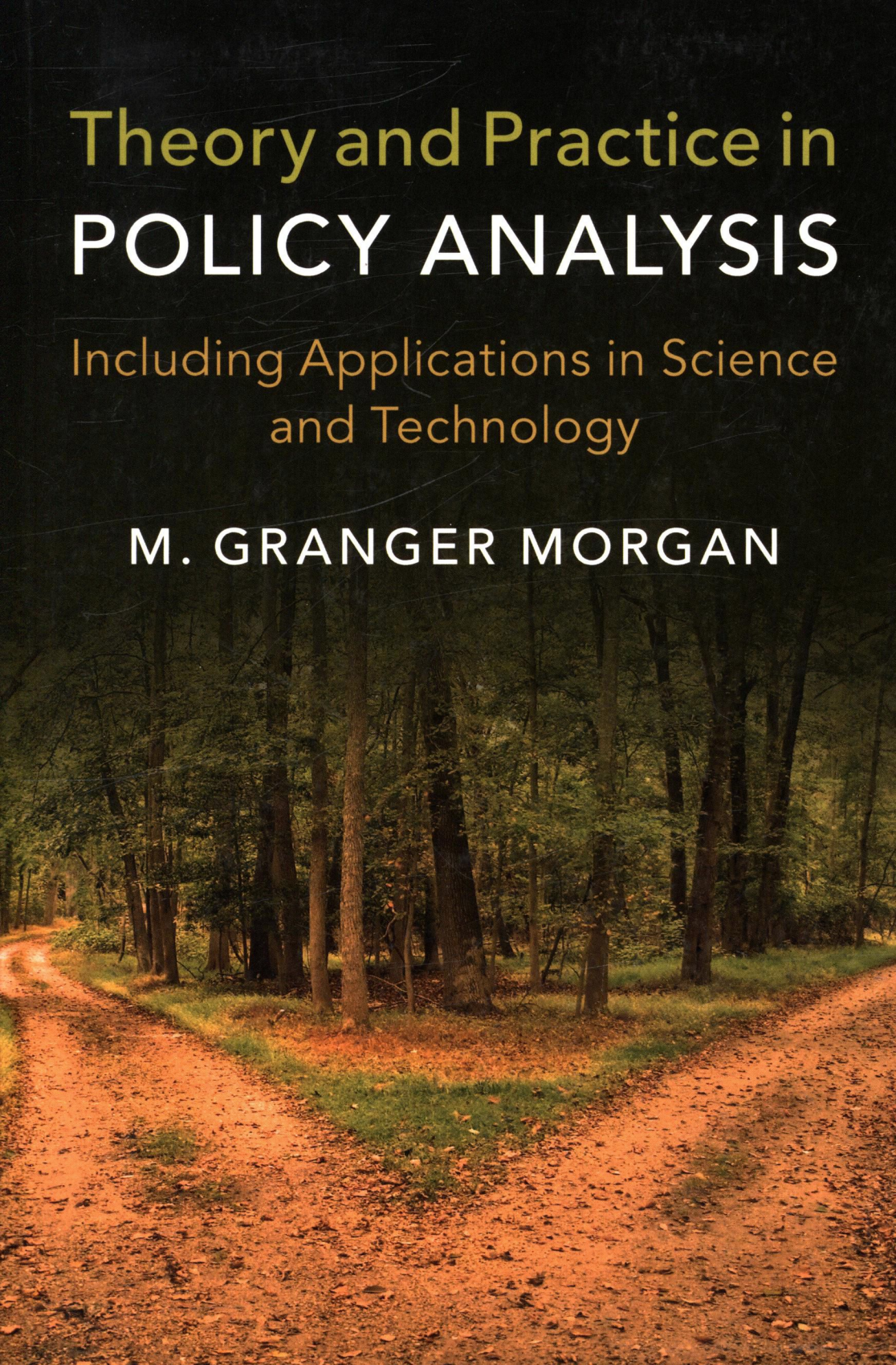
Theory and Practice in POLICY ANALYSIS

Including Applications in Science and Technology

M. GRANGER MORGAN



Many books instruct readers on how to use the tools of policy analysis. This book is different. Its primary focus is on helping readers to look critically at the strengths, limitations, and the underlying assumptions analysts make when they use standard tools or problem framings. Using examples, many of which involve issues in science and technology, the book exposes readers to some of the critical issues of taste, professional responsibility, ethics, and values that are associated with policy analysis and research. Topics covered include policy problems formulated in terms of utility maximization such as benefit-cost, decision, and multi-attribute analysis, issues in the valuation of intangibles, uncertainty in policy analysis, selected topics in risk analysis and communication, limitations and alternatives to the paradigm of utility maximization, issues in behavioral decision theory, issues related to organizations and multiple agents, and selected topics in policy advice and policy analysis for government.

