
Contents

Preface	xv
Acknowledgments	xvii
1 The Engineering Project Lifecycle and Historical Development of Engineering Project Management Tools and Techniques	1
1.1 The 1980s	2
1.1.1 Design for Manufacturing	3
1.1.2 Reducing Variability and Optimizing the Design	7
1.1.3 Design for Quality Tools: Six Sigma and Process Capability C_p and C_{pk}	11
1.2 The 1990s	21
1.2.1 Robust Design of the High-Technology Product	22
1.2.2 Low Costs for New Products	22
1.2.3 Time to Market	22
1.2.4 Meeting Expectations and Customer Satisfaction through QFD	32
1.3 The 2000s and Beyond	37
1.4 Conclusions	39
References and Bibliography	41
Discussion Topics	42
Problems	43
2 Product and Project Perspectives and Managing Different Types of Engineering Projects	45
2.1 The Overall Product Lifecycle Model	46
2.2 The Role of Technology in Product Development and Obsolescence	52
2.3 Technology Product Types and the Project Management Models Needed to Develop Them	56
2.3.1 Types of Products That Can Be Created with New Technology Adoption	56
2.3.2 Project Management Structures Needed to Support Product Creation	59
2.4 Creating an Environment for Successful Project Management ...	65
2.4.1 Create a Total Quality Culture within New Product Development Projects	66
2.4.2 Develop Product Focus Organizations within the Company	67
2.4.3 Emphasize the Team Focus Approach to Project Management	69

2.4.4	Implement a Phase Review Process for Project Management Control	70
2.4.5	Key Processes to Enhance the Project Management Process	71
2.5	Conclusions	72
	References and Bibliography	73
	Discussion Topics	74
	Problems	74
3	Project Inception: Benchmarking, IP, and VoC	77
3.1	Benchmarking of Products and Processes	78
3.1.1	Attributes of Benchmarking Global Technology Companies	78
3.1.2	Evolution of Customer Expectations	82
3.1.3	Concerns about Benchmarking	86
3.2	Intellectual Property Concerns in New Technology Product Inception	87
3.2.1	Intellectual Property Trends in High-Technology Companies	87
3.2.2	Patent Law and Issues of Filing a Patent	88
3.2.3	Intellectual Property Infringement	88
3.2.4	Summary of Intellectual Property Issues for New Products	90
3.3	Voice of the Customer	90
3.3.1	VoC in Design to Market Products	91
3.3.2	Quality Functions Deployment	96
3.3.3	VoC Structured Methods in Design to Customer Projects	100
3.4	Conclusions	101
	References and Bibliography	102
	Discussion Topics	103
	Problem	103
4	Voice of the Customer Case Study	105
4.1	Voice of the Customer Methods and Techniques	106
4.2	Voice of the Customer as Part of the Lean Product Development Tools and Processes	108
4.3	Preparing for the Voice of the Customer	111
4.4	Initiating the VoC; Summary of the Key Steps	113
4.5	Skill Sets Required for the Host IPT Team	113
4.6	Supplies Needed for the VoC Activity	114
4.7	Steps in Understanding VoC	114
4.8	Start of Affinitization When the IPT Team Does the Groupings	126
4.9	Label the Groupings	128
4.10	Analyze the Groupings	128

4.11	Capturing Customer Intents and Additional Project Success Criteria	128
4.12	What's Next? Other Ways to Use the VoC	130
4.13	Lessons Learned from Use of the VoC	130
4.14	VoC Process Risks	131
4.15	Benefits from Using the VoC Process	131
	Discussion Topics	132
	Chapter Exercise	132
	Suggested Discussion for Chapter Exercise	134
5	Engineering Project Justification, Financial Aspects, and Return on Investment	139
5.1	The Business Plan for New Products and Its Potential Impact on the Company's Strategy	140
5.1.1	New Product Opportunities in Technology Companies	142
5.1.2	Collecting Data for the Business Plan	143
5.2	Techniques for Evaluating Projects Based on Economic Analysis	145
5.2.1	Return Factor or Benefit/Cost Ratio Calculations	146
5.2.2	Payback Period Calculations	147
5.2.3	Internal Rate of Return (aka Return on Investment)	147
5.3	Capital Equipment Planning and Acquisition Decision Based on Economic Analysis	153
5.3.1	Capacity Planning for Capital Equipment	154
5.3.2	Capacity Planning for Capital Equipment in the Electronics Industry	157
5.3.3	Issues with Manufacturing Machines ROI Calculations	161
5.4	Techniques for Increasing Management Confidence in the Economic Analysis	162
5.5	Conclusions	167
	References and Bibliography	167
	Websites	168
	Discussion Topics	168
	Problems	169
6	Make or Buy: Subcontracting and Managing the Supply Chain	173
6.1	The Lean Enterprise Concept and the Supply Chain	174
6.1.1	Development of Outsourcing	176
6.1.2	Competency versus Dependency	179
6.2	The Outsourcing Strategy to Be Considered and the Associated Pitfalls	182
6.2.1	Operational Issues When Outsourcing at Different Levels of the Product Realization Process	184
6.2.2	Types and Levels of Outsourcing	186

