Contents

Acknowledgments		xix			
Chapter	1 Inti	roduction—Why This Book?	1		
•	1.1 Background				
1.2 Factors Common to Good Projects					
	1.3	•	4		
	1.4	The Scenarios in the Book	6		
		1.4.1 The Earth Monitoring and Data Archiving System (EMDAS) Project	6		
		1.4.2 The Data Archive and Distribution System	U		
		(DADS) Project	7		
		1.4.3 The Telemetry, Tracking, and Control (TTC)	,		
		Facility Upgrade Project	7		
	1.5	The Contents of This Book	8		
Chapter	2 Mo	tivating Concepts	12		
•	2.1	What's In It For Me?	12		
	2.2	The Nature of Man	12		
	2.3	Goal-Directed Behavior	13		
	2.4	Some Theories of Motivation	13		
		2.4.1 Murray's Lists of Needs	14		
		2.4.2 Maslow's Hierarchical Theory	14		
		2.4.3 Alderfer's Theory	15		
		2.4.4 The Herzberg Motivation-Hygiene Theory	16		
		2.4.5 Morris Massey's Theory	16		
	2.5	Recognition and Rewards	18		
	2.6	Expectations and Performance	19		

2.7	A Slice of the Pie	19
2.8	Summary	21
Chapter 3 Aı	n Overview of Systems Engineering	23
3.1	Systems Engineering	23
3.2	The Systems Development Life Cycle (SDLC)	23
	3.2.1 The Preliminary Planning Phase	24
	3.2.2 The Requirements Analysis Phase	25
	3.2.3 The Preliminary Design Phase	26
	3.2.4 The Design Phase	27
	3.2.5 The Build, Integrate, and Test Phases	28
	3.2.6 The Operations and Maintenance Phases	28
3.3	The Role of the Systems Engineer	28
	3.3.1 Effective Systems Engineers	32
	3.3.2 The Ideal Systems Engineer	34
3.4	Interdependency	34
3.5	The Systems Engineering Team	35
	3.5.1 Adaptive and Innovative Characteristics for	
	Process Improvers	37
	3.5.2 Assembling Teams	37
	3.5.3 Characteristics of Effective Teams	37
3.6	3.5.4 Metrics for People	38
	Summary	39
Chapter 4 Me	thodologies and Models in Systems Engineering	41
4.1	Methodology Maturity Measurements	41
4.2	MIL-STD-499A Systems Engineering	42
	4.2.1 Introduction	42
	4.2.2 Referenced Documents	43
	4.2.3 Definitions	43
	4.2.4 General Criteria	44
	4.2.5 Detailed Requirements	45
	4.2.6 Contractual Provisions	45
	4.2.7 Noncontractual Provisions	46
	4.2.8 Review of Contractor's Engineering	
	Management	46
4.3	4.2.9 Notes to MIL-STD-499A	46
2.0	The Draft MIL-STD-499B and the Electronics Industries	
4.4	Association Interim Standard (EIA IS) 632	48
-	Adapting MIL-STD-2167A (Software Engineering) to Systems Engineering	
	4.4.1 Introduction	50
	4.4.2 Referenced Documents	51
		51

		4.4.3 Definitions	51
		4.4.4 General Requirements	52
		4.4.5 Detailed Requirements	54
		4.4.6 Notes to MIL-STD-2167A	55
		4.4.7 Appendices	55
		4.4.8 Summary	55
	4.5	Using Models in Systems Engineering	56
	4.6	Adapting the Ward & Mellor Methodology to	
		Systems Engineering	56
		4.6.1 The Five Phases	57
		4.6.2 The Structured and Object-Oriented	
		Analysis Choice	58
		4.6.3 Problem State Language	58
		4.6.4 Formal and Informal Reviews	58
		4.6.5 Real-Time Extensions	59
		4.6.6 The Relationship of the Ward and Mellor	
		Models to the SDLC	59
	4.7	The Hatley & Pirbhai Methodology	61
		4.7.1 The Models	61
		4.7.2 The Methodology	62
	4.8	Object-Oriented Methodologies	62
	4.9	Summary	63
Chapte	r 5 On	timizing the Systems Engineering Process	65
onupte.	5.1	Understanding the Customer's Real Requirements	65
	5.2	Performing Systems Engineering with Skilled	00
	3.2	Systems Engineers	66
		5.2.1 The Tendency to Reinvent the Wheel on Each Project	66
		5.2.2 The Tendency to Reuse Existing Hardware	•
		and Software	66
	5.3	Communicating and Maintaining the Vision	67
	5.4	Performing Adequate Specialty Engineering	68
	5.5	Applying Lessons Learned from Previous Projects	69
	5.6	Planning Ahead to Ensure Resources Are Available	
		When Needed	70
	5.7	Documenting the Reasons for Decisions	70
	5.8	Controlling Changes	70
	5.9	Using Personal Computers and Computer Enhanced	
		Systems Engineering (CESE) Tools	72
		5.9.1 CORE	73
		5.9,2 DOORS	74
		5.9.3 FORESIGHT	74
		5.9.4 RDD-100	74

	5.9.5 RTM	75
	5.9.6 SES/objectbench	75
	5.9.7 SIR/REX	75
	5.9.8 SLATE	76
