
Contents

	List of figures	xiii
	Preface to sixth edition	xvii
	Acknowledgments	xix
Part 1	Nature and organization of project management	1
Chapter 1	The nature and purpose of project management	3
	<i>Projects</i>	4
	<i>Project objectives</i>	5
	<i>The time/cost relationship</i>	7
	<i>The performance/cost/time triangle</i>	8
	<i>INTERNET and the Association of Project Managers</i>	10
Chapter 2	Project management organization	11
	<i>Effective organization and communications</i>	11
	<i>The emergence of project management in a developing company</i>	12
	<i>Seniority of the project manager in manufacturing projects</i>	20
	<i>Project management organization in general</i>	20
	<i>Organizations with more than one project manager</i>	27
	<i>The project manager</i>	31
	<i>Support, cooperation and training for the project manager</i>	33
	<i>Project services groups</i>	34
	<i>PRINCE and project organization</i>	35
Part 2	The financial and commercial framework	37
Chapter 3	Defining the project	39
	<i>Receipt of customer enquiries</i>	39
	<i>Screening enquiries for industrial projects</i>	41
	<i>Projects which are difficult or impossible to define</i>	41
	<i>Defining a project for financial appraisal</i>	44
	<i>The customer's project specification</i>	46

	<i>Project scope</i>	46
	<i>Use of checklists</i>	47
	<i>The contractor's project and design specifications</i>	50
	<i>Specifications for product development projects</i>	52
	<i>Developing and documenting the project specification</i>	57
	<i>References and further reading</i>	58
Chapter 4	Cost estimates – Part 1: Definitions and principles	59
	<i>Essential cost definitions and principles</i>	59
	<i>Estimating accuracy</i>	65
	<i>Classification of estimates according to confidence</i>	66
	<i>Estimating accuracy in relation to prices and profits</i>	67
	<i>Version control of project cost estimates</i>	68
	<i>Work breakdown</i>	68
	<i>Cost coding systems</i>	70
	<i>Benefits of a logical coding system</i>	74
	<i>Choosing a coding system</i>	77
	<i>What happens when the customer says 'Use my coding system!'</i>	78
Chapter 5	Cost estimates – Part 2: Estimating in practice	80
	<i>Compiling the task list</i>	80
	<i>Level of detail in project cost estimating</i>	81
	<i>Estimating forms</i>	82
	<i>Estimating manufacturing costs</i>	89
	<i>Collecting estimates for labour times</i>	92
	<i>Personal estimating characteristics</i>	94
	<i>Estimates for material and equipment costs</i>	96
	<i>Below-the-line costs</i>	97
	<i>Reviewing the cost estimates</i>	99
	<i>Further reading</i>	100
Chapter 6	Commercial management	101
	<i>Financial project appraisal</i>	101
	<i>Project funding</i>	106
	<i>Contracts</i>	108
	<i>Contracts with standard conditions</i>	110
	<i>Contract payment structures</i>	111
	<i>Insurance</i>	118
	<i>Further reading</i>	123
Part 3	Planning and scheduling	125
Chapter 7	An introduction to planning and scheduling	127
	<i>Distinction between planning and scheduling</i>	127
	<i>The planning time frame</i>	128
	<i>Simple tabular planning (timetables)</i>	129

