Contents

Preface xi
A Personal Note from William T. Scherer xv
A Personal Note from William F. Gibson xvii
A Personal Note from Scott F. Ferber xix
Original Preface from Jack Gibson xxi
Acknowledgments xxiii

1 Introduction 1

1.1 What Is a System? 2
1.2 Terminology Confusion 4
1.3 Systems Analysis Equals Operations Research Plus Policy Analysis 6
1.4 Attributes of Large-Scale Systems 7
1.5 Intelligent Transportation Systems (ITS): An Example of a Large-Scale System 8
1.6 Systems Integration 11
1.7 What Makes a “Systems Analysis” Different? 12
1.8 Distant Roots of Systems Analysis 14
1.9 Immediate Precursors to Systems Analysis 15
1.10 Development of Systems Analysis As a Distinct Discipline: The Influence of RAND 17
vi CONTENTS

Historical Case Study: IIASA (A) 20
Exercises 24
Case Study: Fun at Six Flags? 25
Historical Case Study: IIASA (B) 26

2 Six Major Phases of Systems Analysis 29

2.1 The Systems Analysis Method: Six Major Phases 29
2.2 The Goal-centered or Top-Down Approach 35
2.3 The Index of Performance Concept 40
2.4 Developing Alternative Scenarios 44
2.5 Ranking Alternatives 45
2.6 Iteration and the “Error-embracing” Approach 46
2.7 The Action Phase: The Life Cycle of a System 48
Exercises 50
Case Study: Methodologies or Chaos? Part A 51
Case Study: Methodologies or Chaos? Part B 52
Case Study: Wal-Mart Crisis! 53

3 Goal Development 55

3.1 Seven Steps in Goal Development 55
3.2 On Generalizing the Question 59
3.3 The Descriptive Scenario 61
3.4 The Normative Scenario 62
3.5 The Axiological Component 63
3.6 Developing an Objectives Tree 66
3.7 Fitch’s Goals for an Urbanizing America: An Example of Objectives Tree Construction 73
3.8 Content Analysis of Fitch’s Goals 79
3.9 Validate 82
3.10 Iterate 83
Case Study: Distance Learning in the Future? 84
Historical Case Study: Goals of 4C, Inc. 85

4 The Index of Performance 89

4.1 Introduction 89
4.2 Desirable Characteristics for an Index of Performance 91
4.3 Economic Criteria 95
4.4 Compound Interest 96
CONTENTS

4.5 Four Common Criteria of Economic Efficiency 98
4.6 Is There a Problem with Multiple Criteria? 100
4.7 What Is Wrong with the B–C Ratio? 105
4.8 Can IRR Be Fixed? 107
4.9 Expected Monetary Value 109
4.10 Nonmonetary Performance Indices 111
Exercises 114
Case Study: Sky High Airlines 116
Case Study: Bridges—Where to Spend the Security Dollars? 122
Case Study: Measuring the Process and Outcomes of Regional Transportation Collaboration 122
Case Study: Baseball Free Agent Draft 123

5 Develop Alternative Candidate Solutions 129

5.1 Introduction 129
5.2 The Classical Approach to Creativity 129
5.3 Concepts in Creativity 131
5.4 Brainstorming 132
5.5 Brainwriting 135
5.6 Dynamic Confrontation 137
5.7 Zwicky’s Morphological Box 137
5.8 The Options Field/Options Profile Approach 139
5.9 Computer Creativity 143
5.10 Computer Simulation: a Tool in Option Development 144
5.11 Why a Dynamic Simulation for Creating Options? 145
5.12 Context-Free Simulation Models? 147
5.13 Bottom-Up Simulation or Top-Down? 148
5.14 Lessons from the Susquehanna River Basin Model 151
5.15 The Forrester Urban Model (FUM) and Societal Values 153
5.16 Extensions and Variations 157
5.17 Where to go from Here? 159
Exercises 159
Case Study: Winnebago 160
Case Study: Distance Learning in the Future? 160
Historical Case Study: Real-Time Television Link with Mars Orbiter 160
Historical Case Study: A Highway Vehicle Simulator RFP From DOT 180
CONTENTS

6 Rank Alternative Candidates 185
   6.1 Introduction 185
   6.2 Rating and Ranking Methods 186
   6.3 Condorcet and Arrow Voting Paradoxes 188
   6.4 A MultiStage Rating Process 192
   6.5 Decision Analysis 197
   6.6 Basic Axioms of Decision Theory 199
   6.7 Properties of Utility Functions 203
   6.8 Constructing a Utility Curve 205
   6.9 Some Decision Analysis Classic Examples 207
   6.10 Estimation Theory in Decision Analysis 213
   6.11 Some Practical Problems with Decision Analysis 221
   6.12 Practical Trade Studies 224
   Exercises 231
   Case Study: Training Center Location 234
   Case Study: Corporate Headquarters Location 235
   Case Study: Business School Selection 236

7 Iteration and Transition 239
   7.1 Iteration 239
   7.2 Segment and Focus 241
   7.3 The Transition Scenario 241
   7.4 The Gantt Chart 242
   7.5 Interaction Matrices 243
   7.6 The Delta Chart 248
   7.7 The Audit Trail 250
   7.8 Cost of Failure to Stay on Schedule 252
   7.9 Responsibilities of Major Actors 253
   7.10 Sign-Offs by Cooperating Groups 253
   Exercises 254

8 Management of the Systems Team 257
   8.1 Introduction 257
   8.2 Personal Style in an Interdisciplinary Team 257
   8.3 “Out-Scoping” and “In-Scoping” in a System Study 260
   8.4 Building the Systems Team 261
   8.5 Tips on Managing the Team 263
   8.6 Functional or Project Management? 264
CONTENTS

8.7 How to Make an Effective Oral Presentation 266
8.8 How to Write a Report 273

9 Project Management 277

  9.1 Introduction 277
  9.2 Project Management Versus Process Management 279
  9.3 The Hersey–Blanchard Four-Mode Theory 281
  9.4 Relation of Management Style to Project Management 285
  9.5 Preliminary Project Planning 286
  9.6 Dealing with Conflict in Project Management 287
  9.7 Life-Cycle Planning and Design 288
  9.8 PERT/CPM Program Planning Method: An Example 292
  9.9 Quality Control in Systems Projects 297
    Case Study: Project Management 298

10 The 10 Golden Rules of Systems Analysis 301

  10.1 Introduction 301
  10.2 Rule 1: There Always Is a Client 302
  10.3 Rule 2: Your Client Does Not Understand His Own Problem 303
  10.4 Rule 3: The Original Problem Statement is too Specific: You Must Generalize the Problem to Give it Contextual Integrity 304
  10.5 Rule 4: The Client Does Not Understand the Concept of the Index of Performance 306
  10.6 Rule 5: You are the Analyst, Not the Decision-Maker 309
  10.7 Rule 6: Meet the Time Deadline and the Cost Budget 310
  10.8 Rule 7: Take a Goal-Centered Approach to the Problem, Not a Technology-Centered or Chronological Approach 311
  10.9 Rule 8: Nonusers Must be Considered in the Analysis and in the Final Recommendations 312
  10.10 Rule 9: The Universal Computer Model is a Fantasy 314
  10.11 Rule 10: The Role of Decision-Maker in Public Systems is Often a Confused One 314

References 319

Index 331