	5.9.9 Statemate	76
5.10	Employing a Tested Methodology	77
5.11		
	That Seamlessly Interfaces to the Software	
	Development Methodology	77
5.12	Summary	77
Chapter 6 Mi	itigating Project Development Risks	79
6.1	The EMDAS Project	79
6.2	The Size of the Project	80
6.3	The Number of Organizations and Companies Involved	82
6.4	The Geographical Separation of the Installations	83
6.5	The Planned Evolutionary Changes	83
6.6	The Overseas Interfaces	84
6.7	Incomplete Requirements	85
6.8	Failure to Control Changes	85
6.9	Team Problems	87
6.10	Summary	87
Chapter 7 Th	e Contractual Background to Systems Engineering	89
7.1	Contracts	89
7.2	Firm Fixed Price (FFP) Contracts	90
7.3	Cost Plus Contracts	91
7.4		92
7.5	Cost Plus Incentive Fee (CPIF) Contracts	92
7.6	Cost Plus Award Fee (CPAF) Contracts	94
7.7	The Elements of the CPAF	94
	7.7.1 The Statement of Work (SOW)	95
	7.7.2 The Target Cost	95
	7.7.3 The Minimum Fee	95
	7.7.4 The Award Fee	95
	7.7.5 The Award Fee Evaluation Criteria	95
7.8	Optimizing CPAF Performance	96
7.9	Advantages and Disadvantages of the CPAF	97
7.10	Summary	98
hapter 8 Co	sts and Their Relation to Quality	101
8.1	The Three Dimensions of Cost-Effective Engineering	101
8.2	Measuring Project Progress	102
8.3	The Generic Process	102

11.3		151
	11.3.1 Metrics for Documents	151
	11.3.2 Metrics for Reviews	152
11.4		152
11.5	Summary	152
Chapter 12 S	ystems Engineering Documentation	155
12.1	Improving Engineering Documentation	155
	12.1.1 The Purpose of a Document	156
	12.1.2 The Current Document Preparation Process	156
	12.1.3 Characteristics of Effective	100
	Engineering Documents	156
	12.1.4 The Effective Document Preparation Process	157
	12.1.5 Locate and Evaluate a Similar Document	157
	12.1.6 Prepare an Annotated Outline	157
	12.1.7 Iterative Part	158
	12.1.8 Produce Peer Review Copy of Document	159
	12.1.9 Circulate Document for Comment	159
	12.1.10 Receive Comments	160
	12.1.11 Evaluate and Incorporate Comments	160
	12.1.12 Hold Informal Document Review/Walkthrough	160
	12.1.13 Publish Formal Draft Copy of Document	160
	12.1.14 Update Document Based on	
	Customer's Comments	161
12.0	12.1.15 Publish Document	161
12.2	Joseph Mild Operations Concent I Manhant	162
12.3 12.4	A	162
12.4	Requirements Documents	163
12.5	12.4.1 Requirements for Writing Requirements	166
12.5	Interface Control Documents (ICD)	168
12.0	Test Plans	170
12.7	12.6.1 Sample Annotated Outline of a Test Plan	170
	Summary	174
	ne Procurement	177
13.1	Government Contracts	177
	13.1.1 The Federal Acquisition Regulations (FAR)	177
	13.1.2 Office of Management and Budget	1//
	(OMB) Circulars	178
40.0	13.1.3 The Competition in Contracting Act (CICA)	178
13.2	THE ACQUISITION PROCESS	179
	13.2.1 Develop the Acquisition Plan	179
	13.2.2 Develop the Statement of Work (SOW)	180
	13.2.3 The Purchase Request	100

	13.2.4 The Commerce Business Daily Synopsis	181
	13.2.5 Develop the Solicitation	181
	13.2.6 Proposal Technical Evaluation	181
	13.2.7 Price/Cost Analysis	182
	13.2.8 Negotiations	182
	13.2.9 The Award	182
	13.2.10 Contract Administration	182
	13.2.11 Contract Modifications	183
	13.2.12 Completion or Termination	183
13.3	The Effect of a Protest	184
13.4	Improving the Acquisition Process	184
13.5	Summary	185
Chapter 14 Pr	roposals	187
14.1		188
		188
14.3	The Importance of a Winning Proposal Improving the Proposal Process	188
14.4	Definition of the Process	189
	14.4.1 The Initial Intent-to-Try Decision	190
	14.4.2 Preliminary Design	190
	14.4.3 Request for Proposal Release	191
	14.4.4 Design Check	191
	14.4.5 Basic Bid/No Bid Decision	191
	14.4.6 The First Draft	191
	14.4.7 Preliminary Document Review (PDR)	192
	14.4.8 Second Draft	192
	14.4.9 Intermediate Document Review (IDR)	192
	14.4.10 Final Polish	192
	14.4.11 Corporate Document Review (CDR)	193
	14.4.12 Publish	193
	14.4.13 Deliver	193
	14.4.14 Party and Internal Debriefing	193
	14.4.15 Follow-Up With Customer	193
14.5	Understanding the Process	193