	<i>Bar charts</i>	132
	<i>Line of balance charts</i>	138
Chapter 8	Network analysis: logic diagrams and the critical path	141
	<i>Background</i>	141
	<i>The different network notation systems</i>	142
	<i>Critical path analysis using arrow diagrams</i>	143
	<i>Critical path analysis using precedence notation</i>	148
	<i>Case study: gantry project</i>	152
	<i>Optimized crash action using critical path analysis</i>	158
	<i>PERT</i>	159
	<i>More complex notation</i>	160
	<i>Complex constraints using precedence notation</i>	164
	<i>Further reading</i>	164
Chapter 9	Network analysis in practice	166
	<i>Drawing a project network</i>	166
	<i>Level of detail in network planning</i>	170
	<i>Interface events and activities</i>	172
	<i>Milestones</i>	174
	<i>Estimating activity durations</i>	174
	<i>Is the time-scale shown too long?</i>	175
	<i>A case for drawing networks from right to left</i>	176
	<i>Early consideration of resource constraints</i>	177
	<i>Network analysis as a basic management tool</i>	178
Chapter 10	Scheduling resources – Part 1: Principles	180
	<i>Resources that can be scheduled</i>	181
	<i>The role of network analysis in resource scheduling</i>	181
	<i>Case study: garage project</i>	182
	<i>Float</i>	192
	<i>Two fundamental priority rules for resource scheduling</i>	196
	<i>Summary: the essential elements of a practicable schedule</i>	198
Chapter 11	Scheduling resources – Part 2: In practice	200
	<i>Choice of labour resources to be scheduled</i>	200
	<i>Choice of resource units</i>	202
	<i>Rate-constant and non rate-constant usage of resources</i>	203
	<i>Specifying departmental resource availability levels</i>	204
	<i>Calendars</i>	205
	<i>Scheduling labour costs</i>	206
	<i>Scheduling costs for materials and other purchases</i>	207
	<i>Scheduling cash flow</i>	209
	<i>The seven steps of project scheduling</i>	214
	<i>Project scheduling in the corporate context</i>	215

Part 4	Computer applications	217
Chapter 12	Project management computer systems – Part 1: Preparation	219
	<i>Scheduling with or without a computer</i>	219
	<i>Facilities required</i>	221
	<i>System requirements</i>	223
	<i>Choosing a suitable computer program</i>	225
	<i>Special network logic requirements for computer applications</i>	230
	<i>Preparing for the first computer schedule</i>	231
Chapter 13	Project management computer systems – Part 2: Typical application	241
	<i>Case study project</i>	241
	<i>Case study data preparation</i>	243
	<i>Error prevention and checking – in general</i>	245
	<i>Error detection for the case study project</i>	247
	<i>Network plot</i>	250
	<i>Time analysis of the garage project network</i>	250
	<i>Resource scheduling – the general process</i>	254
	<i>Resource scheduling for the garage project</i>	256
	<i>Output reports</i>	259
	<i>Updating</i>	269
Chapter 14	Project management computer systems – Part 3: Specialized applications	273
	<i>Multiproject resource scheduling</i>	273
	<i>The concept of standard library networks</i>	280
	<i>Standard networks in practice</i>	280
	<i>Standard subnetwork modules or templates</i>	282
	<i>A templating case study</i>	285
	<i>Skeletons and hammocks</i>	294
	<i>A program for probability and risk analysis</i>	295
	<i>Integrated databases</i>	297
	<i>The database approach in practice</i>	300
	<i>Software sources</i>	302
	<i>References and further reading</i>	303
Part 5	Purchasing and materials management	305
Chapter 15	Scheduling parts for manufacturing projects	307
	<i>The scheduling framework</i>	307
	<i>Case study: single filing cabinet project</i>	308
	<i>Collating materials requirements</i>	311
	<i>Line of balance</i>	316
	<i>Line of balance case study: filing cabinet project</i>	316
	<i>Computer solutions</i>	324
	<i>Further reading</i>	324

