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# Mental Modeling Approach

Risk Management Application Case Studies

 Springer

# Foreword

Effective risk communication requires contributions from subject matter experts, who know the issues; analysts, who can identify the essential ones; behavioral scientists, who can address audience members' information needs; and specialists, who can create channels for trusted two-way communication between the parties. The mental models approach provides a framework for organizing the information needed to accomplish this task. However, it takes deep personal and organizational commitment to bring and keep the parties together. *Mental Modeling* shows how to make that happen, integrating theory and practice.

The range of its applications is remarkably broad, including plastic surgery, climate change, dairy farming, deep mining, biosolids, nuclear power, and carbon capture and sequestration. So is the range of stakeholders and audiences, including physicians, patients, regulators, laborers, engineers, land use planners, and river managers. And, so are the methods, including community workshops, in-depth interviews, expert elicitation sessions, computer models, worker training, and broad and narrowband communication. These ranges of topics, audiences, and method show the generality of the approach and the creativity of the authors in its use.

Readers of *Mental Modeling* will acquire an understanding of the theory underlying the approach, with its basic principles illustrated in diverse, practical examples. Readers will learn methods that they can apply directly and strategies for generating their own. And they will come away with an appreciation of the diligence needed to create communications worthy of the stakes riding on them. Although not easy, the work is exciting—and gratifying.

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of the Institute of Medicine (IOM) and of the National Academies and has participated in some two dozen committees of the IOM and National Research Council. Baruch is a coauthor of several books including *Acceptable Risk (1981)*, *Risk Communication—a Mental Models Approach (2002)*, and *Intelligence Analysis: Behavioral and Social Science Foundations (2011)*. He has also coauthored *Communicating Risks and Benefits: An Evidence-Based User's Guide (2011)*. He holds a PhD in psychology from the Hebrew University of Jerusalem.

## **Perspective on *Mental Modeling***

Throughout the U.S. Army Corps of Engineers (USACE), leaders at all levels and across all mission areas face increasingly complex demands. Projects are more technically challenging than ever before, regulatory requirements are more difficult, economic pressures are greater, and the universe of stakeholders is broader and more engaged than even a decade ago. At USACE's Engineer Research and Development Center's (ERDC's) Environmental Lab, one of our key charges is to develop, test, and disseminate practical tools and methods throughout USACE, including those designed to better align and integrate ecological, engineering, and social sciences considerations that result in more socially acceptable, economically viable, and environmentally sustainable projects. The stakes are high for the USACE's activities, as all projects USACE undertakes are done through different degrees of collaboration with agency partners and key stakeholders, with potential for both positive and negative impacts on local ecology and environment, socioeconomic health of the community and region, etc. As we have learned, the quality of our stakeholder engagement processes from project design through implementation affects both the efficiency and quality of project decision making and, often, project success or failure.

The USACE's typical agency partners and external stakeholders are wide ranging and include a number of other federal agencies. Often lead agency partners have overlapping, or sometimes conflicting, regulatory authorities. They and other stakeholders may have competing objectives, interests, values, and priorities. "Social friction" arises in the planning process when different agency and key stakeholder perceptions, goals, values, and capacities lead to different judgments about a proposed project's value (Chap. 10). This means that partner and stakeholder interaction is often difficult, complicated, highly scrutinized, and under pressure due to lack of alignment on goals and desired outcomes. A recent internal USACE assessment documented the need for better, more flexible stakeholder collaboration processes, more internal training, and ready access to resources and specialized skills. Identified concerns included perceptions that some stakeholders believe they are engaged too late for their input to be valued in decision-making processes, that their input is not valued, and that USACE is not really concerned about the environment. These difficulties increase completion time and operational costs of infrastructure

projects. Lack of clear process, increasing time constraints, and diminishing financial and human resources within USACE and agency partners compound these challenges.

