DECISION MAKING IN SYSTEMS ENGINEERING AND MANAGEMENT

DECISION MAKING IN SYSTEMS ENGINEERING AND MANAGEMENT

Second Edition

Edited by

GREGORY S. PARNELL
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DALE L. HENDERSON

WILEY

A JOHN WILEY & SONS, INC., PUBLICATION

Published by John Wiley & Sons, Inc., Hoboken, New Jersey
Published simultaneously in Canada

Library of Congress Cataloging-in-Publication Data:

Decision making in systems engineering and management / [edited by] Gregory S. Parnell, Patrick J. Driscoll, Dale L. Henderson.—2nd ed.
p. cm.—(Wiley series in systems engineering and management ; 79)
ISBN 978-0-470-90042-0 (hardback)
1. Systems engineering–Management. 2. Systems engineering–Decision making. I. Parnell, Gregory S. II. Driscoll, Patrick J. III. Henderson, Dale L.
TA168.D43 2010
620.001′171–dc22

2010025497

Printed in the United States of America

oBook ISBN: 978-0-470-92695-6
ePDF ISBN: 978-0-470-92695-6
ePub ISBN: 978-0-470-93471-5

10 9 8 7 6 5 4 3 2 1

Systems engineers apply their knowledge, creativity, and energy to making things better. Rarely do we assume grave personal risk to do so.

We dedicate this book to our colleagues from the Department of Systems Engineering at The United States Military Academy who have sacrificed their lives to make the world a place where systems engineers are free to make things better.

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Foreword to the Second Edition

The first edition of this book was developed by the faculty of the Department of Systems Engineering at the United States Military Academy and two colleagues at the University of Arkansas. We used the book in draft and final form for four years as a text for undergraduate courses and professional continuing education courses for systems engineers and engineering managers, and the book has been used as a text for undergraduate and graduate courses at other universities. In addition, we used the foundational material on systems thinking, systems engineering, and systems decision making on very diverse and important research and consulting projects by our students and faculty. The development and use of this text resulted in restructuring part of our curriculum and has significantly improved our academic programs and the research of our faculty and our students.

However, we have continued to develop new material and refine the techniques that we use to present the material. The second edition keeps the problem-solving focus on systems thinking, systems engineering, and systems decision making but incorporates our learning based on teaching students and helping senior leaders solve significant challenges in many important problem domains.

The major changes include an increased focus on risk analysis as a key tool for systems thinking and decision making; explicit inclusion of cost analysis in our solution design phase; additional techniques for the analysis of uncertainty and risk in the decision making phase; and a revised solution implementation chapter more aligned with project management literature.

With the new material, this second edition can be used as an undergraduate or a graduate text in systems engineering, industrial engineering, engineering management, and systems management programs. In addition, the book is an excellent resource for engineers and managers whose professional education is not in systems engineering or engineering management.

We hope that the material in this book will improve your problem solving skills by expanding your system thinking ability, increasing your understanding of the roles of systems engineers, and improving the systems decision making processes required to solve the complex challenges in your organization.

Brigadier General Tim Trainor, Ph.D.
Dean of the Academic Board

United States Military Academy
West Point, New York
September 2010

Foreword to the First Edition

The Department of Systems Engineering is the youngest academic department at the United States Military Academy. Established in 1989, the department has developed into an entrepreneurial, forward-looking organization characterized by its unique blend of talented military and civilian faculty. This book is our effort to leverage that talent and experience to produce a useful undergraduate textbook focusing on the practical application of systems engineering techniques to solving complex problems. Collectively, the authors bring nearly two centuries of experience in both teaching and practicing systems engineering and engineering management. Their work on behalf of clients at the highest levels of government, military service, and industry spans two generations and a remarkably broad range of important, challenging, and complex problems. They have led thousands of systems engineering, engineering management, information engineering, and systems management students through a demanding curriculum focused on problem solving.

Teaching systems engineering at the undergraduate level presents a unique set of challenges to both faculty and students. During the seven years I served as the department head, we searched for a comprehensive source on systems engineering for undergraduates to no avail. What we found was either too narrowly focused on specific areas of the systems engineering process or more intended for practitioners or students in masters or doctoral programs.

While conceived to fill the need for an undergraduate textbook supporting the faculty and cadets of the United States Military Academy, it is designed to be used by faculty in any discipline at the undergraduate level and as a supplement to graduate level studies for students who do not have a formal education or practical experience in systems engineering.

