

Project Management

Ninth Edition

DENNIS LOCK

GOWER

Contents

<i>List of Figures</i>	<i>xiii</i>	
<i>Acknowledgments</i>	<i>xix</i>	
<i>Preface to Ninth Edition</i>	<i>xxi</i>	
Chapter 1	Introduction to Project Management	1
	Brief history of project management	1
	Different types of projects	5
	Project life cycles and life histories	7
	Customers, clients, contractors and end users	12
	Associations representing the profession of project management	13
	References and further reading	15
Chapter 2	Factors for Project Success or Failure	17
	Success or failure factors in relation to the initial project definition	17
	Factors for success or failure during the project fulfilment (execution) period	19
	Triangle of objectives and trade-offs between cost, performance and time	21
	Perceptions of project success or failure beyond the three primary objectives	24
	Identifying and ranking the stakeholders	25
	Benefits realization	26
	References and further reading	27
Chapter 3	Defining the Project Task	29
	Importance of initial project definition	29
	Projects which are difficult or impossible to define	29
	Feasibility studies to improve early project definition	32
	Checklists	32
	Enquiries and proposals for new projects	34
	Defining the project scope	37
	Contractor's strategy and design specification	39
	Specifications for internally funded projects	41
	Developing and documenting the project specification	46

Chapter 4	Estimating the Project Costs	49
	Introduction to cost estimating	49
	Classification of costs as direct or indirect	51
	Estimating accuracy	51
	Classification of estimates according to confidence	52
	Estimating accuracy in relation to prices and profits	53
	Version control of project cost estimates	54
	Top-down or bottom-up?	55
	Compiling the task list	55
	Level of detail in project cost estimating	57
	Estimating formats	57
	Estimating manufacturing costs	61
	Estimating project labour costs	63
	Personal estimating characteristics	66
	Estimates for material and equipment costs	67
	Reviewing the cost estimates	68
	References and further reading	69
Chapter 5	First Steps in Planning the Timescale	71
	General introduction to project planning	71
	What makes an ideal project plan?	75
	Museum project: a case example	75
	Distinction between planning and scheduling	81
	References and further reading	81
Chapter 6	Financial Appraisal and the Business Plan	83
	Project feasibility analysis	83
	Different viewing platforms for the project investor and the project contractor	84
	Introduction to project financial appraisal methods	86
	Simple payback method	87
	Discounted cash flow	89
	How much confidence can we place in the data?	92
	Project funding	95
	References and further reading	97
Chapter 7	Risk	99
	Introduction to project risk management	99
	Identifying the possible risks	100
	Risk appraisal and analysis	100
	Risk register	104

	Methods for dealing with risks	105
	Insurance	107
	Planning for a crisis	112
	References and further reading	113
Chapter 8	Project Authorization	115
	Introduction to project authorization	115
	Project authorization criteria for the project owner	116
	Authorization documents issued by the project owner	118
	Project registration and numbering	120
	Project authorization in a contracting organization	121
	Authorizing work without a contract or customer's order	123
	References and further reading	125
Chapter 9	Project Organization Structures	127
	Effective organization and communications	127
	Organization charts	127
	Emergence of project management in a developing company	129
	Project matrix organizations	133
	Project teams and task forces	137
	Organization of central administration functions	139
	Which type of project organization is best?	140
	Organizations with more than one project manager	144
	References and further reading	148
Chapter 10	Organization of Management Change and IT Projects	149
	Special characteristics of management change projects	149
	Case example: the Coverite plc office relocation project	150
	PRINCE2™	154
	References and further reading	154
Chapter 11	Key People in the Organization	155
	Project manager	155
	Director of projects or programme manager	159
	Project engineer	159
	Project support office	161
	References and further reading	162
Chapter 12	Work Breakdown and Coding	165
	WBS concept	165
	Coding systems	170
	Benefits of a logical coding system	173

