

Contents

Foreword xiii

Preface..... xv

**SECTION I *Multi-Criteria Decision Analysis:
Methods and Applications***

Chapter 1 Introduction to Multi-Criteria Methods 3

 Introduction 3

 Background 3

 MCDA Methods 4

 MAUT 5

 AHP 5

 Outranking 6

 Uncertainty in Models..... 7

 Using MCDA with This Book..... 7

 Concluding Remarks 8

 References 9

Chapter 2 Multi-Criteria Decision Analysis in Environmental Sciences:
 Applications and Trends..... 11

 Introduction 11

 Literature Review and Paper Classification 11

 Growth of MCDA in Environmental Fields..... 13

 Trends in MCDA Methodologies Usage 14

 Trends in Application Areas 15

 MCDA Usage by Geographic Region 16

 Conclusion 17

**SECTION II *MCDA Methods in Depth: Sediment
Management***

Chapter 3 Problem Formulation and MCDA Model..... 21

 Background: Sediment Dredging..... 21

 Sediment Dynamics 21

 Dredging 21

Impacts of Dredging.....	24
Environmental and Ecological Effects	24
Socioeconomic Impacts.....	25
Dangers of Contaminated Sediments	25
New York–New Jersey Harbor Case	26
Problem Identification for New York–New Jersey Harbor	26
Problem Structuring / Formulation of Criteria and	
Alternatives for the New York–New Jersey Harbor Project.....	26
Alternatives Selection	27
Criteria Selection	28
Cocheco River Case	29
Problem Identification for Cocheco Dredging	29
Criteria Identification	30
Formulation of Alternatives	30
References	30
 Chapter 4	
Weighting and Scoring	33
Weighting for New York–New Jersey Harbor.....	33
Ranking	33
Pairwise Comparison (AHP).....	34
Swing-Weighting	35
Evaluation of Alternative Performance	36
Weighting for Cocheco Project	36
Ranking	36
Pairwise Comparison (AHP).....	37
Swing-Weighting	38
Evaluation of Alternative Performance	40
References	40
 Chapter 5	
MAUT	41
New York–New Jersey Harbor	41
Information Synthesis.....	41
Planning.....	45
Questions to Consider.....	46
Cocheco River	46
Planning.....	47
Questions to Consider.....	50
References	50
 Chapter 6	
Outranking	51
New York–New Jersey Harbor Case	51
Questions to Consider.....	55
Cocheco River	56

Contents

Questions to Consider.....	58
References	58

Chapter 7	Analytical Hierarchy Process (AHP)	59
	New York–New Jersey Harbor	59
	Questions to Consider.....	63
	Cocheco River	63
	Questions to Consider.....	67
	References	67

SECTION III MCDA Application in Depth: Nanomaterials

Chapter 8	Nanomaterials: Background and Environmental Challenges	71
	Background	71
	Importance.....	71
	Uncertainty and Risk.....	72
	Moving Forward.....	73
	References	74

Chapter 9	Risk-Based Classification of Nanomaterials	75
	Introduction	75
	MCDA Methodology	75
	Problem Identification	75
	Goal	75
	Choosing the Appropriate Methodology	75
	Problem Structuring / Formulation of Criteria and Alternatives.....	76
	Criteria Selection	76
	Alternatives Selection	76
	Model Assessment/Building: Weights and Scores	78
	Weighting.....	79
	Scores.....	79
	Model Application and Analysis	79
	Planning.....	81
	Questions to Consider	81
	References	81

Chapter 10	Nanomaterials Risk in Perspective: Bringing Together Technical Judgment and Stakeholder Preference.....	83
	Introduction	83
	Problem Identification	83

Problem Structuring/Formulation of Criteria and Alternatives	83
Alternatives.....	83
Criteria.....	84
Model Assessment/Building: Weights and Scores.....	85
Weights	85
Scores	85
Model Application and Analysis	87
Planning and Extensions	88
Questions to Consider	89
Reference.....	89
 Chapter 11 Insurability of Nanotechnology.....	91
Problem Identification	91
Problem Structuring/Formulation of Criteria and Alternatives.....	92
Alternatives.....	92
Criteria.....	92
Model Assessment/Building: Weights and Scores.....	93
Weights	93
Scores	94
Model Application and Analysis	94
Planning/Extensions.....	96
Questions to Consider	97
References	98
 Chapter 12 Selecting Optimal Nanomanufacturing Technology.....	99
Introduction	99
MCDA Methodology.....	99
Problem Identification	99
Problem Structuring/Formulation of Criteria and	
Alternatives.....	100
Model Assessment/Building: Weights and Scores	102
Criteria Weighting	102
Scores.....	102
Model Application and Analysis	105
Planning/Extensions.....	106
Questions to Consider	107
References	108
 Chapter 13 Value of Information Analysis for Nanomanufacturing	109
Introduction	109
MCDA and Uncertainty	109
VOI Methodology and Application Example.....	110
References	112

SECTION IV MCDA Application Case Studies

Chapter 14	Setting Dredging Windows for Sensitive Fish Species	115
	Introduction	115
	Background	115
	Importance.....	115
	Uncertainty/Risk	116
	Moving Forward	117
	MCDA Methodology	117
	Problem Identification	117
	Problem Structuring/Formulation of Criteria and Alternatives	118
	Criteria Selection	118
	Alternative Selection.....	120
	Model Assessment/Building: Weights and Scores	120
	Weights	120
	Scores.....	121
	Model Application and Analysis	121
	Planning/Extensions.....	122
	Questions to Consider	125
	References	125
Chapter 15	Management of Harmful Algal Blooms.....	127
	Introduction	127
	Background	127
	Importance.....	127
	Uncertainty and Risk.....	129
	Moving Forward.....	130
	MCDA	131
	Problem Identification	131
	Problem Structuring/Formulation of Criteria and Alternatives	131
	Alternatives.....	131
	Criteria	131
	Model Assessment/Building: Weights and Scores	132
	Alternative Scoring.....	133
	Model Application and Analysis	134
	Planning/Extensions.....	135
	Questions to Consider.....	136
	References	137
Chapter 16	Restoring Oysters in Chesapeake Bay	139
	Introduction	139
	Background	139
	Importance.....	139

Uncertainty and Risk.....	140
Moving Forward.....	141
MCDA Methodology.....	141
Problem Identification	141
Goal	141
Choosing the Appropriate Model	142
Problem Structuring/Formulation of Criteria and Alternatives	142
Criteria Selection	142
Alternative Selection.....	142
Model Assessment/Building: Weights and Scores	142
Scores.....	144
Model Application and Analysis	145
Planning/Extensions.....	149
Questions to Consider	149
References	149
 Chapter 17 Performance Metrics for Oil Spill Response	151
Introduction	151
Background	151
Importance.....	151
Uncertainty and Risk.....	153
Moving Forward.....	155
MCDA Methodology.....	155
Problem Identification	155
Problem Structuring/Formulation of Criteria and Alternatives	156
Alternative Selection.....	156
Criteria Selection	156
Model Assessment/Building: Weights and Scores	156
Weights	156
Scores.....	157
Model Application and Analysis	161
Planning/Extensions	162
Questions to Consider	163
References	164
 Appendix: Decerns Software Guide	165
Index	179