6.3	The Changes to the Product Realization Process and Communications with the Supply Chain	187
6.3.1	Supply Chain Development	188
6.4	The Supplier Selection Process	189
6.4.1	Criteria for the Supplier Selection Process	191
6.4.2	Presenting the Subcontracting Plan to Management ...	195
6.4.3	Issue to Address Before Signing a Contract with a Supplier	196
6.4.4	Outsourcing Quality Issues	198
6.4.5	Legal and Liability Issues in the Instruction to Bidders	199
6.4.6	Infrastructure to Manage Subcontractors	200
6.5	Summary and Case Studies of Subcontracting	201
	References and Bibliography	204
	Discussion Topics	204
	Problems	205
7	Engineering Project Planning and Execution	207
7.1	Historical Approaches to Engineering Project Planning	208
7.1.1	Initial Project Planning Steps and Project Statement ...	209
7.1.2	Development Plans for Design to Customer Projects ...	210
7.1.3	Development Plans for DTM Projects	210
7.2	Project Requirements Definitions	211
7.2.1	Task Identification Plans	212
7.2.2	Project Planning Methodology	212
7.3	Engineering Project Scheduling Tools	214
7.3.1	Project Planning Tools and Techniques	215
7.3.2	PERT Chart Methodology	215
7.3.3	Steps in Creating and Implementing a PERT Chart ...	216
7.3.4	Example of the Planning of a PERT Chart	217
7.3.5	Determining Slack (Float) Time Extension	220
7.4	Methods and Techniques for Reducing Project Duration and Cost	222
7.4.1	Resource Leveling and Allocation	222
7.4.2	PERT Example 2	222
7.4.3	Estimating Expected Project Completion Time	225
7.4.4	Gantt Charts	226
7.4.5	Plans to Be Completed by the PM Prior to Project Start	227
7.5	The Causes of Engineering Project Execution Problems and How to Mitigate Project Delays	228
7.5.1	Engineering Project Design Phase Delay Factors	228
7.5.2	Engineering Project Manufacturing Phase Delay Factors	229
7.6	Techniques for Monitoring Project Expense Progress and Estimating Project Completion Profile	230
7.6.1	Earned Value Management System	232

7.6.2	Project Cost Measurement	233
7.6.3	Project Variances Extrapolated for Estimates at Completion	233
7.6.4	Earned Value System Example	235
7.7	Successful Project Execution and Lessons Learned	237
	References and Bibliography	238
	Discussion Topics	239
	Problems	240
8	Engineering Project Phases, Control, Communications, Leadership, and Risk Assessment	243
8.1	The Phase Gate Review Process	244
8.1.1	Attributes and Metrics of Success for Each Design Phase	248
8.1.2	New Product Creation for the Global Economy	249
8.1.3	Phase Gate Design Reviews	250
8.1.4	Design Review Preparation	252
8.2	Types of Phase Gate Review Processes	253
8.2.1	Complex Product Phase Review Process	256
8.3	Implementing a Phase Gate Process	257
8.3.1	Changing Traditional Design Communications	257
8.3.2	Supplier Control and Communications Needs	261
8.3.3	Phase Review Process Communications Needs	261
8.4	Project Risk Assessment and Management	262
8.4.1	Steps in Risk Assessment and Management	264
8.4.2	Risk Identification and Qualification	264
8.4.3	Project Risk Analysis	265
8.4.4	Risk Handling Techniques	268
8.4.5	Risk Monitoring and Control	269
8.5	Managing Engineering Project Teams	269
8.5.1	Team Development Stages	271
8.5.2	Team Leadership and Interactions with Team Members	272
8.5.3	Engineering Career Stages	273
8.5.4	Team Motivation and Compensation Policies	275
8.5.5	Understanding and Nurturing Team Member Skills	277
8.6	Resolving Engineering Team Conflict and Managing a Successful Engineering Team	278
8.6.1	Understanding the Sources of Conflict and How to Mitigate Them	279
8.6.2	Conflict Resolution Strategies	280
8.6.3	Conflict Resolution Methodology and Settlement	281
8.6.4	Managing a Successful Team	282
8.7	Conclusions	284
	References and Bibliography	285
	Discussion Topics	286
	Problems	287