	Choosing a coding system	175
	What happens when the customer says ‘You shall use my coding system!?’	176
	References and further reading	177
Chapter 13	Completing the Breakdown Structures	179
	Developing a project organization breakdown structure	180
	Relationship between the project WBS and OBS	183
	Introducing the cost breakdown structure	185
	References and further reading	186
Chapter 14	Detailed Planning: An Introduction to Critical Path Networks	187
	Gantt charts: their advantages and limitations	187
	Background to critical path analysis	188
	Different network notation systems	188
	Critical path analysis using arrow diagrams	190
	Critical path analysis using precedence notation	196
	Case example: furniture project	199
	More complex network notation	203
	References and further reading	207
Chapter 15	Detailed Planning: Critical Path Networks in Practice	209
	Developing the network logic	209
	Level of detail in network planning	212
	Interface events and activities	215
	Milestones	215
	Estimating task durations	216
	Is the predicted timescale too long?	218
	Case example: the museum project	218
	A case for drawing networks from right to left	226
	Network analysis as a management tool	227
	References and further reading	228
Chapter 16	Principles of Resource Scheduling	229
	What are resources and which of them can be scheduled?	229
	Role of network analysis in resource scheduling	231
	Resource scheduling case example: the garage project	231
	Float (or slack)	240
	Two fundamental priority rules for resource scheduling	245
	Summary: the elements of a practicable schedule	247
	References and further reading	248

Chapter 17	Scheduling People (and Other Reusable Resources)	249
	Choosing which resources to schedule	249
	Choice of resource units	251
	Rate-constant and non rate-constant usage of resources	252
	Specifying resource availability levels	253
	Using different calendars for resource scheduling	254
	Seven logical steps of project resource scheduling	256
	References and further reading	257
Chapter 18	Scheduling Materials	259
	Manufactured parts and materials scheduling compared with general project scheduling	259
	Identifying and quantifying common parts for manufacturing projects	260
	Case example: a filing cabinet project	261
	Line of balance	264
	Computer solutions for scheduling manufacturing materials	272
	Using purchase control schedules to schedule equipment for capital projects	272
	References and further reading	274
Chapter 19	Scheduling Cash Flows	275
	Cash flow scheduling in general	275
	Scheduling cash flows in different kinds of projects	276
	Using project management software to schedule cash outflows	281
	Using the computer to schedule cash inflows	283
	Conclusion	283
Chapter 20	Computer Applications	285
	Choosing suitable software	285
	Special network logic required for computer applications	291
	Preparing for the first computer schedule	292
	Case example: the garage project	299
	Data entry errors	303
	Network plotting	306
	Time analysis of the garage project network	306
	Resource scheduling for the garage project	308
	Standard and customized output reports	313
	Updating the schedules and reports	316
Chapter 21	Managing Project Start-up	317
	Preliminary organization of the project	317
	Correspondence and other documents	318

Engineering standards and procedures	322
Physical preparations and organization	323
Getting work started	325
Issuing detailed planning and work instructions	327
Chapter 22 Aspects of Commercial Management	331
Contracts	331
Purchase orders	334
Terms of trade used in international business (Incoterms 2000)	337
Pricing a contact proposal	338
Contract payment structures	340
Timing of payments	343
Financial viability of participating organizations	344
References and further reading	344
Chapter 23 Managing Procurement	345
Purchasing cycle	345
Roles in the purchasing organization for a large international project	346
Purchase specification: defining what has to be bought	349
Supplier selection	357
Purchase requisition and order	361
Expediting	364
Special timing of orders and deliveries	364
Purchase quantities	366
Purchase order amendments	367
Correlation between specification, enquiry, requisition and order numbers	367
Project or stock purchasing?	368
Marking and labelling goods before transit	369
Goods receipt	369
Stores administration	370
Vendors' documents	372
Materials management as a shared or common service	373
References and further reading	374
Chapter 24 Managing Progress	375
Progress management as a closed-loop control system	376
'Management by' styles	376
Updating schedules and records	379
Collecting progress information	380
Statistical checks	383
Managing the progress and quality of bought-in materials and equipment	383