The need to find and apply science-informed, evidence-based stakeholder engagement and communication processes in order to take into account the varying goals, values, and priorities of the many stakeholders with an interest in a USACE project led us to explore Mental Modeling Technology™ over a decade ago. The Mental Modeling approach starts with engaging experts to develop a system model, or *expert model*. An expert model is a formal, comprehensive graphic representation that summarizes and integrates the current knowledge and understanding of experts about the key factors of the topic being studied. It can be thought of as an *expert's mental model*, as it typically comprises a composite of the knowledge and beliefs—mental models—of several experts. That model then serves as the foundation to systematically engage a wide range of stakeholders through formal or informal research. This approach has provided the base for developing a number of initiatives at ERDC, in collaboration with other USACE colleagues. Examples of challenges that have benefited from this approach are described in the chapters that follow.

We have found for complex topics, especially those where the science is uncertain or incomplete, bringing together experts in a workshop setting and using Mental Modeling tools and techniques to elicit a broad range of expertise and experience is highly beneficial. In the case studies that follow on Flood Risk Management (Chap. 4) and Adaptive Management for Climate Change, as well as our work on beneficial use of dredged material (Chap. 5), we did just that. In each case, the focused expert elicitation resulted in the development of a comprehensive system picture, or expert model, which was then validated with the respective expert participants. Not only did this approach build shared understanding of the system and the critical influences on the desired outcomes, but it also served as a focal point for bringing diverse experts from across USACE, along with those from agency partner and stakeholder organizations, together to share insight and expertise on the subject matter at hand in a neutral forum. The resulting models were then used to establish strategic priorities, research agendas, and, in the case of Flood Risk Management (Chap. 4), the analytical framework for the follow on *mental models* research.

The application of Mental Modeling to Technology Infusion and Marketing (Chap. 6) was a different application and one of major significance to ERDC. A critical challenge for any research organization, including ERDC, is the ability to get new technology out of the lab and applied in the field. With pressure on budgets, time, and resources, this challenge was increasingly becoming a barrier. The Mental Modeling approach was used to first understand the current situation for technology transfer and adoption, then to develop, with USACE stakeholders, a recommended Technology Infusion and Marketing approach, along with the critical success criteria. This streamlined approach is producing results for the Environmental Lab and beyond.

We continue to apply the Mental Modeling process, methods, and tools to a range of complex challenges across the USACE's mission areas. With our first applications in Navigation and Flood Risk Management, we've since broadened its

application across Civil Works and, to a small degree, our Military mission, bringing our internal and external stakeholders together to solve multidimensional problems using this integrated approach.

Perhaps the strongest case for the Mental Modeling approach is its application in the design, implementation, and measurement of our groundbreaking Engineering with Nature (EWN) initiative. Since early 2011, a core team of scientists and engineers at ERDC have been applying the fundamental concepts and approaches of Mental Modeling to develop EWN. Collaboration with key internal USACE stakeholders and with external agency partners and stakeholders was a critical component of its design. Now a USACE Program, EWN represents a paradigm shift from USACE's traditional decision-making model, perceived by some agency partners and stakeholders as confrontational, to one of more effective decision making through early and ongoing collaboration with partners and stakeholders. And as the demonstration projects are showing, it produces triple win results, typically faster, more efficiently, and without the social friction typical of many previous USACE-led projects. EWN is seen as enabling transformation across USACE and beyond, with and through the Corps' agency partners and stakeholders. It is noteworthy that EWN was recently recognized with two awards, USACE 2014 Green Innovation Award and Western Dredging Association (WEDA) 2015 Environment Award, and the publication of the North Atlantic Coast Comprehensive Study (NACCS) Natural and Nature-Based Features Report.

Our application of Mental Modeling continues to add value across USACE and beyond as we apply it to a range of increasingly complex challenges, while building our skills and stakeholder engagement capacity in the process.

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Todd Bridges is Senior Research Scientist, U.S. Army Corps of Engineers (USACE), Engineer Research & Development Center (ERDC). He currently leads USACE's Engineering with Nature Initiative, which includes a network of research projects, field demonstrations, and communication activities to promote environmentally sustainable infrastructure development. He has chaired international working groups for the London Convention and Protocol which have developed technical guidance for assessing sediments as well as managing risks associated with CO<sub>2</sub> sequestration operations in the oceans. As U.S. representative to the Environmental Commission of the International Navigation Association (PIANC), Dr. Bridges has led efforts to develop new international standards for managing environmental risks, while promoting environmental benefits, related to navigation infrastructure.