14.6	Definition of Improvements	194
14.7	Gather Data about the Process	194
14.8	Analyze the Data	195
14.9		196
	14.9.1 Red Team Evaluation Reports	196
	14.9.2 Cost per Page	198
	14.9.3 Ratio of Costs Incurred Before Red Team	
	Review to Costs After Red Team Review	198
	14.9.4 Finding Other Metrics	198

8.4 The Typical Process with Defects 104 8.5 Lowering the Costs 106 8.6 The Cost of Quality 108 8.7 Summary 108 Chapter 9 Process Improvement 111 9.1 Adaptive and Innovative Process Improvements 111 9.2 The Process Improvement Spiral 112 9.3 Tools for Process Improvement 114 9.4 Charts 114 9.4 Charts 114 9.4.1 The Table 114 9.4.2 The Bar Chart 114 9.4.2 The Bar Chart 115 9.4.3 The Plow Chart 116 9.4.5 The Flow Chart 117 9.4.6 The Trend Chart 117 9.4.7 The Control Chart 118 9.4.8 The XY Chart 119 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125				
8.6 The Cost of Quality 8.7 Summary 108 Chapter 9 Process Improvement 9.1 Adaptive and Innovative Process Improvements 111 9.2 The Process Improvement Spiral 112 9.3 Tools for Process Improvement 114 9.4 Charts 9.4.1 The Table 114 9.4.2 The Bar Chart 115 9.4.3 The Pie Chart 116 9.4.3 The Pie Chart 117 9.4.5 The Cause and Effect Chart 117 9.4.6 The Trend Chart 117 9.4.7 The Control Chart 118 9.4.8 The XY Chart 119 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 9.7 Presentations 128 9.7 Presentations 128 9.7 Presentation Handouts 130 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.4.1 The Project Organization 10.4.1 The Project Organization 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing Department 10.7 Summary Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149		8.4	The Typical Process with Defects	
Summary 108		8.5	Lowering the Costs	106
Chapter 9 Process Improvement 9.1 Adaptive and Innovative Process Improvements 111 9.2 The Process Improvement Spiral 112 9.3 Tools for Process Improvement 114 9.4 Charts 114 9.4.1 The Table 114 9.4.2 The Bar Chart 115 9.4.3 The Pie Chart 115 9.4.4 The Flow Chart 115 9.4.5 The Cause and Effect Chart 117 9.4.6 The Trend Chart 117 9.4.7 The Control Chart 118 9.4.9 The Yoduct-Activity-Milestone (PAM) Chart 119 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 135 10.1 The Calamity Jane/John Wayne Paradigm 137 10.2 The Anticipatory Testing 135 10.4 Organizing for Anticipatory Testing 139 10.3 The Anticipatory Testing Paradigm 137 10.4 Organizing for Anticipatory Testing 142 10.4.1 The Project Organization 142 10.4.2 The Anticipatory Testing Department 144 10.5 Lowering the Baseline Costs of Government Contracts 145 10.6 The Advantages of Anticipatory Testing 149 10.7 Summary 147		8.6	The Cost of Quality	106
9.1 Adaptive and Innovative Process Improvements 9.2 The Process Improvement Spiral 9.3 Tools for Process Improvement 9.4 Charts 9.4.1 The Table 9.4.2 The Bar Chart 9.4.3 The Pic Chart 9.4.5 The Pic Chart 115 9.4.5 The Cause and Effect Chart 117 9.4.6 The Trend Chart 118 9.4.7 The Control Chart 119 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 9.7 Presentations 128 9.8 Presentation Handouts 9.9 Certificates of Appreciation 130 9.10 Meetings 131 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Paradigm 10.4 Organizing for Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing Department 10.7 Summary Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149		8.7	Summary	108
9.1 Adaptive and Innovative Process Improvements 9.2 The Process Improvement Spiral 9.3 Tools for Process Improvement 9.4 Charts 9.4.1 The Table 9.4.2 The Bar Chart 9.4.3 The Pic Chart 9.4.5 The Pic Chart 115 9.4.5 The Cause and Effect Chart 117 9.4.6 The Trend Chart 118 9.4.7 The Control Chart 119 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 9.7 Presentations 128 9.8 Presentation Handouts 9.9 Certificates of Appreciation 130 9.10 Meetings 131 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Paradigm 10.4 Organizing for Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing Department 10.7 Summary Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149	Chapter	9 Pro	cess Improvement	111