Managing subcontractors and agency employees	387
Routine priority allocation in manufacturing projects	389
When the news is bad	390
Corrective measures	391
Immediate action orders	392
Construction site organization and management	395
Project meetings	396
Progress reports	401
References and further reading	402
Chapter 25 Managing Changes	403
Impact of changes in relation to the project life cycle	403
Origin and classification of changes	403
Authorization arrangements	406
General administration	408
Estimating the true cost of a change	411
Forms and procedures	414
Version control for modified drawings and specifications	422
Emergency modifications	424
Chapter 26 Managing Project Costs	429
Principles of cost control	429
Controlling variable costs	430
Controlling fixed costs and overhead cost recovery	431
Additional cost control factors	433
Total cost approach	434
Checklist of cost management factors	436
Setting and resetting cost budgets	437
Cost collection methods	438
Audits and fraud prevention measures	442
Comparing actual costs against planned costs	443
References and further reading	443
Chapter 27 Earned-Value Analysis and Cost Reporting	445
Milestone analysis	445
Earned-value analysis	450
Earned-value analysis prediction reliability and implications	455
Evaluating cost performance for materials and bought-in equipment	457
Effect of project changes on earned-value analysis	458
Project ledger concept	459
Predicting profitability for a whole project	459

Post mortem	464
References and further reading	464
Chapter 28 Managing Multiple Projects, Programmes and Portfolios	465
Project management or programme management?	465
Managing a portfolio of management change and IT projects	466
Multi-project resource scheduling	467
Project resource scheduling in the corporate context	473
References and further reading	474
Chapter 29 More Advanced or Less Frequently Used Techniques	475
Line of balance charts in construction projects	475
Dealing with network plans for large projects	477
PERT	478
Standard networks	480
Templates (standard network modules)	482
Chapter 30 Managing Project Closure	491
Reasons for closing a project	491
Formal project closure	492
Final project cost records	494
Disposal of surplus material stocks	494
Final project definition: the end of a continuous process	494
As-built condition of a manufacturing or capital engineering project	495
As-built condition of a multiple manufacturing project	497
As-built condition of a project that is interrupted before completion	498
Managing files and archives	500
<i>Bibliography</i>	<i>503</i>
<i>Contents Comparison Between the Eighth and Ninth Editions</i>	<i>507</i>
<i>Index</i>	<i>511</i>

List of Figures

1.1	Whistle-stop journey through project management history	2
1.2	Four project types	5
1.3	Project life cycle	8
1.4	More comprehensive example of a project life history	9
1.5	Demonstration of how the chapters in this book broadly follow a project life history	12
1.6	Examples of project relationships	13
2.1	Perceptions of success or failure during a project life history	18
2.2	Barnes's original triangle of objectives and some derivatives	21
2.3	Matrix of stakeholders' objectives	26
3.1	Definition of a large project from initial concept to completion	30
3.2	Part of a project definition checklist	33–4
3.3	Initial task checklist for a management change project	35–6
3.4	An action plan for screening and progressing sales enquiries	38
4.1	Typical summary layout of a project cost estimate	50
4.2	Project cost estimate arranged by the work breakdown structure	58
4.3	Useful format for general cost estimating	59
4.4	Format for estimating the costs of materials and bought-out equipment on larger projects	60
4.5	General purpose format for indicating the price of a small project	61
5.1	Project planning environment	72
5.2	Checklist for an ideal plan (shown checked early in the project life cycle)	76
5.3	Museum project: Gantt chart	78
5.4	Museum project: linked Gantt chart with date cursor set at week 15	79
5.5	Museum project: checklist comparing diary and linked Gantt chart plans	80
6.1	Luxury service apartments project: cost/benefit patterns	85
6.2	Boiler replacement project: payback calculation	88
6.3	Boiler replacement project: payback graphs	88
6.4	Table of discount factors for calculating net present values	89
6.5	Boiler replacement project: net present value calculation	90
6.6	Tollbridge project: net present value calculation	92
6.7	Histogram and probability curve from Monte Carlo Analysis	94
6.8	Chart comparing project cost and benefits after Monte Carlo analysis	95
7.1	Ishikawa fishbone diagram	101