Chapter 16	Purchasing – Part 1: Principles and ordering	326
	<i>The importance of purchasing and materials control</i>	326
	<i>The purchasing cycle</i>	327
	<i>The purchase order</i>	330
	<i>Commercial conditions of purchase</i>	332
	<i>Terms of trade used in international business (INCOTERMS)</i>	333
	<i>Specifying the goods</i>	334
	<i>Timing of orders and deliveries</i>	335
	<i>Purchase quantities</i>	337
Chapter 17	Purchasing – Part 2: Post order activities and wider aspects of materials control	340
	<i>Purchase order amendments</i>	340
	<i>Expediting</i>	341
	<i>Shortages</i>	342
	<i>The Pareto principle and stock management</i>	343
	<i>Project or stock purchasing?</i>	345
	<i>Project purchasing as a condition of contract</i>	349
	<i>Stores administration</i>	350
	<i>Materials management as a shared or common service</i>	353
Chapter 18	Purchasing – Part 3: Procedures for capital projects	355
	<i>The purchasing organization</i>	355
	<i>Purchase control schedules</i>	357
	<i>Purchase specifications</i>	363
	<i>Purchase enquiries</i>	368
	<i>Bid evaluation</i>	372
	<i>Purchase requisitions and orders</i>	373
	<i>Correlation between specification, enquiry and order numbers</i>	375
	<i>Assuring quality and progress</i>	376
	<i>Vendors' documents</i>	378
	<i>Shipping, port and customs formalities</i>	379
	<i>Purchase order status reports</i>	380
	<i>Further reading</i>	381
Part 6	Managing work and costs	383
Chapter 19	Implementing the programme	385
	<i>Project authorization</i>	385
	<i>Authorizing work without a contract or order</i>	390
	<i>Preliminary organization of the project</i>	392
	<i>Correspondence and document transmission methods</i>	393
	<i>Project engineering standards and procedures</i>	397
	<i>Physical preparations and organization</i>	397
	<i>Getting work started</i>	399
	<i>Detailed planning and work instructions</i>	402

	<i>Issuing work schedules: targeting action instructions</i>	402
	<i>Drawing and purchase control schedules</i>	404
Chapter 20	<i>Managing progress</i>	405
	<i>Project progressing as a closed loop control system</i>	405
	<i>Routine collection of progress data</i>	406
	<i>The non-routine approach to progressing</i>	409
	<i>Managing subcontractors and agency employees</i>	410
	<i>Routine priority allocation in manufacturing projects</i>	414
	<i>When the news is bad</i>	415
	<i>Corrective measures</i>	416
	<i>Immediate action orders</i>	418
	<i>Construction site organization and management</i>	423
	<i>Conduct of project meetings</i>	425
	<i>Progress meetings</i>	429
	<i>Progress meetings abandoned</i>	429
	<i>Project progress reports</i>	430
	<i>References and further reading</i>	432
Chapter 21	<i>Managing changes and production permits</i>	433
	<i>Classification of changes</i>	433
	<i>Authorization arrangements</i>	434
	<i>Administration</i>	436
	<i>Estimating the true cost of a design modification</i>	439
	<i>Recording the actual cost of a modification</i>	441
	<i>Forms and procedures</i>	442
	<i>Document modification discipline</i>	451
	<i>The interchangeability rule</i>	454
	<i>Emergency modifications</i>	454
Chapter 22	<i>Cost management – Part 1: Principles</i>	459
	<i>Objectives of project cost management</i>	459
	<i>Checklist of cost management factors</i>	460
	<i>The total cost approach</i>	461
	<i>Budgets</i>	463
	<i>Cost collection methods</i>	466
	<i>Audits</i>	470
	<i>Comparing actual costs against planned costs</i>	470
Chapter 23	<i>Cost management – Part 2: Evaluation, prediction and reporting</i>	471
	<i>Milestone monitoring</i>	471
	<i>The concept of achievement analysis</i>	477
	<i>Achievement analysis methods in design engineering</i>	479
	<i>Measuring manufacturing achievement</i>	485
	<i>Achievement analysis for construction</i>	486
	<i>Subcontract achievement</i>	486
	<i>Regular achievement analysis</i>	487

	<i>Materials and bought-out equipment</i>	488
	<i>Effect of modifications on achievement</i>	490
	<i>The project ledger concept</i>	491
	<i>Predicting profitability for the whole project</i>	492
	<i>Post-mortem</i>	497
	<i>Further reading</i>	497
Chapter 24	<i>Final project definition and closure</i>	498
	<i>Formal project closure</i>	498
	<i>Final project cost records</i>	501
	<i>Disposal of surplus material stocks</i>	501
	<i>Final project definition: the end of a continuous process</i>	501
	<i>Documenting engineering design</i>	503
	<i>Documenting purchased equipment</i>	503
	<i>As-built condition of a simple engineering project</i>	504
	<i>As-built condition of a multiple manufacturing project</i>	504
	<i>Recording the as-built condition of capital projects</i>	507
	<i>Correspondence and internal memoranda</i>	507
	<i>Case history or project diary</i>	508
	<i>Managing files and archives</i>	508
	Index	511

