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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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Dr. Fischhoff is Howard Heinz University Professor with the Departments of Social and Decision Science and of Engineering and Public Policy at Carnegie Mellon University, and Decision Partners' Chief Scientist. Dr. Fischhoff is a Fellow of the American Psychological Association and a Fellow of the Society of Risk Analysis, as well as recipient of its Distinguished Achievement Award (1991). He is a member

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 it 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.

Todd Bridges, PhD
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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_2 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, landowners¸ 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.

Denise Carpenter
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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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