The book is organized around the principles we teach and apply in our research efforts. It goes beyond exposing a problem-solving procedure, offering students the opportunity to grow into true systems thinkers who can apply their knowledge across the full spectrum of challenges facing our nation.

BRIGADIER GENERAL (Ret.) MICHAEL MCGINNIS, PH.D.

Formerly
Professor and Head,
Department of Systems Engineering, 1999–2006
United States Military Academy

Executive Director
Peter Kiewit Institute
University of Nebraska

Preface to the Second Edition

WHAT IS THE PURPOSE OF THE BOOK?

The purpose of this book is to contribute to the education of systems engineers by providing them with the concepts and tools to successfully deal with systems engineering challenges of the twenty-first century. The book seeks to communicate to the reader a philosophical foundation through a systems thinking world view, a knowledge of the role of systems engineers, and a systems decision process (SDP) using techniques that have proven successful over the past 20 years in helping to solve tough problems presenting significant challenges to decision makers. This SDP applies to major systems decisions at any stage of their system life cycle. The second edition makes several important refinements to the SDP based on our teaching and practice since the first edition was published in 2008. A sound understanding of this approach provides a foundation for future courses in systems engineering, engineering management, industrial engineering, systems management, and operations research.

WHAT IS THIS BOOK?

This book provides a multidisciplinary framework for problem solving that uses accepted principles and practices of systems engineering and decision analysis. It has been constructed in a way that aligns with a structure moving from the broad to the specific, using illustrative examples that integrate the framework and demonstrate the principles and processes for systems engineering. The book is not a detailed engineering design book nor a guide to system architecting. It is a complement to engineering design and system architecting. It introduces tools and techniques sufficient for a complete treatment of systems decision making with references for future learning. The text blends the mathematics of multiple objective decision analysis with select elements of stakeholder theory, multi-attribute value theory, risk analysis, and life cycle cost analysis as a foundation for trade studies and the analysis of design solutions.

WHO IS THIS BOOK FOR?

The first edition of this book was intended primarily to be a textbook for an undergraduate course that provides an introduction to systems engineering or systems management. Based on the recommendations and requests from a host of academic and professional practitioners, this second edition extends much of the existing material and adds new material to enable the book to be comfortably adopted as a graduate text or a text in support of professional continuing education while remaining a valuable resource for systems engineering professionals. The book retains all of the features that readers identified as useful for any individual who is leading or participating in a large, complex systems engineering or engineering management process. Not surprisingly, readers of the first edition have highlighted the usefulness of the approach we present to other disciplines as well, such as human factors engineering, law, history, behavioral sciences, and management, in which the object of focus can be conceptualized as a system.

WHY DID WE WRITE THIS BOOK?

We authored the first edition of this book to fill a critical gap in available resources that we (and others) needed to support systems engineering projects that our faculty, and hence our students as future systems engineers, were being asked to engage with concerning high-visibility, high-impact systems in both government and corporate settings. Moreover, it was nearly always the case in these projects that key stakeholders vested in the potential solutions demanded-large amounts of decision support throughout the engagement horizon. Thus, systems engineering with a systems decision-making emphasis had evolved to be our primary professional practice with clients and yet the field was lacking a single source that students and practitioners could turn to for guidance.

Specifically, there were three immediate needs driving us to the task. First, we needed a textbook for our lead-in systems engineering courses offered by the Department of Systems Engineering at the United States Military Academy at West Point. Second, we needed to more fully describe the problem solving process that we developed and successfully applied since the Systems Engineering Department was formed in 1989. The process introduced in this book, called the systems decision process (SDP), is the refined version of this process we currently use. Lastly, we wanted to document the problem solving lessons we have learned by hard knocks, happenstance, and good fortune as leaders, military officers, engineering managers, systems engineers, teachers, and researchers.

We teach two foundational systems engineering undergraduate courses at West Point that serve a broad clientele. SE301, Foundations of Engineering Design and System Management, is the first course we offer to our approximately 100 academic majors each year. These majors include systems engineering, engineering management, and systems management. The first two of these are programs accredited by ABET Inc.