Figures

1.1	Triangle of project objectives	9
2.1	Example of a manufacturing company organization chart	15
2.2	A manufacturing project cycle	16
2.3	Organization for a single project in a manufacturing company	17
2.4	Organization for handling several simultaneous projects in a manufacturing company	19
2.5	Project team organization	22
2.6	Matrix organization	23
2.7	Project team versus matrix organization	26
2.8	A hybrid organization	28
2.9	Project with more than one project manager	30
2.10	Organization structure for PRINCE	35
3.1	The process of project definition	40
3.2	Screening and action plan form for new project proposals	42
3.3	Part of a project definition checklist	48
4.1	Cost and price structure for a simple manufacturing project	60
4.2	Part of a work breakdown for a major mining project	69
4.3	Work breakdown and cost coding structure for a manufacturing project	72
4.4	Coding system example for a manufacturing project	73
4.5	Numbering system used by a heavy engineering company	75
4.6	Numbering system used by a mining engineering company	76
5.1	A general purpose cost estimating form	84
5.2	Form for equipment and material cost estimates	86
5.3	Form for listing cost estimates for capital items	87
5.4	General purpose estimating and pricing form	88
6.1	Simple payback tabulation for new boiler project	103
6.2	Table of discount factors	105
6.3	Net present value of new boiler project	106
6.4	Relationship between the type of contract and control emphasis	115
6.5	Risk and insurance in project management	119
7.1	Bar chart for the design and manufacture of a prototype electromechanical assembly	131
7.2	An adjustable, wall mountable bar chart with 'rotating' panels	134

7.3	Bar chart for desk and chair project	135
7.4	Linked bar chart for desk and chair project	136
7.5	Five house project: conventional bar chart	137
7.6	Five house project: line of balance chart	138
7.7	80 house project: line of balance chart	139
8.1	The main elements of arrow network logic	144
8.2	Tree project network (arrow notation)	145
8.3	An example of arrow network time analysis	146
8.4	A precedence activity	149
8.5	Tree project network (precedence version)	150
8.6	The critical path (precedence version)	151
8.7	Gantry project	153
8.8	Gantry project network (arrow notation)	154
8.9	Gantry project network (precedence version)	155
8.10	Ladder activities in arrow notation	161
8.11	Precedence notation: complex constraints	162
8.12	One disadvantage of precedence logic	163
9.1	An arrow logic error trap	168
9.2	Precedence version of Figure 9.1(c)	169
9.3	Level of network detail in a project purchasing sequence	173
9.4	Interfaces	174
10.1	Garage construction network	183
10.2	Arrow version of the garage construction network	184
10.3	Network data and time analysis results for the garage project	185
10.4	Garage project resource schedule before levelling	186
10.5	Garage project resource histogram before levelling	188
10.6	Garage project schedule levelled within available resources	189
10.7	Garage project histogram levelled within available resources	189
10.8	Garage project resource schedule levelled to achieve earliest possible finish	190
10.9	Garage project resource histogram levelled for earliest possible finish	191
10.10	Garage project: float analysis of floor screed activity	191
10.11	Garage project: float analysis of activity G1016 (10 to 16)	193
10.12	Time-limited versus resource-limited constraints	196
11.1	Cash flow schedule	210
11.2	Table of rules for timing cash flow for a client's project	212
11.3	Conflicting factors in project resource scheduling preparation	213
11.4	Seven logical steps towards a project resource schedule	214
12.1	Checklist for use when buying project management software	226
12.2	Parallel activities in arrow diagrams	230
12.3	Tidying network starts and finishes	232
13.1	Garage construction network	242
13.2	Garage project material cost estimates	244
13.3	Garage project input data error warnings	248
13.4	Garage project network plotted by Open Plan	249
13.5	Garage project network plotted by 4C for Windows	251
13.6	Time analysis report of the garage project	252
13.7	Resource-limited scheduling log from Open Plan	257

