

Contents

Preface	xi
CHAPTER 1 Design projects.....	1
1.1 Introduction.....	1
1.2 Projects and design.....	4
1.3 Needs identification and customer specifications.....	8
1.4 Concept generation and technical specifications.....	15
1.5 Detailed design	18
1.6 Building and testing.....	19
1.7 Project closure	20
1.8 Project planning and management	21
1.9 Project problems and disasters	23
1.10 Businesses.....	25
1.11 Decision-making	28
Further reading.....	32
CHAPTER 2 Planning and managing projects.....	33
2.1 Introduction.....	33
2.2 Chunking the project.....	34
2.3 Task identification	37
2.4 Work breakdown structure.....	40
2.5 Resources and people.....	42
2.6 Microsoft Project tutorial: setup and work breakdown structure.....	45
2.7 Schedule synthesis and analysis	50
2.8 Program evaluation and review technique	54
2.9 Plan review and documentation.....	56
2.10 Project tracking and control.....	59
2.11 Assessment.....	63
Further reading.....	66
CHAPTER 3 Customer requirements and specifications.....	67
3.1 Introduction.....	67
3.2 Needs.....	75
3.3 Research.....	78
3.4 Benchmarking and surveys.....	79
3.5 Market-driven design	80
3.6 Patents.....	84
3.7 Customer specifications.....	89

3.8 Quality functional deployment.....	94
Further reading.....	107
CHAPTER 4 Concepts and technical specifications.....	109
4.1 Introduction.....	109
4.2 Concepts.....	110
4.3 Specifications to concepts.....	113
4.4 Representing concepts.....	115
4.5 Identifying concepts.....	118
4.6 Concept generation.....	119
4.7 Prototyping.....	121
4.8 Brainstorming.....	123
4.9 Morphological matrix methods.....	124
4.10 Free thinking.....	125
4.11 Deconstruction.....	126
4.12 TRIZ.....	128
4.13 Back-of-the-envelope calculations and functional prototypes.....	128
4.14 Factor of safety.....	132
4.15 Concept selection.....	135
4.16 Decision matrices.....	139
4.17 Embodiment design alternatives for a technical specification.....	141
4.18 Intellectual property.....	142
References.....	147
Further reading.....	147
CHAPTER 5 People and teams.....	149
5.1 Introduction.....	149
5.2 Individuals.....	149
5.2.1 Personal growth.....	151
5.2.2 Learning.....	153
5.2.3 Attention and focus.....	155
5.3. Organizations.....	158
5.3.1 Motivation.....	158
5.3.2 Politics.....	160
5.3.3 Loyalty and trust.....	162
5.3.4 Responsibility and authority.....	164
5.4 Managing individuals in organizations.....	167
5.4.1 Leadership habits.....	168
5.4.2 Delegation.....	172
5.4.3 Making inclusive decisions.....	173
5.4.4 Wellness and productivity.....	174

5.4.5 Conflicts and intervention	176
5.4.6 Hiring and promotion	177
5.5 Teams	178
5.5.1 Skills matrix	180
5.5.2 Profiling	181
5.5.3 Personality matching	184
5.5.4 Managing teams	186
5.6 Ethics	188
5.7 Professionalism	192
5.7.1 Time management	192
5.7.2 Being organized	197
5.7.3 Diversity	200
5.7.4 Entrepreneurship	202
5.7.5 A professional image	206
References	209
Further reading	209

CHAPTER 6 Decision-making	211
6.1 Introduction	211
6.2 Critical thinking	212
6.3 Critical analysis	213
6.4 Selecting between alternatives	217
6.5 Triage	219
6.6 Project decisions	221
6.7 Solving formal problems	221
6.8 Risk	226
6.9 Market	230
6.10 Technical	232
6.11 Procurement and purchasing	235
6.12 Cost and schedule	238
6.13 Staffing and management	239
6.14 Organization	241
6.15 External	242
6.16 Risk analysis	243
6.17 Design alternatives	244
6.18 Risk reduction with design alternatives	247
6.19 Business strategy	248
6.20 Assessment and planning	251
Further reading	254

CHAPTER 7 Finance, budgets, purchasing, and bidding	255
7.1 Introduction.....	255
7.2 Corporate finance	255
7.2.1 Accounting.....	256
7.3 Value.....	257
7.4 Design and product costs	261
7.5 Project costs	265
7.5.1 Budgets and bills of material.....	266
7.5.2 Tracking budgets.....	269
7.6 Return on investment	271
7.7 Financial project justification.....	273
7.8 Product life-cycle cost.....	277
7.9 Business decisions	278
7.10 Purchasing.....	279
7.11 The supply chain for components and materials.....	282
7.12 Bidding.....	286
Further reading.....	292
CHAPTER 8 Reliability and system design	293
8.1 Introduction.....	293
8.2 Human and equipment safety.....	293
8.3 System reliability	298
8.4 Component failure.....	300
8.5 System reliability	306
8.6 Passive and active redundancy	308
8.7 Modeling system failures.....	311
8.7.1 Failure modes and effects analysis.....	312
8.8 Complex fault modeling and control.....	316
8.9 Designing reliable systems.....	318
8.10 Verification and simulation.....	322
Reference.....	329
Further reading.....	329
CHAPTER 9 Communication, meetings, and presentations.....	331
9.1 Introduction.....	331
9.2 Speakers/writers and listeners/readers.....	333
9.3 What are you saying?.....	335
9.4 Critical listening and reading as the audience	338
9.5 Interpersonal communication skills.....	342
9.5.1 Verbal communication.....	342
9.6 Casual written communication.....	343

9.7	Selling.....	344
9.8	Praise and criticism.....	345
9.9	Saying yes, maybe, or no.....	348
9.10	Answering questions.....	349
9.11	Meetings.....	351
9.12	Purpose and procedures.....	352
9.13	Customer and supplier meetings.....	355
9.14	Presentations.....	358
9.15	Presentation motivation.....	359
9.16	Content.....	361
9.17	Presentation appearance and effectiveness.....	363
9.18	Presentation style.....	365
9.19	Harmful and deadly presentations.....	367
	Further reading.....	369
CHAPTER 10	General design topics.....	371
10.1	Introduction.....	371
10.2	Human factors.....	371
10.2.2	Ergonomics.....	374
10.2.3	Law.....	377
10.2.4	Sustainability and environmental factors.....	381
10.2.5	Engineering for our environment.....	384
10.2.6	Design for X.....	390
10.3	Quality.....	392
10.4	Identification of problem causes and control variables.....	397
10.4.1	Cause and effect diagrams.....	398
10.4.2	Pareto analysis.....	399
10.4.3	Experimentation.....	402
10.4.4	Design of experiments.....	404
10.5	Statistical process control.....	408
10.5.1	Control chart calculations.....	411
10.5.2	Parts inspection.....	418
10.5.3	Six-sigma process capability.....	420
10.6	Parametric design and optimization.....	422
	Further reading.....	427
APPENDIX A	Checklists.....	429
APPENDIX B	Technical writing.....	449
APPENDIX C	Accreditation requirements mapping.....	471
	Index.....	483