment The availability of clean and inexpensive water can no longer be taken for granted as the need for water continues to increase due a growing global population Heavy water consumers such as agriculture and industry often contribute to its contamination Water distribution networks in urban areas and soiled water collection systems present serious problems as well as the need to maintain ageing infrastructures Possible technologically solutions such as desalination or pumping systems are energy demanding but as costs rise the techniques currently developed may need to be re assessed

**Assessing Progress Towards Sustainability** Carmen Teodosiu,Silvia Fiore,Almudena Hospido,2022-04-14 Assessing Progress toward Sustainability Frameworks Tools and Case Studies provides practical frameworks for measuring progress toward sustainability in various areas of production consumption services and urban development as they relate to environmental impact A variety of policies strategies or frameworks are available at national and international levels This book presents an integrated approach to sustainability progress measurement by considering both the frameworks and methodological developments of various tools as well as their implementation in assessing the sustainability of processes products and services through a global perspective Combining methods and their application the book covers a variety of topics including lifecycle assessment risk assessment nexus thinking and connection to SDGs Organized clearly into three main sections Frameworks Tools and Case Studies this book can serve as a practical resource for researchers and practitioners alike in environmental science sustainability environmental management and environmental engineering Offers an integrated approach to sustainability assessment using the most up to date frameworks and tools Includes extensive diverse case studies to illustrate the methods and process for using the frameworks and tools outlined Provides practical insights related to challenges and opportunities to reduce environmental impacts and increase resources and energy efficiency

Mental Modeling Approach Matthew D. Wood,Sarah Thorne,Daniel Kovacs,Gordon Butte,Igor Linkov,2016-12-09 This book provides an easy to read user oriented introduction to mental models research and Mental Modeling Technology™ Mental models are powerful influences human behavior The book offers insight from the developers and most experienced application professionals of a widely proven methodology for understanding and influencing human judgment decision making and behavior The case studies show examples of the methodological concepts in their application context It is one of the most comprehensive collections of cases focused on government needs of any similar qualitative analysis approach Finally it presents an introduction to software tools and tutorials that enable readers to use the approach for their own research needs

**A review of multi-criteria decision-making applications to solve energy management problems: Two decades from 1995 to 2015** Abbas Mardania ,Edmundas Kazimieras Zavadskas,Zainab Khalifah,Norhayati Zakuan,Ahmad Jusoh,Khalil Md Nor,Masoumeh Khoshnoudi, Energy management problems associated

with rapid institutional political technical ecological social and economic development have been of critical concern to both national and local governments worldwide for many decades thus addressing such issues is a global priority Sustainable Cities and Military Installations Igor Linkov,2013-11-12 Access to reliable and affordable energy water and services is an important determinant of the prosperity of cities along with effective mission sustainment at military installations The idea for this book was conceived at the NATO Advanced Research Workshop ARW in June 2012 in Hella Iceland The workshop was attended by 50 scientists engineers and policymakers representing 15 different nations and multiple fields of expertise reflecting the global and interdisciplinary nature of climate change and sustainability research The focus of the workshop was on ways in which military installations and small cities can integrate energy water and infrastructure sustainability strategies into city and installation management plans that account for climate change uncertainties The organization of the book reflects major topic sessions and discussions during the workshop *Strategic Environmental Assessment and Urban Planning* Giovanni Campeol,2020-07-06 This volume gathers a selection of research contributions on Strategic Environmental Assessment SEA including theoretical and methodological studies and real world case studies It sheds new light on the respective steps in the procedure defined in the SEA Directive from theoretical and operational standpoints intended to enhance the sustainability of plans and programmes adopted by local regional and national authorities Improving the legitimacy and transparency of decision making in the field of environmental management was one of the goals that led the European Commission EU to adopt Directive 2001 42 EC on the assessment of environmental programmes effects This book provides a multidisciplinary approach to SEA and addresses the demand for policies and strategies to strengthen resilience through concrete measures to reduce energy consumption mitigate pollution promote social inclusion and create urban identity **Fuzzy Systems Modeling in Environmental and Health Risk Assessment** Boris Faybishenko,Rehan Sadiq,Ashok Deshpande,2023-03-13 Fuzzy Systems Modeling in Environmental and Health Risk Assessment Demonstrates the successful application of fuzzy systems modeling to real world environmental and health problems In Fuzzy Systems Modeling in Environmental and Health Risk Assessment a team of distinguished researchers delivers an up to date collection of the most successful and innovative attempts to apply fuzzy logic to problems involving environmental risk assessment healthcare decision making the management of water distribution networks and the optimization of water treatment and waste management systems By explaining both the theoretical and practical aspects of using fuzzy systems modeling methods to solve complex problems analyze risks and optimize system performance this handy guide maintains a strongly application oriented perspective throughout offering readers a practical treatment of a cutting edge subject Readers will also find Comprehensive explorations of the practical applications of fuzzy systems modeling in environmental science Practical advice on environmental quality assessments and human health risk analyses In depth case studies involving air and water pollution solid waste indoor swimming pool and landfill risk assessments wastewater treatment and more Perfect for