13.8	Resource-limited work-to list for the garage project	258
13.9	Time-limited scheduling log from Open Plan	260
13.10	Time-limited work-to list for the garage project	261
13.11	Garage project: a useful resource and cost summary	264
13.12	Garage project histogram of materials costs	265
13.13	Garage project weekly activity cost tabulation	266
13.14	Garage project resource-limited bar chart plotted by Microsoft Project	268
13.15	Time-limited work-to list for the in-progress garage project	271
14.1	A standard library subnetwork module for the design of one machine in a transfer line	283
14.2	A standard library subnetwork module for procurement and machining	284
14.3	Example of a standard library subnetwork for a construction project	286
14.4	A templating application	287
14.5	Start template and template B for templating case study	288
14.6	Template D and project finish template for templating case study	289
14.7	Template library list	291
14.8	Network plot for the template case study project	292
14.9	Network plot detail for the template case study project	292
14.10	Template case study project bar chart	293
14.11	Risk analysis histogram produced by OPERA	296
14.12	Elements of a database	299
14.13	A typical project information database structure	301
15.1	Filing cabinet: exploded view	309
15.2	Filing cabinet: simple parts list	310
15.3	Filing cabinet: family tree	312
15.4	Parts list for filing cabinet arranged in family tree order of subassemblies	313
15.5	Single batch stock collation card	314
15.6	Multi-project stock collation card	315
15.7	Filing cabinet delivery schedule	317
15.8	Filing cabinet: family tree redrawn for line of balance	317
15.9	Filing cabinet: calculation of lead times for parts	318
15.10	Filing cabinet: delivery commitment graph	320
15.11	Filing cabinet: calculation of balance quantities at day 4	321
15.12	Filing cabinet: the line of balance at day 4	322
15.13	Filing cabinet: completed line of balance chart for day 4	323
16.1	The purchasing cycle	327
16.2	Purchase order form	331
17.1	Shortage list form	344
17.2	Monitoring cumulative materials costs	347
18.1	Elements of a purchasing organization for a capital project	356
18.2	Typical stages in the purchase of equipment for a capital project	358
18.3	A purchase control schedule format	361
18.4	A purchase control schedule set	363
18.5	Purchase specification – front sheet	365
18.6	Purchase specification – second sheet	366
18.7	Purchase specification – continuation sheet	367
18.8	Purchase enquiry request form	369

18.9	Bid summary form	371
18.10	Purchase requisition	374
18.11	Inspection and expediting report	377
19.1	Project register sheet	386
19.2	Works order form	388
19.3	Project authorization form	389
19.4	Typical relationship between project costs and time	391
19.5	Document distribution matrix	395
19.6	Standard network for starting up a manufacturing project	401
20.1	A combined work-to list and progress questionnaire	407
20.2	A subcontract suborder	413
20.3	Immediate action order	419
20.4	Typical construction site organization	424
20.5	A combined meeting agenda and action sheet	428
21.1	A general purpose change register sheet	438
21.2	A project variation	444
21.3	Engineering change request form	446
21.4	One type of concession form	448
21.5	Engineering query note	450
21.6	Inspection report form	452
22.1	A weekly time-sheet	467
23.1	A simple comparison of costs against budget	472
23.2	Comparing project cost and achievement using milestones	476
23.3	Departmental achievement analysis sheet	483
23.4	Graph of departmental achievement and cost predictions	487
23.5	A cost/profit prediction graph for a project	493
23.6	Project cost report in tabular form	495
24.1	Project closure notice, with checklist	499
24.2	Drawing schedule	502
24.3	A build schedule sheet	506