9.2 The Process Improvement Spiral 9.3 Tools for Process Improvement 114 9.4 Charts 9.4.1 The Table 9.4.2 The Bar Chart 114 9.4.3 The Pie Chart 115 9.4.4 The Flow Chart 116 9.4.5 The Cause and Effect Chart 117 9.4.6 The Trend Chart 118 9.4.7 The Control Chart 118 9.4.8 The XY Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 131 10.1 The Calamity Jane/John Wayne Paradigm 135 10.1 The Calamity Jane/John Wayne Paradigm 136 10.2 The Anticipatory Testing Paradigm 137 10.2 The Anticipatory Testing Paradigm 139 10.3 The Anticipatory Testing Paradigm 130 10.4 Organizing for Anticipatory Testing Department 140 151 162 The Advantages of Anticipatory Testing Department 163 165 The Advantages of Anticipatory Testing Department 175 186 187 189 189 180 180 180 180 180 180 180 180 180 180	*			
9.3 Tools for Process Improvement 9.4 Charts 9.4.1 The Table 9.4.2 The Bar Chart 9.4.3 The Pie Chart 114 9.4.3 The Pie Chart 115 9.4.4 The Flow Chart 116 9.4.5 The Cause and Effect Chart 117 9.4.6 The Trend Chart 118 9.4.8 The XY Chart 119 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 137 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Paradigm 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 142 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary Chapter 11 Metrics for System Engineering 11.1 Basic Metrics		9.2	•	112
9.4 Charts 9.4.1 The Table 9.4.2 The Bar Chart 9.4.3 The Pic Chart 9.4.3 The Pic Chart 9.4.4 The Flow Chart 115 9.4.4 The Flow Chart 116 9.4.5 The Cause and Effect Chart 117 9.4.6 The Trend Chart 118 9.4.7 The Control Chart 119 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.7 Presentations 129 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Paradigm 10.4 Organizing for Anticipatory Testing Department 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 140 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing Department 145 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics				114
9.4.2 The Bar Chart 9.4.3 The Pie Chart 9.4.4 The Flow Chart 9.4.5 The Cause and Effect Chart 9.4.6 The Trend Chart 9.4.6 The Trend Chart 9.4.7 The Control Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 117 9.4.10 The Work Breakdown Structure (WBS) 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 9.6 Documents 9.7 Presentations 128 9.8 Presentation Handouts 130 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 118 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics		9.4	<u>•</u>	114
9.4.3 The Pie Chart 9.4.4 The Flow Chart 9.4.5 The Cause and Effect Chart 9.4.6 The Trend Chart 9.4.7 The Control Chart 9.4.8 The XY Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 9.6 Documents 9.7 Presentations 128 9.7 Presentation Handouts 130 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics			9.4.1 The Table	114
9.4.3 The Pie Chart 9.4.4 The Flow Chart 9.4.5 The Cause and Effect Chart 9.4.6 The Trend Chart 9.4.7 The Control Chart 9.4.8 The XY Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 119 9.4.10 The Work Breakdown Structure (WBS) 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 9.6 Documents 9.7 Presentations 128 9.7 Presentation Handouts 130 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics				114
9.4.4 The Flow Chart 9.4.5 The Cause and Effect Chart 9.4.6 The Trend Chart 9.4.7 The Control Chart 9.4.8 The XY Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 9.4.10 The Work Breakdown Structure (WBS) 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 9.6 Documents 9.7 Presentations 128 9.8 Presentations 129 9.8 Presentation Handouts 9.9 Certificates of Appreciation 130 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 11.0 Herrics for System Engineering 149 11.1 Basic Metrics				115