environmental engineers and scientists Fuzzy Systems Modeling in Environmental and Health Risk Assessment will also benefit policy makers computer scientists mathematicians and researchers and practitioners interested in applying soft computing theories to environmental problems *New Approaches to Economic Challenges A Systemic Recovery* OECD,2022-10-26 New economic thinking and acting through a systemic approach could outline policy alternatives to tackle the global scale systemic challenges of financial economic social and environmental emergencies and help steer our recovery out of the current crisis A systemic recovery requires an economic approach that balances several factors markets and states efficiency and resilience growth and sustainability national and global stability short term emergency measures and long term structural change Multi-Criteria Decision Analysis Muhammet Gul,Melih Yucesan,Melike Erdogan,2022-12-16 Multi Criteria Decision Making MCDM includes methods and tools for modeling and solving complex problems MCDM has become popular in the production and service sectors to improve the quality of service reduce costs and make people more prosperous This book illustrates applications through case studies focused on disaster management With a presentation of both Multi Attribute Decision Making MADM and Multi Objective Decision Making MODM models this is the first book to merge these methods and tools with disaster management This book raises awareness for society and decision makers on how to measure readiness and what necessary preventive measures need to be taken It offers models and case studies that can be easily adapted to solve complex problems and find solutions in other fields Multi Criteria Decision Analysis Case Studies in Disaster Management will offer new insights to researchers working in the areas of industrial engineering systems engineering healthcare systems operations research mathematics business computer science and disaster management and hopefully the book will also stimulate further work in MCDM **Geographic Information Systems and Applications in Coastal Studies** Yuanzhi Zhang,Qiuming Cheng,2022-12-07 In recent years geographic information systems GIS and their coastal applications have drawn increasing awareness globally regionally and locally These systems are used to monitor model and predict coastal zone issues New technologies including advances in GIS platforms and techniques are being adopted and innovatively applied to coastal environments and disasters coastal resources coastal social systems and coastal urban environments using new algorithms big data processing and deep learning approaches This book examines a variety of GIS applications providing a comprehensive overview of techniques approaches and experiences in GIS for coastal zones **Life Cycle Sustainability Assessment for Decision-Making** Jingzheng Ren,Sara Toniolo,2019-11-19 Life Cycle Sustainability Assessment for Decision Making Methodologies and Case Studies gives readers a comprehensive introduction to life cycle sustainability assessment LCSA methodology for sustainability measurement of industrial systems proposing an efficiency methodology for stakeholders and decision makers Featuring the latest methods and case studies the book will assist researchers in environmental sciences and energy to develop the best methods for LCA as well as aiding those practitioners who are responsible for making decisions for promoting sustainable development The past current status and

future of LCSA Life Cycle Assessment method LCA Life Cycle Costing LCC Social Life Cycle Assessment SLCA the methodology of LCSA typical LCSA case studies limitations of LCSA and life cycle aggregated sustainability index methods are all covered in this multidisciplinary book Includes models for assessing sustainability in environmental energy engineering and economic scenarios Features case studies that help define the advantages and obstacles of real world applications Presents a complete view from theory to practice of a life cycle approach by exploring the methods and tools of sustainability assessment analysis and design of sustainability assessment

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