"Professor Morgan deftly and methodically unravels the intricacies of public policymaking, illustrating its intersection with science and technology with precision. Moreover, he equips readers with the tools necessary to understand today's complex global challenges and work toward their solutions."

Dr. Pradeep K. Khosla, Chancellor, University of California, San Diego

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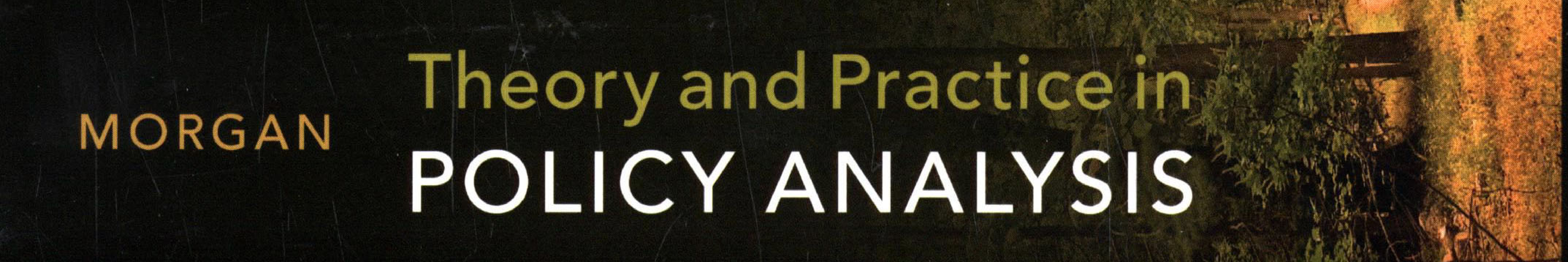

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Carnegie Mellon University

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M. Granger Morgan is the Hamerschlag University Professor of Engineering at Carnegie Mellon University where he was the founding Head of the Department of Engineering and Public Policy. He also holds appointments in Electrical and Computer Engineering and in the H. John Heinz III College of Public Policy and Management. He has worked extensively on policy problems that involve issues in science and technology. Much of his work has focused on the characterization and treatment of uncertainty, especially as applied to environmental issues, that involve energy and electric power, and many aspects of the problem of climate change. Morgan's formal academic training is in applied physics. He is a member of the U.S. National Academy of Sciences and of the American Academy of Arts and Sciences. He is the author of many papers and five books, including two with Cambridge University Press: *Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis* and *Risk Communication: A Mental Models Approach*.

Preface

As the title indicates, this is a book about the theory and practice of policy analysis. It is not a book designed to make readers expert in the use of specific analytical tools. That is something that can be gained through more specialized books, courses, and practice. Rather, this is a book designed to help readers to develop their own independent understanding and critical assessment of the strengths, limitations, and underlying assumptions of key policy research and analysis tools and problem framings. Hence my focus is on:

- the underlying assumptions and implications of various analytical techniques;
- the strengths and limitations of these techniques;
- the role and objective of policy-related studies, especially those that involve technology and public policy;
- the behavioral, institutional, organizational, political, and historical contexts in which issues of technology and public policy play out and the role of analysis in the broader process of policy development and implementation.

The book grew out of a course that I have taught for many years as one of the core courses in the Ph.D. program in the Department of Engineering and Public Policy at Carnegie Mellon University. That course has revolved around intensive classroom discussion of a large number of readings. In writing this book I have faced the problem of trying to figure out how to preserve at least some elements of the process of self-discovery and learning that has occurred through those classroom discussions.

Because I believe it is important for readers to be exposed to some of the more important writings in the primary literature, I have used more direct quotations from the literature than are found in many books, and in many sections I have included recommended readings and a number of discussion questions. I have tried to limit my summary of many of the readings, since the point of this book is not to supply Granger Morgan's "CliffsNotes" but rather to help

readers to develop and refine their own views. This is of course an explicitly normative process.

While I have not been reluctant to express my views about specific methods or literatures, I have tried to do so in a way that encourages readers to consider, and perhaps disagree with, those views. When I have taught the course at Carnegie Mellon, it has always been most successful when students in the class were prepared to disagree vigorously with some of the views I expressed.

In order to avoid the awkward use of "his or her" in sentences such as "the decision maker must consider his or her preferences," I have sometimes adopted the (grammatically incorrect) phrasing, "the decision maker must consider their preferences." In discussing decision making, I have also sometimes adopted the convention, widely used in the decision analysis literature, of referring to "your" decision.