This is the course where our faculty make “first contact” with each new class of talented students. Based on a host of discussions with students, faculty, and external stakeholders to our curriculum, we concluded that this needed to be the flagship course of the department, taught by our most experienced faculty; to communicate a fundamentally different thought process than that emphasized by other engineering fields; and to change the way our students thought about problem solving and their role in the process. Moreover, the course needed to set the professional standards required to put our students in front of real-world clients with real-world systems decision problems at the start of their senior year, to support the requirement of their year-long senior capstone experience.

The other course, SE300, Introduction to Systems Engineering, is the first course in a three-course Systems Engineering sequence taken by 300–400 nonengineering majors each year. Rather than simply providing an introduction to a field that was not their academic major, we structure this course to deliver value to the students both in their chosen majors and as future decision makers in their role as military officers. These design considerations became part of our plan for the first edition of the textbook, and we retained these for the second edition as well.

HOW DID WE WRITE THE BOOK?

We wrote the book in the manner that we advocate good systems engineering be applied in practice. The editors led a team effort that leveraged the expertise of each of the authors, several of whom were personally responsible for the structure of the downstream courses for each of our academic majors. In this manner, each author could craft critical material in direct support of later courses so that the book retained value as a reference beyond the initial program course.

A host of regularly scheduled collaboration and communication sessions were used to develop and refine the terminology, content, and voice used throughout the book. The concept maps in each chapter serve two purposes. First, they define the key concepts of the chapter. Second, they help us identify a common lexicon for the book. Since the book includes a systems decision process, we tried to incorporate several illustrative examples as an integrating tool that would carry the reader through the various systems decision process chapters. Our faculty and students read and evaluated each of the chapters for clarity, consistency, and ease of use.

As with most iterative processes, we learned a great deal about our own programs in the process. The writing of this book became a wonderful means of cross-leveling knowledge and understanding among the faculty as to the emphasis and content that was being taught across our curriculum. This book and the approach contained within have significantly contributed to our curriculum assessment process, enabling us to more clearly articulate program and course outcomes and objectives in a manner that communicates value return while aligning with accepted professional standards. Valuable feedback from faculty and students using the initial three preliminary printings and the first edition has been incorporated into this edition.

HOW IS THIS BOOK ORGANIZED?

The book is organized in three parts. Part I provides an introduction to systems thinking, system life cycles, risk management, systems modeling and analysis, and life cycle costing. Part II provides an introduction to systems engineering, the practice of systems engineering, and systems effectiveness. Part III introduces the systems decision process (SDP) and describes the four phases of our systems decision process: problem definition, solution design, decision making, and solution implementation, in addition to the primary environmental factors that house important stakeholders and their vested interests. The systems decision process can be used in all stages of a system life cycle. The final chapter provides a summary of the book.

Gregory S. Parnell and Patrick J. Driscoll

West Point, New York
July 2010

Acknowledgments

We would like to acknowledge several individuals for their contributions and support for this second edition. Our design editor, Dale Henderson, again did a superb job on many design details that add quality to this work. The department leadership under COL Robert Kewley continues to provide great support and encouragement for the project. Thanks also go to many of the U.S. Military Academy Department of Systems Engineering faculty contributed to what was to become the Systems Decision Process (SDP).

The editors would like to thank the chapter authors for their hard work and flexibility as we defined and refined many of the concepts included in the book. Crafting a text such as this is a challenging undertaking. Having a tight production schedule adds to this challenge in a significant way. Their continuing level of patience, professionalism, and commitment to the project is acknowledged with our heartfelt gratitude.

A great example of this flexibility was how the Rocket Problem, developed for the first edition by Dr. Paul West, was quickly accepted and used as the example to present the concepts in Chapters 10–13. It continues to prove its usefulness for many of the extended concepts and new material of this second edition. We would also like to acknowledge COL Kewley's development of the Curriculum Management System example, along with the real system that has been implemented at our institution as a result. We also thank COL Donna Korycinski for a very careful read of the initial manuscript and many helpful suggestions for clarification.

We continue to extend thanks to the many, many cadets who have taken courses in the Department of Systems Engineering. We honor their commitment to service with our best efforts to inspire and lead them. Their enthusiasm and high standards make us all better teachers and better leaders. Finally, the entire project team would like to thank their families for their selfless support and encouragement during this demanding book project.