9.4.5 The Cause and Effect Chart 9.4.6 The Trend Chart 9.4.7 The Control Chart 9.4.8 The XY Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 9.4.10 The Work Breakdown Structure (WBS) 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics				116
9.4.6 The Trend Chart 9.4.7 The Control Chart 9.4.8 The XY Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 9.4.10 The Work Breakdown Structure (WBS) 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 9.6 Documents 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics				117
9.4.8 The XY Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 145 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics				117
9.4.8 The XY Chart 9.4.9 The Product-Activity-Milestone (PAM) Chart 9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 145 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics			9.4.7 The Control Chart	118
9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Paradigm 10.4 Organizing for Anticipatory Testing Approach to Systems Engineering 139 10.4 Organizing for Anticipatory Testing Department 10.4.1 The Project Organization 142 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics				119
9.4.10 The Work Breakdown Structure (WBS) 121 9.4.11 The PERT Chart 124 9.4.12 Quality Function Deployment (QFD) 125 9.5 The Personal Computer 127 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 130 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Paradigm 10.4 Organizing for Anticipatory Testing Approach to Systems Engineering 139 10.4 Organizing for Anticipatory Testing Department 10.4.1 The Project Organization 142 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics			9.4.9 The Product-Activity-Milestone (PAM) Chart	119
9.4.12 Quality Function Deployment (QFD) 9.5 The Personal Computer 9.6 Documents 9.7 Presentations 9.8 Presentation Handouts 9.9 Certificates of Appreciation 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.4.2 The Anticipatory Testing Department 10.4.3 Lowering the Baseline Costs of Government Contracts 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 149 11.1 Basic Metrics 149				121
9.4.12 Quality Function Deployment (QFD) 9.5 The Personal Computer 9.6 Documents 9.7 Presentations 9.8 Presentation Handouts 9.9 Certificates of Appreciation 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.4.2 The Anticipatory Testing Department 10.4.3 Lowering the Baseline Costs of Government Contracts 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 149 11.1 Basic Metrics 149			9.4.11 The PERT Chart	124
9.5 The Personal Computer 9.6 Documents 128 9.7 Presentations 128 9.8 Presentation Handouts 130 9.9 Certificates of Appreciation 131 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 139 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics				125
9.6 Documents 9.7 Presentations 9.8 Presentation Handouts 9.9 Certificates of Appreciation 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 11.10 128 130 128 128 128 128 128 128 128 129 130 130 131 131 133 133 133 134 135 135 136 137 137 137 138 139 139 139 139 139 139 139 139 139 139		9.5		127
9.8 Presentation Handouts 9.9 Certificates of Appreciation 9.10 Meetings 9.11 Summary 133 Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 119 110 110 110 110 110 120 130 131 132 133 133 134 135 135 136 137 137 138 139 139 139 139 139 139 139 139 139 139		9.6	<u>-</u>	128
9.9 Certificates of Appreciation 130 9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 135 10.1 The Calamity Jane/John Wayne Paradigm 137 10.2 The Anticipatory Testing Paradigm 139 10.3 The Anticipatory Testing Approach to Systems Engineering 139 10.4 Organizing for Anticipatory Testing 142 10.4.1 The Project Organization 142 10.4.2 The Anticipatory Testing Department 144 10.5 Lowering the Baseline Costs of Government Contracts 145 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics 149		9.7	Presentations	128
