Contents

Preface to the Third Edition  xix
  Technical Competency: Necessary but Not Sufficient  xix
  Audiences: Students and Practitioners  xx
  Organization and Content  xx
  Additions and Improvements  xxi
  This Book and ABET Engineering Accreditation Criteria  xxii
  This Book and the Body of Knowledge Movement  xxiii
Acknowledgments  xxvii
  Cited Sources  xxviii
List of Abbreviations  xxix

Chapter 1  Introduction: Engineering and the Engineer  1
  The Playing Field  1
  Definitions of Engineering  3
  Leading, Managing, and Producing: Deciding, Directing, and Doing  4
    Leading, Managing, and Producing Defined  4
    The Traditional Pyramidal, Segregated Organizational Model  4
    The Shared Responsibility Organizational Model  6
    The Focus of This Book: Managing and Leading  7
    Leading Misconceptions  8
  The Seven Qualities of Effective Leaders  8
    Honesty and Integrity  9
    Vision: Reach and Teach  9
    Strategies and Tactics to Achieve the Vision  12
    Always a Student  13
    Courageous  15
    Calm in a Crisis and Chaos  17
    Creative, Innovative, Collaborative, and Synergistic  18
  The Engineer as Builder  19
  Concluding Thoughts: Common Sense, Common Practice, and Good Habits  20
  Cited Sources  22
Annotated Bibliography  23
Exercises  24
Chapter 2 Leading and Managing: Getting Your Personal House in Order

Start with You

Time Management: But First Roles and Goals
- Time is a Resource
- Roles, Goals, and Then, and Only Then, Time Management
- Time Management: The Great Equalizer
- Time Management Tips: The ABCs
- A Time Management System
- Key Ideas about Time Management

Employment or Graduate School?
- Full-Time Graduate Study
- Full-Time Employment
- Learn From Potential Employers

The New Work Environment: Culture Shock?
- No Partial Credit
- Little Tolerance for Tardiness
- Assignments are Not Graded
- Schedules are More Complicated
- Higher Grooming and Dress Expectations
- Teamwork is Standard Operating Procedure
- Expect and Embrace Change

The First Few Months of Practice: Make or Break Time
- Recognize and Draw on Generic Qualities
- Guard Your Reputation
- Learn and Respect Administrative Procedures and Structure
- Complete Assignments in Accordance with Expectations
- Get Things Done
- Trim Your Hedges
- Keep Your Supervisor Informed
- Speak Up and Speak Positively
- Dress Appropriately
- Hone Communication Ability
- Seize Opportunities for You and Your Organization
- Choose To Be a Winner
- Summing it Up

Managing Personal Professional Assets: Building Individual Equity
- Personal Professional Assets
- Annual Accounting
- Careful Management of Personal Professional Equity
- Continuing Education
- Involvement in Professional Organizations: Taking and Giving
- Licensing

Concluding Thoughts: Getting Your Personal House in Order
Chapter 3  Communicating to Make Things Happen  73
Five Forms of Communication  73
Three Distinctions between Writing and Speaking  75
   Single-Channel versus Multi-Channel  75
   One-Directional versus Two-Directional  76
   Conveying versus Convincing  76
Listening: Using Ears and Eyes  77
   Be Attentive  77
   The Value of Facts and Feelings  78
   Body Language: The Silent Messenger  78
   Verify Understanding  80
   Use What Is Learned  80
Writing Tips: How to Write to Make Things Happen  80
   Define the Purpose  80
   Profile the Audience  81
   Structure the Document to Reflect the Audience Profile  82
   Ask About Document-Writing Guidelines  84
   Start Writing on “Day 1”  84
   Get Started: Overcome Writer’s Block  85
   Avoid Tin Ear  87
   Retain Some of the Outline in the Document  88
   Write Major Documents in Third Person: Mostly  88
   Employ a Gender-Neutral Style  89
   Write in an Active, Direct Manner Rather Than a Passive, Indirect Manner  89
   Recognize that Less Is More  90
   Apply Rhetorical Techniques  92
   Adopt a Flexible Format for Identifying Tables, Figures, and Sources  93
   Use Lists  94
   Design a Standard Base Map or Diagram  94
   Compose Informative Titles  94
   Establish Milestones  95
   Produce an Attractive and Appealing Document  95
   Cite All Sources  95
   Read One More Time  96
Speaking Tips: How to Speak to Make Things Happen  97
   Conquer Reluctance to Speak: Commit to Competence  98
   Prepare the Presentation  99
   Deliver the Presentation  111
   Follow-Up the Presentation  116
Concluding Thoughts about Writing and Speaking  118
Cited Sources  118
Annotated Bibliography  120
Exercises  121