7.2	Part of a failure, mode and effect matrix (FMEA)	102
7.3	Matrix for qualitative risk classification	102
7.4	Qualitative risk assessment matrix	103
7.5	Part of a failure, mode effect and criticality analysis matrix (FMECA)	104
7.6	Format of a risk register (or risk log)	105
7.7	Risk and insurance in project management	107
8.1	Example contents of a project initiation document (PID)	119
8.2	Project register	120
8.3	Works order example for a manufacturing project	122
8.4	Project authorization form used by a mining engineering company	123
8.5	Typical project engineering cost/time relationship	124
9.1	Organigram conventions	128
9.2	Example of a manufacturing organization	132
9.3	Project cycle	133
9.4	Functional matrix for a single project in a manufacturing company	134
9.5	Matrix organization for several simultaneous manufacturing projects	135
9.6	Matrix organization for mining, petrochemical or construction projects	136
9.7	Project team organization	138
9.8	Project team v balanced matrix	144
9.9	Hybrid organization	145
9.10	Project with more than one project manager	146
9.11	Joint venture organization	147
10.1	Coverite plc: development of the relocation project organization	151
11.1	Possible management roles in a matrix organization	161
11.2	Possible management roles in a multi-team organization	162
12.1	Simplified WBS for an automobile project	166
12.2	WBS for a national charity fundraising week	167
12.3	Part of the first three WBS levels for a very large mining project	168
12.4	Work breakdown for a project to build a new railway	169
12.5	Two alternative WBS patterns for a large wedding project	170
12.6	WBS and coding structure for a radiocommunications project	172
12.7	Detail from the work breakdown for the radiocommunications project	172
12.8	Project coding system used by a heavy engineering company	174
12.9	Project coding system used by a mining engineering company	175
13.1	Organigram of Cuttit Ltd	182
13.2	Lawnmower project: OBS	182
13.3	Lawnmower project: upper WBS levels	183
13.4	Lawnmower project: WBS in relation to the OBS (with cost account examples)	184
13.5	Lawnmower project: analysis of a cost account code (chosen at random)	185
13.6	WBS meets OBS and CBS	186
14.1	Main elements of arrow logic	191
14.2	Tree project using arrow notation	192
14.3	Example of arrow network time analysis	193
14.4	Three different methods for showing times on arrow networks	195
14.5	An activity in precedence notation	196
14.6	Tree project using precedence notation	198
14.7	Example of precedence time analysis	199

14.8	Furniture project: task list	200
14.9	Furniture project: activity-on-arrow network diagram	201
14.10	Furniture project: precedence network diagram	202
14.11	Furniture project: time analysis	203
14.12	Overlapping activities in arrow and precedence networks	204
14.13	Constraint options in precedence networks	206
14.14	Using dummies to clarify cluttered logic	206
15.1	Common error in arrow networks	211
15.2	Level of detail in a purchasing sequence	214
15.3	Network interfaces	215
15.4	Museum project: first precedence diagram	219
15.5	Museum project: time analysis of the initial network diagram	220
15.6	Museum project: network with crashed times	222
15.7	Museum project: time analysis after crash actions	223
15.8	Museum project: network crashed and fast-tracked	225
15.9	Museum project: time analysis after crashing and fast-tracking	226
16.1	Garage project: network diagram	234–35
16.2	Garage project: task list and time analysis	236
16.3	Garage project: bar chart and resource histogram – aggregation	237
16.4	Garage project: bar chart and resource histogram – resource-limited	239
16.5	Garage project: bar chart and resource histogram – time-limited	241
16.6	Garage project: float analysis of activity G1016 (10–16)	242
16.7	Time-limited versus resource-limited rules for resource scheduling	245
17.1	Rate constant and variable resource usage for a project task	253
17.2	The complexity of project resource scheduling	256
17.3	Seven logical steps to a practical project resource schedule	257
18.1	Filing cabinet project: exploded view of the product	261
18.2	Filing cabinet project: simple parts list	262
18.3	Filing cabinet project: family tree	264
18.4	Filing cabinet project: parts list arranged in subassemblies	265
18.5	Filing cabinet project: delivery data	265
18.6	Filing cabinet project: family tree redrawn for line of balance	266
18.7	Filing cabinet project: calculation of lead times for parts	267
18.8	Filing cabinet project: delivery commitment graph	268
18.9	Filing cabinet project: calculation for line of balance at day 4	269
18.10	Filing cabinet project: line of balance at day 4	270
18.11	Filing cabinet project: line of balance completed for day 4	271
18.12	Front page headings for a purchase control schedule	272
18.13	Complete purchase control schedule	274
19.1	Essential elements of a project cash outflow schedule	276
19.2	Project cash flow schedule for an outdoor concert	277
19.3	Essential elements of a project net cash flow schedule	278
19.4	Cash outflow schedule for a construction project	279
19.5	Net cash flow schedule for a construction project	280
19.6	Network detail needed to schedule purchase commitments and cash outflows	282
20.1	Suggested procedure for buying project management software	287
20.2	Checklist for choosing project management software	288–89