He has served on the editorial boards of the journals of *Integrated Environmental Assessment and Management*, *Environmental Toxicology and Chemistry*, and *Dredging Engineering*. He is an active member of the Society for Risk Analysis, The Society of Environmental Toxicology and Chemistry, The Ecological Society of America, and the International Navigation Association.

Over the last 20 years, Dr. Bridges has published more than 60 journal articles and book chapters and numerous technical reports. He received his B.A. (1985) in Biology/Zoology from California State University, Fresno, and his PhD (1992) in Biological Oceanography at North Carolina State University.

## **From a Practitioner’s Perspective**

Prior to first hearing about Mental Modeling, I had spent several years developing and implementing reputation management processes for various private industry organizations. I was working on a new, large-scale project that I knew would be challenging—challenging not just because we were building significant energy infrastructure in farm country but also because we were dealing with many different stakeholder viewpoints. Recognizing that we as an organization needed to change the way we approached infrastructure development, I was searching for a tool that would take into account the values and interests of engineers, business people, land-owners, environmentalists, and government, find the alignments among all these stakeholders and, based on that, enable us to develop a respectful, collaborative process. A chance meeting with Decision Partners at an industry event led me to that tool—Mental Modeling Technology™.

Since then, I have used Mental Modeling not only in stakeholder consultation on infrastructure development but also in strategic plan development for industry associations undergoing intense change. In each instance, the systematic, science-based Mental Modeling approach enabled us to dive deeply into the thinking of a range of stakeholders and truly understand what’s in their hearts and minds, and what forms that.

The Mental Modeling interviewing process is a very deep process that gets not only at what people think and believe but why they think and believe it. Having this insight enables the industry practitioner to identify trends in these thoughts and beliefs as to how they influence stakeholder judgment. To me and many of my colleagues, this critical insight is what makes Mental Modeling the ideal strategic tool to formulate an appropriate consultation strategy and respectful dialogue with stakeholders that enables them to participate in the decision-making process in a way that is meaningful to them.

Ultimately, it doesn’t matter whether you’re a corporate CEO, a government person, or a landowner. It’s about respecting stakeholder beliefs and values and working within the confines of those beliefs and values so that you understand all of those different stakeholders.

My advice to other private industry practitioners would be: if you’re looking for a truly systematic and science-based approach to understand the decision making of both industry leaders and their key stakeholders, Mental Modeling offers great value.

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Denise Carpenter is Chief Executive Officer of the Neighbourhood Pharmacy Association of Canada. Her diverse leadership experience spans key economic sectors and organizations. As an applied management and social sciences professional, Denise has used Mental Modeling in varied organizational contexts: corporate governance, strategic planning and implementation, systematic behavior change, integrated risk management, public policy and public affairs. She also has expertise in leadership development, change management, and culture change through innovative communications.

# Preface

## Purpose of the Book

The goal of this book is to introduce readers to *Mental Modeling*, an evidence-based process to facilitate decision making by describing the values and knowledge of individuals involved in the decision-making process. The book is tailored to students and practitioners in environmental and risk management domains who have some experience with the complex, often difficult projects that require engagement and understanding of the thoughts and beliefs of different stakeholder groups. Mental Modeling is ideally suited to contexts in which (a) the issues of interest are complex with a significant degree of consequence, (b) disparate viewpoints related to the issue or opportunity gaps must be synthesized, (c) decisions are required among multiple potential alternative risk management options, and/or (d) transparency is required when characterizing the issue, incorporating stakeholder input, designing appropriate risk management solutions, and justifying risk management actions. It is particularly well suited to identifying relationships among influences that may not be easily anticipated and providing a basis for developing or comparing solution alternatives for complex real-world problems.

## How to Read This Book

This book is designed as an introduction to students and practitioners in public policy, risk communication, and related disciplines. The first sections provide an introduction to the process historically and as it stands today, and should be reviewed first to provide context to the other content in the book. Subsequent chapters, in contrast, are intended as a showcase of the different application domains where Mental Modeling



has been successfully applied to address complex problems. These chapters can be read piecemeal depending on the reader's needs and interests. Commentaries and testimonials are dispersed throughout the text to highlight some of the method's strengths and future directions for using the Mental Modeling approach.