Chapter 4 Developing Relationships  123
Taking the Next Career Step  123
Personality Profiles  124
Maslow’s Hierarchy of Needs  125
  The Hierarchy  125
  Application  126
Theories X and Y  127
  Definitions  127
  Applications of Theory X and Theory Y Knowledge  127
  Dominance of Theory Ys  128
  Reasons to Delegate  129
  Reluctance to Delegate  131
  Delegation Isn’t Always Down  133
  Delegation Tips  133
  Three Possible Outcomes  134
Orchestrating Meetings  135
  Reasons to Meet  135
  When Not To Call a Meeting  136
  Tips for Successful Meetings  136
  Additional Meeting Thoughts  145
Working with Technologists, Technicians, and Other Team Members  145
  Essential Members of the Organization  146
  Challenges Unique to Working with Varied Team Members  147
  A Dozen Tips for the Entry-Level Technical Person  148
Selecting Co-Workers and “Managing Your Boss”  150
  Carefully Select Your “Boss” and Co-workers  150
  Seek a Mutually-Beneficial Relationship  150
  Avoid Being a “Yes” Man/Woman  151
Caring Isn’t Coddling  151
Coaching  152
  Coaching Tips  152
  Concluding Thought  153
Teamwork  153
  Three Teamwork Essentials  154
  Creating a Team  155
  The Forming-Storming-Norming-Performing Process  157
  Closing Thoughts about Teams  157
Effective Professional Meeting and Conference Attendance  158
Chapter 5  Project Management: Planning, Executing, and Closing  167

Project Broadly Defined  167
Project Management Defined  168
The Centrality of Project Management  169
Relevance of Project Management to the Student and Entry-Level Technical Person  172
Planning the Project  173
  All Projects Are Done Twice  173
  The Project Plan: Introduction  174
  Consequences of Poor or No Planning  175
  The Project Plan Avoidance Syndrome  175
  Preparing the Project Plan  176
  Principal Project Plan Elements  177
  Element 1: Objectives – What Do We Want to Accomplish?  178
  Element 2: Scope – How Are We Going to Do It?  178
  Element 3: Risks – What Could Go Wrong?  178
  Element 4: Deliverables – What Will We Provide to the Client/Owner/Customer?  181
  Element 5: Milestones/Schedule – When Will We Provide the Deliverables?  181
  Element 6: Tasks – What Tasks Need to be Done and in What Order to Provide the Deliverables?  182
  Element 7: Resources/Budget – How Much Will the Project Cost?  183
  Element 8: Directory – Who Will Participate?  184
  Element 9: Communication Protocol – How Will We Collaborate?  185
  Element 10: Monitoring and Control Procedure – How Will We Know How We Are Doing Relative to the Project Plan?  185
  Ten Possible Additional Project Plan Elements  186