9.10 Meetings 131 9.11 Summary 133 Chapter 10 Anticipatory Testing 135 10.1 The Calamity Jane/John Wayne Paradigm 137 10.2 The Anticipatory Testing Paradigm 139 10.3 The Anticipatory Testing Approach to Systems Engineering 139 10.4 Organizing for Anticipatory Testing 142 10.4.1 The Project Organization 142 10.4.2 The Anticipatory Testing Department 144 10.5 Lowering the Baseline Costs of Government Contracts 145 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics 149		9.8	Presentation Handouts	130
9.10 Meetings 9.11 Summary Chapter 10 Anticipatory Testing 10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary Chapter 11 Metrics for System Engineering 11.1 Basic Metrics		9.9	Certificates of Appreciation	130
Chapter 10 Anticipatory Testing 135 10.1 The Calamity Jane/John Wayne Paradigm 137 10.2 The Anticipatory Testing Paradigm 139 10.3 The Anticipatory Testing Approach to Systems Engineering 139 10.4 Organizing for Anticipatory Testing 142 10.4.1 The Project Organization 142 10.4.2 The Anticipatory Testing Department 144 10.5 Lowering the Baseline Costs of Government Contracts 145 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics 149				131
10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149		9.11	Summary	133
10.1 The Calamity Jane/John Wayne Paradigm 10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149	Chapter	10 An	ticipatory Testing	135
10.2 The Anticipatory Testing Paradigm 10.3 The Anticipatory Testing Approach to Systems Engineering 139 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 144 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149				137
10.3 The Anticipatory Testing Approach to Systems Engineering 10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149				139
10.4 Organizing for Anticipatory Testing 10.4.1 The Project Organization 10.4.2 The Anticipatory Testing Department 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149			The Anticipatory Testing Approach to Systems Engineering	139
10.4.1 The Project Organization 142 10.4.2 The Anticipatory Testing Department 144 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149			Organizing for Anticipatory Testing	142
10.4.2 The Anticipatory Testing Department 144 10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149				142
10.5 Lowering the Baseline Costs of Government Contracts 10.6 The Advantages of Anticipatory Testing 146 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149				144
10.6 The Advantages of Anticipatory Testing 10.7 Summary 147 Chapter 11 Metrics for System Engineering 11.1 Basic Metrics 149		10.5	Lowering the Baseline Costs of Government Contracts	145
10.7 Summary 147 Chapter 11 Metrics for System Engineering 149 11.1 Basic Metrics 149			The Advantages of Anticipatory Testing	146
11.1 Basic Metrics 1149				147
11.1 Basic Metrics 149	Chapter	11 Me	etrics for System Engineering	149
150	p tol			149
				150

	14.10	Lessons Learned	198
		14.10.1 Lack of Resources	198
		14.10.2 Things We Had, but Didn't Follow through On	199
		14.10.3 Things We Did Not Do	199
		14.10.4 Things We Needed	199
		14.10.5 Things We Did Right	200
		Establish a Baseline	200
	14.12	Modify, Measure, and Continuously Improve	
		the Process	201
		14.12.1 Change the Organizational Structure	201
		14.12.2 Modify the Proposal Production Process	203
	14.13	Summary	207
Chapte	r 15 Re	equirements Definition Phase	209
•	15.1	Types of Requirements	209
	15.2	How to Collect Requirements	210
	15.3	Metrics for Requirements	210
		Where to Store Requirements	210
	15.5	Summary	212
Chamta		•	213
Cnapter		ne Preliminary Design Phase	215
	16.1	Facilitate Communications	217
	16.2		217
		Perform Tradeoffs	217
		Coordinate Peer Reviews	217
	16.5	Pr-) messors bearined from Hevious Projects	218
	16.6	Determine Suitability of COTS Products	218
	16.7	Make Dumb Comments	218
	10.8	Develop Transition Plans	219
	16.9	Make Sure Action Items are Completed in a	
	16 10	Timely Manner	220
	10.10	Summary	220
Chapter	17 Th	e Design, Build, Integrate, and Test Phases	221