9	Project Monitoring and Control Case Study	289
9.1	Key Project Monitoring and Control Processes	290
9.2	The Daily Stand-Up Board and Area	291
9.2.1	Area Design Essentials	291
9.2.2	Metrics and Status Elements	293
9.2.3	Setup and Operation	294
9.2.4	Lessons Learned	294
9.3	Other Uses for Stand-Up: Supply Chain, Operations, Red Flag, and Risk Register Reviews	294
9.3.1	Red Flag Reviews	296
9.3.2	Basic Elements of the Red Flag Review	298
9.4	Lessons Learned and Chapter Conclusions	301
	Stand-Up Board Exercise	301
10	Engineering Project Communications	305
10.1	The Role of the Project Manager	306
10.2	A Communication Model	307
10.2.1	Noise	308
10.2.2	Impedance	309
10.2.3	Choosing the Right Medium	309
10.2.4	Using the Communication Model in Planning and Execution	316
10.3	Distance and Communication	317
10.4	Collaboration and Concurrent Engineering	318
10.4.1	Concurrent Engineering	320
10.4.2	Collaboration across the Value Chain	322
10.5	Collocated Teams	324
10.5.1	The Collocation Environment	325
10.5.2	Partial Collocation	327
10.6	Dispersed Teams	328
10.6.1	Dislocation	328
10.6.2	Time Differences	330
10.6.3	Language and Cultural Differences	330
10.6.4	Remote Meetings	332
10.6.5	Using Time Differences to Your Advantage	333
10.7	Technology and Communication	334
10.7.1	Project Websites	336
10.7.2	Security and Communication	336
10.7.3	Exchanging Engineering Product Data	337
10.8	Architecture as a Collaboration Tool	339
10.8.1	Developing the Architecture	340
10.8.2	Change Management and Architecture	341
10.8.3	Organizing around Architecture	342
10.8.4	Integration Risk	343
10.9	The Project Communication Plan	344
10.9.1	Stakeholder Registry and Team Directory	344

10.9.2	Communication Protocols	345
10.9.3	Activities and Resources	346
10.9.4	Stakeholders	347
	References and Bibliography	348
	Discussion Topics	349
11	Engineering Project and Product Costing	351
11.1	Project and Product Cost Relationship with Lifecycle Stages	351
11.1.1	The Start-Up Stage	352
11.1.2	The Growth Stage	353
11.1.3	The Maturity Stage	353
11.1.4	The Final Stage	354
11.2	New Product Cost Estimating Methodologies	355
11.2.1	Activity-Based Costing	357
11.2.2	ABC for Electronic Products	360
11.2.3	ABC Summary and Variance from Classical Cost Accounting	366
11.3	New Product Cost Estimating Process	366
11.3.1	Determination of Costs and Tracking Tools for New Product Development	368
11.4	Conclusions	369
	References and Bibliography	370
	Discussion Topics	370
	Problem	371
12	Building and Managing Teams	373
12.1	Teams versus Groups: What's the Difference?	374
12.1.1	When Are Teams Needed?	374
12.1.2	Differences: The Team Advantage	375
12.1.3	Selecting and Launching Teams: A Recipe for Success	376
12.1.4	Team Dynamics: The Four Phases	381
12.1.5	Roles and Responsibilities	383
12.2	Managing Events and Activities	385
12.2.1	Managing Meetings	385
12.3	Leading People and Managing Performance	393
12.3.1	Leadership Responsibilities	394
12.3.2	Motivating Team Members	396
12.3.3	Team Communications	397
12.3.4	Managing Conflict	398
12.4	Our Project Team Leadership Summary	405
	References and Bibliography	405
	Discussion Topics	406
A	ROI Tables	409
	Index	417