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# Contents

<b>1 An Introduction to Mental Modeling</b> .....	1
Matthew D. Wood, Sarah Thorne, Daniel Kovacs, Gordon Butte, and Igor Linkov	
Supporting Evidence-Based Strategies and Communications.....	2
Understanding People’s Mental Models.....	4
Mental Modeling: Critical to Effective Risk Communication.....	4
Key Benefits of the Mental Modeling.....	5
Applied Mental Modeling.....	6
Who Should Use Mental Modeling?.....	7
Overview of the Chapters.....	7
Part I: The Mental Modeling Approach.....	7
Part II: Applications in USACE.....	7
Part III: Applications in Other Contexts and Industries.....	8
Part IV: Mental Modeling Software Support.....	9
References.....	9
<b>Part I The Mental Modeling Approach</b>	
<b>2 Mental Modeling Research Technical Approach</b> .....	13
Sarah Thorne, Gordon Butte, Daniel Kovacs, and Matthew D. Wood	
Introduction.....	13
Overview of Mental Modeling Research Methodology.....	14
Key Benefits of Mental Modeling.....	15
Mental Modeling Core Technique.....	16
Key Steps in the Mental Modeling Process.....	17
Step 1: Define the Opportunity.....	18
ASPS Opportunity Statement Example.....	19
Step 2: Develop the Expert Model.....	19
ASPS Expert Model Example.....	20
Drivers.....	21
Outcomes.....	22

Step 3: Design, Conduct, and Analyze Mental Models Interviews ..... 22  
 ASPS Protocol Example ..... 24  
 ASPS Top Line Findings..... 24  
 Step 4 (Optional): Design, Conduct, and Analyze Qualitative  
 and/or Quantitative Research, Building on Foundational  
 Mental Models Research..... 25  
 Step 5: Use Research Results to Design and Pretest Strategies,  
 Policies, Interventions, and Communications..... 26  
 ASPS Strategy Example ..... 28  
 Step 6: Implement and Evaluate Strategies ..... 28  
 ASPS Case: Implementation Results ..... 29  
 References..... 30

**3 Science of Mental Modeling ..... 31**  
 Matthew D. Wood and Igor Linkov  
 Mental Modeling as Evidence-Based Practice ..... 31  
 Mental Model Theory ..... 32  
 Mental Model Diagrams ..... 33  
 Mental Modeling History and Method ..... 33  
 Other Methods for Representing Mental Models ..... 34  
 Concept Mapping..... 34  
 Semantic Web ..... 35  
 System Dynamics Diagramming ..... 36  
 Conclusions..... 37  
 References..... 37

**Part II Applications at U.S. Army Corps of Engineers (USACE)**

**4 Flood Risk Management..... 43**  
 Matthew D. Wood, Igor Linkov, Daniel Kovacs, and Gordon Butte  
 Introduction..... 43  
 Literature Review of Layperson Stakeholder Perceptions..... 46  
 Literature Review Results..... 47  
 Expert Modeling ..... 49  
 Expert Modeling Results..... 50  
 Mental Models Interviews and Comparative Analysis ..... 51  
 Interview Results ..... 52  
 Discussion ..... 53  
 References..... 54

**5 Adaptive Management for Climate Change..... 57**  
 Matthew D. Wood, Sarah Thorne, Gordon Butte, Igor Linkov,  
 and Daniel Kovacs  
 Introduction..... 57  
 Expert Modeling ..... 60

Results.....	61
Conclusions.....	64
References.....	65
<b>6 Technology Infusion and Marketing .....</b>	<b>69</b>
Matthew D. Wood, Sarah Thorne, and Gordon Butte	
The Opportunity.....	69
Base Model of the TIM Approach .....	71
Step One: Opportunity Formulation .....	71
Critical Definitions.....	72
Step Two: Validation.....	73
Step Three: Implementation.....	73
Workshop: Technology Infusion and Marketing (TIM):	
Guided Thinking on Three Technologies.....	74
Preworkshop with EL Sponsors and Project Leads .....	74
Facilitators’ Protocol.....	75
Workshop Agenda Overview .....	75
Breakout Group Results.....	76
TREECS: Training Range Environmental Evaluation	
and Characterization System.....	76
Computational Chemistry .....	77
Risk .....	77
Key Learnings and Applying the Results.....	78
TIM Path Forward Considerations/Action Options.....	79
An Example of Project-Specific Successes and Learnings: TREECS.....	80
References.....	82