Project Planning Versus Project Doing  187
Executing the Project  188
  Keep the Project Team on Track  188
  Interact With Client, Owner, or Customer  188
  Communicate With Stakeholders  188
  Monitor Project Progress and Take Appropriate Actions  189
Strive to Understand Client, Owner, and Customer Wants and Needs 238
Define the Other Project Requirements 242
Assess and Manage Risk 242
Think Upstream, Not Downstream 242
Create, Use, and Continuously Improve Written Guidance for Repetitive Tasks and Processes 243
Expect Each Person to Check His or Her Work 248
Arrange for External Reviews 249
Reduce Cycle Time 249
Tools and Techniques for Stimulating Creative and Innovative Thinking 250
The Need for and Value of Tools and Techniques 250
Create and Innovate Defined 250
Brainstorming 251
Multivoting 252
Strengths-Weaknesses-Opportunities-Threats 252
Stakeholder Input 253
Process Diagramming 253
Fishbone Diagramming 254
Pareto Analysis 254
Problems-First Meetings 256
Mind Mapping 256
Ohno Circle 258
Metrics 259
Freehand Drawing 260
Take a Break 263
Closure: Commit to Quality 264
Cited Sources 264
Annotated Bibliography 266
Exercises 267

Chapter 8 Design: To Engineer Is to Create 269
The Root of Engineering 269
This Chapter’s Approach 270
Design in the Context of Major Engineering Functions 271
Four Engineering Functions 271
Interaction 271
“Back-of-the-Envelope” Sketches and Calculations 272
Design Phases 273
Hard and Soft Results 274
The Disproportionate Impact of the Design Function 274
Design in Terms of Deliverables 274
Drawings 275
Technical Specifications 276
Non-Technical Provisions 277
Chapter 9 Building: Constructing and Manufacturing 283
The Engineer as Builder 283
Constructing 285
Importance of Constructing 285
What Gets Constructed and How? 286
Roles of Engineers in Constructing 287
Trends in Constructing 289
Manufacturing 290
Importance of Manufacturing 290
What Gets Manufactured and How? 291
Roles of Engineers in Manufacturing 292
Trends in Manufacturing 293
Differences between Constructing and Manufacturing 294
Closing Thoughts about Constructing and Manufacturing 294
Cited Sources 295
Annotated Bibliography 295
Exercises 296

Chapter 10 Basic Accounting: Tracking the Past and Planning the Future 299
Relevance of Accounting to the Engineer 299
The Balance Sheet: How Much Is It Worth? 300
Personal Balance Sheet 301
Business Balance Sheet 302
The Income Statement: Inflow and Outflow 304
Personal Income Statement 305
Business Income Statement 306
Relationship between the Balance Sheet and the Income Statement 308
Accounting for Your Future 309
Estimating the Necessary Net Worth at the End of Your Earning Phase 309
Accumulating the Necessary Net Worth by the End of Your Earning Phase 312
Is This Overkill? 314
<table>
<thead>
<tr>
<th>Teaching and Learning Ethics</th>
<th>356</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal and Ethical Domain</td>
<td>359</td>
</tr>
<tr>
<td>Codes of Ethics</td>
<td>362</td>
</tr>
<tr>
<td>Introduction to Codes: What They Are</td>
<td>362</td>
</tr>
<tr>
<td>Engineering Society Codes of Ethics</td>
<td>363</td>
</tr>
<tr>
<td>Ethics Codes for Other Professions</td>
<td>365</td>
</tr>
<tr>
<td>Business Codes of Ethics</td>
<td>366</td>
</tr>
<tr>
<td>Government Codes of Ethics</td>
<td>367</td>
</tr>
<tr>
<td>University Codes of Ethics</td>
<td>369</td>
</tr>
<tr>
<td>Codes Cannot Anticipate All Circumstances</td>
<td>370</td>
</tr>
<tr>
<td>Dealing with Ethical Dilemmas: Using Codes and Other Resources</td>
<td>370</td>
</tr>
<tr>
<td>Ethics Codes</td>
<td>371</td>
</tr>
<tr>
<td>Advice of Experienced Personnel</td>
<td>371</td>
</tr>
<tr>
<td>A Nine-Step Individual or Group Process</td>
<td>371</td>
</tr>
<tr>
<td>A Systematic Group Process</td>
<td>372</td>
</tr>
<tr>
<td>Application of Moral Imagination</td>
<td>373</td>
</tr>
<tr>
<td>Case Study: Discovering a Major Design Error after Construction Is Complete</td>
<td>374</td>
</tr>
<tr>
<td>Design and Construction</td>
<td>374</td>
</tr>
<tr>
<td>Post-Construction Discovery</td>
<td>374</td>
</tr>
<tr>
<td>The Engineer’s Actions</td>
<td>375</td>
</tr>
<tr>
<td>What Happened to LeMessurier?</td>
<td>376</td>
</tr>
<tr>
<td>Concluding Thoughts: Seeing Sermons</td>
<td>376</td>
</tr>
<tr>
<td>Cited Sources</td>
<td>377</td>
</tr>
<tr>
<td>Annotated Bibliography</td>
<td>378</td>
</tr>
<tr>
<td>Exercises</td>
<td>379</td>
</tr>
</tbody>
</table>