	17.1	The Role of the Anticipatory Testing Department	221
	17.2	Acting as Communicators to Locate and Resolve	221
		Problems Across Interfaces	222
	17.3	Facilitating Communications Between the Different	224
		Specialized Departments	222
	17.4	The Cataract Approach to Build Planning	223
	17.5	Assessing the Impact of Changes	225 225
	17.6	Performing Hardware-Software Tradeoffs	225 226
	17.7	Test Planning	
		→	226

	17.8	Plannin	g the Transition to the Operations and	
	17.0		nance Phase	227
	17.9	Summa		227
hamtan	10 Th	Onorst	ions and Maintenance Phase	229
napter	18.1		Upgrades	230
	18.2		C Upgrade Rehosting Case	230
			le Alternatives	232
	18.3			232
		18.3.1	Use Existing Equipment	232
		18.3.2	Replace the Entire System	233
		18.3.3	Upgrade Existing System Then Replace It	235
		18.3.4	Upgrade Existing System, Then Replace It	235
	18.4		ion and Decision	236
	18.5	Summa	ry	
hapter	19 Eth	nics in Sy	stems Engineering	237
	19.1	Persona	l Ethics	237
	19.2	Corpora	ate Ethics	238
	19.3	Professi	onal Ethics	238
		19.3.1	The TTC Facility Upgrade Fiber Distributed	
			Data Interface (FDDI) Design	238
		19.3.2	Ineffective Systems Engineering May Break	
			the Law	240
	19.4	Persona	l Integrity	241
	19.5		ical Dilemma	242
		19.5.1	The Law	243
			Your Motives	244
		19.5.3	The Company's Ethics Policy	244
		19.5.4	The Consequences of Your Action	245
	19.6	The Ap	proach to Solving the Ethical Problem	245
		19.6.1	Analyze the Situation	245
		19.6.2	Identify Appropriate Lessons Learned	246
		1963	Develop Alternatives	247
		19.6.4	Determine the Probable Outcome of Each	
			Alternative Decision	247
		19.6.5	Evaluate the Alternatives	248
		1966	Decide What to Do and How to Go about It	248
	19.7		g the Whistle	248
		19.7.1	Consult with a Specialist	248
			Open a Diary	249
		19 7.3	Gather the Evidence	249
			Follow Procedure	250
			External Options	250
	19.8	Summa		251
			- T	

Chapter 20	Analysis a TON (As Contago Parties and a	253	
20		062	
	Implementing TQM Fail	253	
	20.1.1 It's a New Paradigm	254	
	20.1.2 Resistance to Change	254	
	20.1.3 Perceived Lack of Management Support	254	
	20.1.4 It Takes Time Away from Doing It Wrong	256	
	20.1.5 The Tools Are Developed but Are Not Applied		
20	in a Cost-Effective Manner	256	
20.		257	
20.	The state of the s	257	
	4 Training Courses	258	
20		259	
	6 Course Preparation	260	
20.	7 Course Presentation	260	
	20.7.1 Day 1: Theory (More or Less)	260	
	20.7.2 Day 2: Practice	261	
	8 The Wrap-Up Phase	262	
	9 The Course Development Schedule	262	
20.	10 Summary	263	
Chapter 21 ISO 9000 in Systems Engineering 26			
21.		265	
21.		267	
	21.2.1 Management Responsibility	267	
	21.2.2 Quality System	268	
	21.2.3 Contract Review	268	
	21.2.4 Design Control	269	
	21.2.5 Document and Data Control	269	
	21.2.6 Purchasing	269	
	21.2.7 Control of Customer-Supplied Product	270	
	21.2.8 Product Identification and Traceability	270	
	21.2.9 Process Control	270	
	21.2.10 Inspection and Testing	271	
	21.2.11 Inspection, Measuring, and Test Equipment	271	
	21.2.12 Inspection and Test Status	271	
	21.2.13 Control of Nonconforming Products	271	
	21.2.14 Corrective and Preventative Action	272 272	
	21.2.15 Handling, Storage, Packaging, Preservation,	414	
	and Delivery	272	
	21.2.16 Control of Quality Records		
	21.2.17 Internal Quality Audits	272	
	21.2.17 Thermal Quality Audits 21.2.18 Training	273	
	Average transmik	273	

		21.2.19 Servicing	273
		21.2.20 Statistical Techniques	273
	21.3	The Certification Process	274
	21.0	21.3.1 Deciding to Go for It	274
		21.3.2 The Concept Development Phase	275
		21.3.3 The Requirements Development Phase	275
		21.3.4 The Unit Development Phase	276
		21.3.5 The Preassessment Review	276
		21.3.6 The Preassessment Test	277
		21.3.7 The Operations Phase	277
		21.3.8 The Assessment	277
	21.4	Summary	278
Chapte	r 22 E ₁	nilogue	279
Cinapic	22.1		279
	22.2		280
	22.3		281
Acrony	ms		283
About	the Aut	hor	287
Index			289