**Part III Applications in Other Contexts and Industries**

<b>7 Farmers’ Decision Making to Avoid Drug Residues</b>	
<b>in Dairy Cows: A Mental Modeling Case Study.....</b>	<b>85</b>
Sarah Thorne and Gordon Butte	
The Opportunity.....	85
Expert Modeling .....	87
Mental Modeling.....	91
Sample Development.....	92
Protocol Design.....	92
Sampling Process.....	92
Coding and Analysis .....	93
Key Results .....	94
Improving Risk Communication.....	99
Variances Between Violators and Non-violators .....	99
Considerations on Next Steps for Strategic Risk Communications	
with Dairy Farmers .....	102
Key Learnings and Applying the Results.....	103
References.....	104

<b>8</b>	<b>Influence of the CHEMM Tool on Planning, Preparedness, and Emergency Response to Hazardous Chemical Exposures: A Customized Strategic Communications Process Based on Mental Modeling</b> .....	105
	Daniel Kovacs, Sarah Thorne, and Gordon Butte	
	The Opportunity.....	105
	Mental Modeling Approach.....	107
	Expert Models.....	107
	Mental Models Research.....	107
	Expert Models of Influences on CHEMM Effectiveness.....	108
	Expert Model Narrative.....	108
	Influence of the CHEMM Tool on Planning, Preparedness, and Emergency Response to Hazardous Chemical Exposures: System Perspective.....	108
	Influences of the CHEMM Tool on Planning, Preparedness, and Emergency Response to Hazardous Chemical Exposures: User Perspective.....	114
	User Matrices for CHEMM Optimization.....	120
	Deeper Insight into CHEMM Users' Mental Models.....	121
	Research Sample.....	121
	Interview Topics.....	122
	Summary Mental Models Research Findings.....	123
	CHEMM Uses and Information Needs.....	124
	CHEMM Information Quality Criteria.....	126
	CHEMM Functionality.....	127
	Stakeholder Engagement and Continuing CHEMM Development.....	127
	Interview Wrap-Up and Interviewees' Closing Thoughts.....	128
	Building on the Mental Models Research Results.....	128
	Client Perspectives on Mental Models Research, Key Learnings, and Applying the Results.....	129
<b>9</b>	<b>The Chamber of Mines of South Africa Leading Practice Adoption System</b> .....	133
	John Stewart and Gordon Butte	
	Background to Development of the System.....	133
	Leadership Commitment and Exploratory Work.....	134
	Key Outcomes.....	134
	A Residual Communication Challenge.....	137
	The Road Ahead.....	138
	Appendix.....	139
	Reference.....	151

**10 Conducting Effective Outreach with Community Stakeholders About Biosolids: A Customized Strategic Risk Communications Process™ Based on Mental Modeling**..... 153  
 Sara Eggers and Sarah Thorne

Introduction..... 153

The Global Opportunity for Biosolids Professionals..... 154

The Strategic Risk Communications Process ..... 156

Applying the Strategic Risk Communications Process™:

Two Case Studies..... 158

Step 1: Define the Opportunity ..... 159

Sample Opportunity Statement..... 159

Step 2: Characterize the Situation..... 160

    Technical Assessment, Using Expert Modeling..... 160

    Preliminary Stakeholder Analysis..... 160

Step 3: Assess Stakeholders’ Interests, Priorities, and Communications Needs, Through Mental Models Research..... 163

    Sample Development and Recruitment ..... 164

    Protocol Outline ..... 164

    Conducting Interviews..... 165

    Coding and Analysis ..... 165

    Sample Characteristics..... 166

    Highlights from the Mental Models Research..... 167

Step 4: Develop and Pretest Communications Plan and Materials..... 172

    Pretesting Communication Plan and Materials..... 174

Implementation and Evaluation ..... 174

    Developing Guidance for Biosolids Professionals ..... 175

Key Learnings and Demonstrated Value..... 175

References..... 177

**11 Using Mental Modeling to Systematically Build Community Support for New Coal Technologies for Electricity Generation**..... 179  
 Sarah Thorne and Megan Young