G. S. P.
P. J. D.

Thoughts for Instructors

COURSE DESIGN USING THE BOOK

This book has been designed as a systems engineering and management textbook and as a reference book for systems engineers and managers. There are lots of ways to use this material for undergraduate and graduate courses. Chapter 1 is always a good place to start! Part I (Chapters 2 through 5) present systems thinking. Most courses would probably want to start with at least Chapters 2 and 3 to set a good foundation in systems thinking and the system life cycle. Chapters 4 and 5 can be introduced next or during presentation of the systems decision process in Part III. Part III is designed to be presented sequentially but is based on knowledge provided in Chapter 1 through Chapter 5. Chapters 6 and 7 introduce systems engineering and describe systems engineering practice. They can be presented before or after Part III. The most advanced mathematics of the book is in Chapter 8, and Chapter 11, Section 11.4. These can be omitted in an introductory course since they may be covered in other courses in your student's academic program. Instructors will want to supplement the course with additional material.

AN EXAMPLE UNDERGRADUATE COURSE DESIGN

We use the text for our undergraduate systems engineering and management fundamentals course, our introduction to systems engineering course for nonengineering majors, and our year long capstone design course for academic majors. The fundamentals course is taken by our systems engineering, engineering management, and systems management majors, whereas the introductory course is the first of a three course systems engineering sequence taken annually by about

350–400 students. The capstone design course is the final, integrative experience for our students. We have found it useful to have the students learn the systems decision process from three perspectives: a personal systems decision with known or relatively easy to determine alternatives (e.g., buying a car); a complex systems integration problem involving multiple decision makers and stakeholders (e.g., adding new components to perform new missions with an existing unmanned aircraft system); and a complex systems design involving multiple stakeholders with challenging implementation issues (e.g., the IT illustrative example presented at the end of each chapter in Part III of the text).

Figure 0.1 provides the flow of the course material using this approach. We begin with Chapters 1 through 3 to provide an introduction to the course material

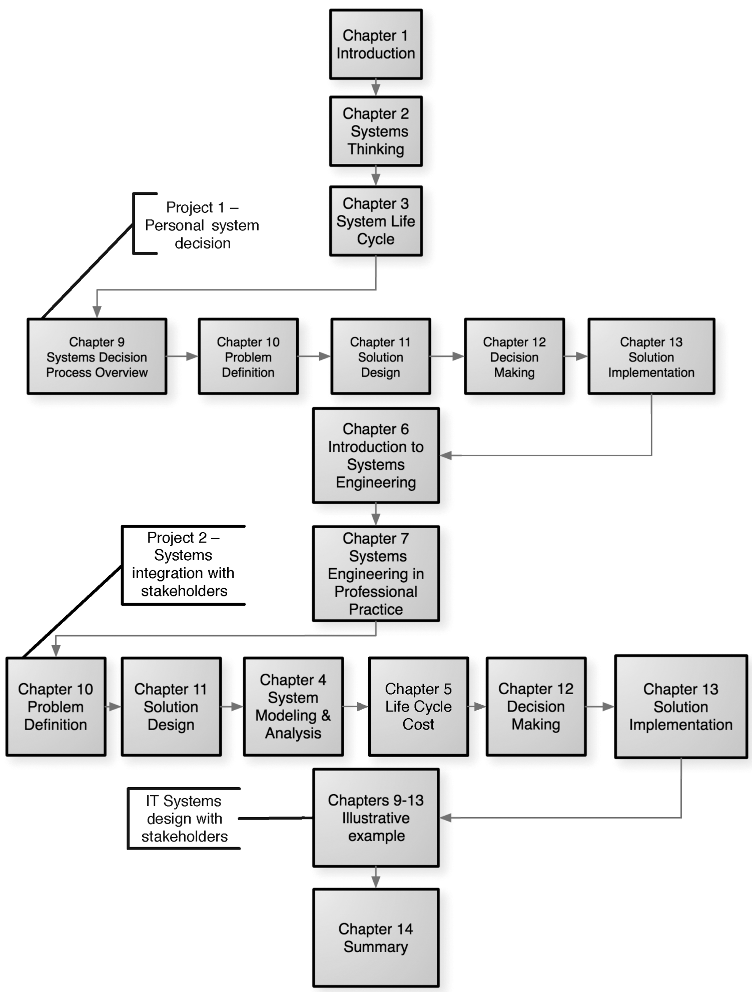

Figure 0.1 Course design with two projects and one illustrative example.

and a good understanding of systems thinking and the system life cycle. Next, we introduce Project 1, a system decision problem that the students may encounter in which, as the assumed primary decision maker, they can easily determine their values, solution alternatives, measure scores, and basic life cycle costs. Example problems might be buying a car or selecting a graduate program of study. The students read Chapter 9 and the introductory parts of the four chapters describing the four phases in the systems decision process (Chapters 10–13). They then apply these concepts to their system decision problem. The effort culminates with a presentation and a paper that demonstrate the degree to which each student understands the multiple objective decision analysis (MODA) mathematics used to evaluate the value of the alternatives. Following this, we present the fundamentals and the practice of systems engineering using Chapters 6 and 7. This is also a good time to give the first exam.