While the book should be accessible to readers from a wide variety of backgrounds, most of the examples I have used involve issues in science and technology. A significant number are drawn from the domain of climate change because policy analysis in this domain often stretches the boundaries of conventional tools and analysis strategies – and because I have been fortunate to help lead three large NSF-supported centers that have focused on a variety of decision-making issues related to climate change. However, in most cases, the issues being illustrated with these climate examples generalize to a variety of other problems in technology and public policy.

During the first week of the course from which this book has grown, I include a brief discussion of some topics in the philosophy of science. Our faculty in Engineering and Public Policy asked me to add this material when it became apparent that a number of our Ph.D. students could not state a "falsifiable proposition." Because I think it is valuable for practitioners in science, technology, and public policy to have some familiarity with the ideas of philosophers such as Popper and Kuhn, I have included a brief discussion in Appendix 1.

There are many important topics related to science, technology, and public policy that this book does *not* address. Two especially important excluded topics are issues related to technological innovation and R&D policy, and issues that are often termed science and technology studies. A few suggested readings on these topics can be found in Appendix 2 and Appendix 3.

Acknowledgments

Carnegie Mellon and the Department of Engineering and Public Policy (EPP) have provided me, and my graduate students, with a uniquely supportive interdisciplinary environment in which to tackle problems in science, technology, and public policy. Indeed, there is no other more attractive academic setting anywhere in the world in which to address such problems. Many people have been responsible for creating the environment that has made EPP possible. Especially notable among them have been Dick Cyert, Herb Simon, Herb Toor, and Bob Dunlap, all of whom are sadly now gone.

Over the course of more than forty years of teaching, doing research, and making practical applications of the ideas that are the focus of this book, I have benefited from associations with many wonderful graduate students and colleagues. None have been more important to my intellectual development than Baruch Fischhoff, Max Henrion, and Lester Lave. I have also benefited greatly from years of collaboration with Jay Apt, Inês Azevedo, Ann Bostrom, Liz Casman, Hadi Dowlatabadi, Greg Fischer, Keith Florig, David Keith, Sam Morris, Indira Nair, Ed Rubin, and Henry Willis. Jerry Cohon made valuable suggestions on my treatment of utility in Chapter 2 and then kindly co-authored Chapter 6 on multiobjective methods.

Additional thanks for assistance, collaboration, critiques, and ideas go to Ahmed Abdulla, Peter Adams, Myles Allen, Deborah Amaral, V.S. Arunachalam, Cindy Atman, Jesse Ausubel, Barbara Barkovich, João Barros, Anshu Bharadwaj, Wändi Bruine de Bruin, Bill Clark, Aimee Curtright, Mike DeKay, Michael Dworkin, Kerry Emanuel, Scott Farrow, Paul Fischbeck, Lauren Fleishman, Marie-Valentine Florin, David Frame, Erica Fuchs, John Graham, Mike Griffin, Iris Grossmann, Ümit Güvenc, Bob Hahn, Manuel Heitor, Gordon Hester, Alex Hills, Paul Hines, David Hounshell, Harald Ibrekk, Paulina Jaramillo, Karen Jenni, Milind Kandlikar, Doug King, Kelly Klima, David Lincoln, Ragnar Löfstedt, Scott Matthews, Sean McCoy, Tim McDaniels,

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My views on many of the topics discussed in this book have been shaped by the research I have done with my students and colleagues with support from many agencies and foundations. I am especially thankful for many years of generous support from the National Science Foundation. Thanks, too, for support from Carnegie Mellon University, the Doris Duke Charitable Foundation, the Department of Energy, the Electric Power Research Institute, the Exxon Education Foundation, the International Risk Governance Council, the MacArthur Foundation, the R.K. Mellon Foundation, the Sloan Foundation, and others.

My original training was in experimental applied physics. Ken Bowles, Henry Booker, and my father, Millett Morgan, imbued me with a set of perspectives on research and professional activity that have been central to all of my subsequent work.

Much of this book was written during stays in the family home in which I grew up, located on 120 acres of New Hampshire countryside five miles east of Hanover, New Hampshire. Interspersing work on the book with work on the house and the land has been an enjoyable way to pass many days.

In my professional life, I have been fortunate to have 37 years of outstanding support from my assistant and very good friend, Patti Steranchak.

In my private life, my best friend, biggest critic, and the love of my life for over fifty years has been my wife, Betty. To her go my greatest thanks of all.

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