**Chapter 13 Role and Selection of Consultants** 381

<table>
<thead>
<tr>
<th>Consultant Defined and Why You Should Care</th>
<th>381</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Meanings of Consultant</td>
<td>381</td>
</tr>
<tr>
<td>Why You Should Care</td>
<td>382</td>
</tr>
<tr>
<td>Why Retain a Consultant? Let’s Do It Ourselves!</td>
<td>383</td>
</tr>
<tr>
<td>Characteristics of Successful Consultants</td>
<td>385</td>
</tr>
<tr>
<td>Consultant Selection Process</td>
<td>387</td>
</tr>
<tr>
<td>Cost Versus Quality</td>
<td>387</td>
</tr>
<tr>
<td>Price-Based Selection</td>
<td>388</td>
</tr>
<tr>
<td>The Ideal Selection Process</td>
<td>389</td>
</tr>
<tr>
<td>Qualifications-Based Selection</td>
<td>390</td>
</tr>
<tr>
<td>Steps in the Selection Process</td>
<td>391</td>
</tr>
<tr>
<td>Welcome Exceptions</td>
<td>396</td>
</tr>
<tr>
<td>Summing Up the Consultant Selection Process</td>
<td>396</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price-Based Selection: Three Costs to the Consultant</th>
<th>397</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offering Less Than We Could</td>
<td>397</td>
</tr>
<tr>
<td>Further Reduction in Profit</td>
<td>398</td>
</tr>
<tr>
<td>Damaged Reputation</td>
<td>398</td>
</tr>
</tbody>
</table>
Chapter 14  Marketing: A Mutually-Beneficial Process  403
Consider Your View of Marketing: Are You Carrying Some Baggage?  403
Chapter’s Scope  404
The Economic Motivation for Marketing Professional Services  405
Marketing and Selling: Different but Related  406
A Simple, Powerful Marketing Model  409
The Model  409
Applying the Model  410
Caution: Respect the Order and Invest Time Wisely  411
Marketing Techniques and Tools  412
Create a Personal Marketing Plan  412
Learn the Marketing Language  414
Schedule Marketing Tasks  416
Find Common Ground  416
Earn Trust  418
Ask-Ask-Ask: The Power of Questions  419
Talk to Strangers  422
Stress Benefits, Not Features  422
Focus on Existing Clients, Owners, and Customers  423
Help to Establish Multiple-Level Links  424
Proactively Establish the Next Step  425
Selectively Share Data, Information, and Knowledge  426
What Works and What Doesn’t Work  426
Marketing Concluding Comments  427
Cited Sources  428
Annotated Bibliography  429
Exercises  429

Chapter 15  The Future and You  431
What Does the Future Hold?  431
The World You Will Work In: Same Role but New Stage  432
After the Knowledge Age, the Conceptual Age?  433
After The Knowledge Age, the Opportunity Age?  434
After The Knowledge Age, the Solving Wicked Problems Age?  435
Additional Views of the World Stage  436
Implications for You  437
How to Lead Change  438