Next, we introduce Project 2. For this project, we look to a systems integration and/or systems design project that has one or more decision makers and multiple stakeholders influencing the system requirements and subsequent trade space. We require the students to perform more extensive research, stakeholder interviews and surveys to develop the data and modeling components required by the MODA approach. Proceeding to Chapters 10 to 13, we introduce additional material to help the students address design and analysis issues associated with more complex systems decision problems. Modeling and simulation techniques introduced in Chapter 4 are used for solution design and evaluation. Time permitting, we include material from Chapter 5 addressing life cycle cost estimating.

While the students are completing their analysis of Project 2, we discuss the design of a system from system need to implementation. The IT illustrative example presented at the end of Chapters 9–13 was included in the book to provide an example of a complete application of the systems decision process. We conclude the Project 2 effort with student presentations and a summary of the course.

EXAMPLE GRADUATE PROGRAM SUPPORT

As mentioned previously, we received a significant number of suggestions for enhancements to the book from academicians and practitioners since the publication of the first edition. A number of these expressed a desire to use the book in support of their graduate programs or for workshops they were offering as continuing professional education. Figure 0.2 shows one perspective that might be helpful in this regard. It describes how that each chapter might support program and course objectives for a select number of graduate programs listed. It is intended purely as illustrative course topic coverage based on the editors' experience teaching courses in these types of programs. Any specific curriculum design would and should obviously be driven by the academic program specifics and course objectives. In addition, several of the chapters include material and associated mathematical content that may be appropriate for advanced undergraduate or graduate courses. These are predominantly:

Chapter \ Program	Industrial & Systems Engineering	Engineering Management	Traditional Engineering	Acquisition Management/ Professional Continuing Education
1. Introduction	Introduces key systems concepts and role of stakeholders	Introduces key systems concepts and role of stakeholders	Introduces key systems concepts and role of stakeholders	Introduces key systems concepts and role of stakeholders
2. Systems Thinking	Foundational systems thinking principles and techniques	Foundational systems thinking principles and techniques	Foundational systems thinking principles and techniques	Foundational systems thinking principles and techniques
3. Systems Life Cycle	Importance of life cycle and risk management for system solutions	Importance of life cycle and risk management for system management	Importance of life cycle and risk management for system engineered solutions	Optional
4. Systems Modeling & Analysis	Introduces roles and techniques of M&S in systems analysis	Introduces roles and techniques of M&S in systems analysis	Introduces roles of M&S in systems analysis	Introduces roles of M&S in systems analysis
5. Life Cycle Costing	Supplements engineering economy course	Supplements engineering economy course	Foundational cost analysis principles and techniques	Foundational cost analysis principles and techniques
6. Introduction to SE	Provides setting and context for SE and system complexity	Provides setting and context for SE and system complexity	Provides setting and context for SE and system complexity	Provides setting and context for SE and system complexity
7. SE in Professional Practice	Help system engineers understand the roles and activities of SEs	Helps engineering manager understand the roles of SE	Help traditional engineers understand the role of SE	Helps acquisition manager understand the role of SE
8. Systems Reliability	Overview of systems effectiveness principles and techniques	Optional	Overview of systems effectiveness principles and techniques	Optional
9. Systems Decision Process Overview	Useful to introduce and compare SDP with other DM processes	Useful to introduce and compare SDP with other DM processes	Useful to introduce and compare SDP with other DM processes	Useful to introduce and compare SDP with other DM processes
10. Problem Definition	Emphasizes importance of problem definition and demonstrates key qualitative techniques	Emphasizes importance of problem definition and demonstrates key qualitative techniques	Emphasizes importance of problem definition and demonstrates key qualitative techniques	Emphasizes importance of problem definition and demonstrates key qualitative techniques
11. Solution Design	Teaches fundamental system design principles and techniques	Teaches fundamental system design principles and techniques	Shows relationship of traditional engineering design in systems design	Teaches fundamental system design principles and techniques
12. Decision Making	Demonstrates sound mathematical techniques for trade studies and analysis of alternatives and presentations to DMs	Demonstrates sound mathematical techniques for trade studies and analysis of alternatives and presentations to DMs	Demonstrates sound mathematical techniques for trade studies and analysis of alternatives and presentations to DMs	Demonstrates sound mathematical techniques for trade studies and analysis of alternatives and presentations to DMs
13. Solution Implement-ation	Introduces key project management techniques	Reinforces project management techniques	Introduces key project management techniques	Reinforces project management techniques
14. Summary	Summarizes key messages of the book	Summarizes key messages of the book	Optional	Optional