Opportunity for New Coal-Based Power Generation Technology ..... 179

Opportunity at Genesee..... 181

Key Challenges ..... 182

Project Steps..... 183

Draft the Opportunity Statement and Guiding Principles..... 183

    Opportunity Statement..... 184

    Guiding Principles ..... 184

Develop Expert Model..... 185

Conduct Mental Models Research..... 186

Key Learnings from the Mental Models Research ..... 186

Hold a Series of Community Advisory Task Group Workshops ..... 187

Draft a Community Engagement Strategy..... 189

Community Workshop to Draft the Environmental Impact Assessment Terms of Reference ..... 190

Finalize Community Engagement Strategy and Plan ..... 191

Conclusions..... 193

References..... 194

**12 Saving Lives from a Silent Killer: Using Mental Modeling to Address Homeowners’ Decision Making About Carbon Monoxide Poisoning**..... 195

Sarah Thorne, Gordon Butte, and Sarah Hailey

Introduction..... 195

Communicating the Risk of Carbon Monoxide in the Home ..... 196

Applying the Mental Modeling Research Approach ..... 197

Step 1: Define the Opportunity ..... 198

Step 2: Characterize the Situation..... 199

    Development of the Expert Model..... 199

    Expert Model Narrative ..... 200

    Expert Model Workshop ..... 201

    Detailed Expert Model of Reducing Carbon Monoxide Risk in the Home..... 202

    Expert Model Validation ..... 204

Step 3: Assess Stakeholders’ Interests, Priorities and Communications Needs, Through Mental Models Research..... 204

    Sample Development ..... 204

    Interview Protocol Outline..... 205

    Conducting Interviews ..... 205

    Coding and Analysis ..... 205

    Weighted Mental Model..... 207

    Key Results ..... 207

    Mental Models Analysis ..... 212

Step 4: Develop and Pretest Communications Plan and Materials..... 212

    Communication Goal and Strategic Objectives..... 212

    Key Communities of Interest and Potential Partners ..... 214

    Message Platforms ..... 215

    TSSA Action Plan ..... 216

    Implementation and Evaluation ..... 220

Key Learnings and Demonstrated Value..... 221

References..... 221

**13 U.S. Census Bureau Integrated Communications Services for Data Dissemination: Mental Modeling Case Study with Key Internal Expert Stakeholders** ..... 223

Daniel Kovacs and Sarah Thorne

The Opportunity ..... 223

Mental Modeling Approach ..... 224

    Developing the Expert Models ..... 225

    Developing the Sample ..... 226

    Conducting Mental Models Research ..... 227

Research Highlights ..... 227

- Key Census Bureau Stakeholders ..... 227
- Modes of Communications and Engagement ..... 228
- What Is Working Well..... 228
- Current Challenges..... 230
- Improving Communication and Engagement ..... 232

Preliminary Considerations on Key Components  
of the Communications Research and Analytics Roadmap (CRAR)..... 233

- Strategic Framework for CRAR ..... 234

Strategic Framework for the Communications Research  
and Analytics Roadmap ..... 235

**Part IV Mental Modeling Software Support**

**14 Supporting and Expanding the Scope and Application of Mental Modeling: Current and Future Software Developments..... 239**

Daniel Kovacs, Alex Tkachuk, Gordon Butte, and Sarah Thorne

Introduction..... 239

CASS Support Software for Mental Modeling Technology™  
(MMT™) Research Processes ..... 239

- eCASS Software for Modeling ..... 240
- cCASS Coding and Analysis Module ..... 244
- CASS Module Integration (eCASS and cCASS)..... 248
- CASS Development..... 248

Case Study: IDST™ used by Enersource Hydro Mississauga  
to Fulfill Customer Engagement Regulatory Requirements ..... 249

- The Customer Engagement Challenge..... 249
- New Technology for Customer Engagement ..... 250
- IDST™ Experience..... 250
- The Results..... 251
- Advantages over Conventional Customer Engagement Methods ..... 253

Considerations on Future Applications of the IDST™..... 253

Mental Modeling Technology™ with Quantitative  
Risk Analysis Tools..... 253

References..... 254

**Index..... 255**