Figure 0.2 Example graduate program topical support.

- Chapter 5: Life Cycle Costing, CER
- Chapter 8: System Reliability
- Chapter 11: Solution Design (section on experimental design and response surface methodology)
- Chapter 12: Decision Making (the sections on Decision-Focused Transformation, Monte Carlo simulation, and decision trees)

Presentation and decision quality	Criteria and grade			
	Worst	Adequate	Very good	Ideal
Bottom line up front	0	7	9	10
	Not used	One bullet chart that summarizes the major results.	Bullet and graphs or pictures that illustrate the major results.	Briefing could be presented in one chart.
1. Appropriate frame	0	14	18	20
	No problem definition	Problem definition based on stakeholder analysis performed using interviews and surveys. Findings, conclusions, and recommendations.	Insightful problem definition clearly supported by stakeholder analysis.	New insights provided to the client.
2. Creative doable alternatives	0	14	18	20
	No alternatives	Alternative generation table used to generate feasible alternatives.	Alternatives identified that have potential to provide high value.	Create alternatives client has not considered.
3. Meaningful, reliable information	0	14	18	20
	No documentation on presentation.	Adequate documentation for values and scores. Assumptions identified.	Appropriate sources.	Very credible sources.
4. Clear values and tradeoffs	0	28	36	40
	No value modal	Value model (measures aligned with system functions), value functions, and swing weight model implemented without errors.	Clear, meaningful objectives and credible measures.	Insightful objectives and direct measures.
5. Logically correct reasoning	0	14	18	20
	No rotational for recommendations	Value versus cost plot presented and interpretated correctly.	Logic for recommendation explained in three sentences.	Logic for recommendation explained in one sentences.
	0	14	18	20
6. Commitment to action	No discussion of implementation	Implementation plan presented using WBS and performance measures. Key risks identified.	Clean plan to reduce implementation risk.	Identified stakeholders who may not support and develop plan to obtain their support.
Total	0	105	135	150

Figure 0.3 A systems-based, project evaluation rubric.

DECISION ANALYSIS SOFTWARE

The text is designed to be independent of software. All of multiple objective decision analysis in Chapter 12 can be performed in a spreadsheet environment. For the case of Microsoft® Excel, macros that perform a linear interpolation useful for converting measure scores to units of value via value functions exist (Kirkwood, 1997).[1] In several of the illustrative examples, we call upon the Excel Solver to support component optimization. Any similar utility within other spreadsheet software would serve this purpose just as well. Certainly, one alternative to using a spreadsheet would be to employ decision analysis software, a number of which we highlight in this text where appropriate. Any Excel templates we use are available upon request from the editors.

STUDENT EVALUATION

Systems engineers face a continuing challenge of balancing robust processes with quality content. Creative ideas without a solid systems decision process will seldom be defended and successfully implemented. However, a wonderful, logical process is of little value without creativity and innovation. We believe we must impart to our students the importance of both process and creativity without sacrificing the benefits of either. Consequently, we used the concepts introduced in this book—the systems decision process, quality decisions, and presentation guidance—to develop a project grading mechanism that rewards both process and content. Figure 0.3 shows our Project 2 grading sheet. The decision quality terms in the first column are explained in Chapter 9. Insofar as grades are concerned, a student able able to perform the process correctly will earn a "C." Performing the process and having very good context will earn a "B." Demonstrating a mastery of the process, appropriate creativity, and producing outstanding insights will typically result in a grade of "A." We have found this grading approach helpful for recognizing student performance and for conveying course expectations.

FINAL THOUGHT

While we have attempted to incorporate all the suggestions and great ideas we have received from readers of the first edition, we wholeheartedly recognize the value of continuous improvement. Thus, while we are certainly limited in the degree to which the outstanding publication staff at Wiley allow us to alter content between printings without engaging in a third edition, we welcome feedback and suggestions whenever they occur.

GREGORY S. PARNELL AND PATRICK J. DRISCOLL

West Point, New York
July 2010

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[1]Kirkwood, CW. *Strategic Decision Making: Multiple Objective Decision Analysis with Spreadsheets*. Pacific Grove, CA: Duxbury Press, 1997.

Contributors

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Acronyms

ABET	Formerly Accreditation Board for Engineering and Technology, now ABET, Inc.
AFT	Alternative-Focused Thinking
AoA	Analysis of Alternatives
ASEM	American Society for Engineering Management
ASI	American Shield Initiative
BRAC	Base Realignment and Closure Commission
CAS	Complex Adaptive System
CCB	Configuration Control Board
CER	Cost Estimating Relationship
CFR	Constant Failure Rate
CIO	Chief Information Officer
CM	Configuration Manager (or Management)
CPS	Creative Problem Solving
CTO	Chief Technology Officer
DDDC	Dynamic, Deterministic, Descriptive, Continuous
DDDD	Dynamic, Deterministic, Descriptive, Discrete
DDPC	Dynamic, Deterministic, Prescriptive, Continuous
DDPD	Dynamic, Deterministic, Prescriptive, Discrete
DFR	Decreasing Failure Rate
DoD	Department of Defense
DOE	Design of Experiments

DPDC	Dynamic, Probabilistic, Descriptive, Continuous
DPDD	Dynamic, Probabilistic, Descriptive, Discrete
DPPC	Dynamic, Probabilistic, Prescriptive, Continuous
DPPD	Dynamic, Probabilistic, Prescriptive, Discrete
EM	Engineering Manager (or Management)
ESS	Environmental Stress Screening
FIPS	Federal Information Processing Standards
FRP	Full Rate Production
GIG	Global Information Grid
ICD	Interface Control Document
ICOM	Inputs, Controls, Outputs, and Mechanisms
IDEF	Integrated Definition for Function Modeling
IE	Industrial Engineer (or Engineering)
IED	Improvised Explosive Device
IFR	Increasing Failure Rate
IIE	Institute of Industrial Engineers
ILS	Integrated Logistic Support
INCOSE	International Council on Systems Engineering
INFORMS	Institute for Operations Research and the Management Sciences
IV& V	Independent Verification and Validation
LCC	Life Cycle Costing
LRIP	Low Rate Initial Production
M& S	Modeling and Simulation
MA	Morphological Analysis
MAS	Multi-Agent System
MTF	Mean Time to Failure
MODA	Multiple Objective Decision Analysis
MOE	Measure of Effectiveness
MOP	Measures of Performance
MORS	Military Operations Research Society
NCW	Network Centric Warfare
NPV	Net Present Value
NSTS	National Space Transportation System
OR/MS	Operations Research & Management Science
ORS	Operational Research Society
PM	Program Manager (or Management)
QA	Quality Assurance
R/C	Radio Controlled
RFP	Request for Proposal
RMA	Reliability, Maintainability, and Availability
RPS	Revised Problem Statement
RSM	Response Surface Method
SADT	Structured Analysis and Design Technique
SCEA	Society of Cost Estimating and Analysis

SDDC	Static, Deterministic, Descriptive, Continuous
SDDD	Static, Deterministic, Descriptive, Discrete
SDP	Systems Decision Process
SDPC	Static, Deterministic, Probabilistic, Continuous
SDPD	Static, Deterministic, Prescriptive, Discrete
SE	System(s) Engineer (or Engineering)
SEC	Securities and Exchange Commission
SEMP	Systems Engineering Master Plan
SME	Subject Matter Expert
SPDC	Static, Probabilistic, Descriptive, Continuous
SPDD	Static, Probabilistic, Descriptive, Discrete
SPPC	Static, Probabilistic, Prescriptive, Continuous
SPPD	Static, Probabilistic, Prescriptive, Discrete
TEMP	Test and Evaluation Master Plan
U.S.	United States
VFT	Value-Focused Thinking
WBS	Work Breakdown Structure