20.3	Suggested procedure for implementing new project management software	293
20.4	Garage project: precedence network diagram	300
20.5	Garage project: cost estimates	302
20.6	Garage project: data errors	305
20.7	Garage project: summary network plotted by <i>4c</i>	307
20.8	Garage project: time analysis using <i>Microsoft Project 2000</i>	309
20.9	Garage project: time-limited resource histograms using <i>Primavera</i>	311
20.10	Garage project: resource-limited resource histograms using <i>Primavera</i>	312
20.11	Garage project: cost report using <i>Primavera</i>	314
20.12	Garage project: useful cost and resource summary	315
21.1	Linear responsibility matrix	319
21.2	Document distribution matrix	320
21.3	Standard project start-up network	326
21.4	Possible column headings for a drawing schedule	329
22.1	Elements of a typical purchase order	335
22.2	Relationship between payment terms and the control needed	341
23.1	Value of purchasing in project management	346
23.2	Purchasing cycle	346
23.3	Elements of a purchasing organization for a large international project	347
23.4	Stages in the purchase of equipment for a large international project	350–52
23.5	Purchase specification: front sheet	354
23.6	Purchase specification: second sheet	355
23.7	Purchase specification: continuation sheet	356
23.8	Purchase enquiry request	358
23.9	Common arrangement for inviting and considering bids	360
23.10	Bid summary example	362
23.11	Purchase requisition	363
24.1	A familiar sign: but will this project start and finish on time?	375
24.2	Control loop	376
24.3	Materials shortage list format	378
24.4	Combined work-to list and progress questionnaire	381
24.5	Inspection and expediting report	385
24.6	Immediate action order	393
24.7	Construction site organization	396
24.8	Combined meeting agenda and action sheet	399
25.1	Cost of a given change in relation to project life cycle phases	404
25.2	Some origins of project changes	405
25.3	Decision tree for change requests	408
25.4	General-purpose change register	410
25.5	Car project: estimated modification cost	412
25.6	Project variation order	416
25.7	Engineering change request	418
25.8	Production permit or concession	419
25.9	Engineering query note	421
25.10	Inspection report	423
26.1	Project cost elements in the context of cost control	430
26.2	Typical project cost/time patterns and the impact of fixed costs	432

26.3	Three ways of recording the cost of project materials	439
26.4	Weekly timesheet	441
27.1	Comparison of actual costs against a time-scaled budget	446
27.2	Project cost and achievement comparison using milestones	448
27.3	Data for a milestone chart	449
27.4	Earned-value analysis for an engineering department	454
27.5	Cost/profit prediction graph	461
27.6	Tabulated project cost report	463
28.1	Programme of projects in a large contracting company	466
28.2	Managing a multi-project model	470
29.1	Five-house project: Gantt chart	476
29.2	Five-house project: line of balance chart	476
29.3	Eighty-house project: line of balance chart	477
29.4	Rolling wave planning	478
29.5	Breaking down a large project plan into subnetworks	479
29.6	Transfer line project: early example of standard network module (template)	483
29.7	Transfer line project: procurement and machining template	484
29.8	Templating case example: template library principle	485
29.9	Templating case example: standard start template TCSAA and template B	486
29.10	Templating case example: template D and standard finish template TCSFF	487
29.11	Templating case example: template library browser	488
29.12	Templating case example: network diagram	488
29.13	Templating case example: network fragment	488
29.14	Templating case example: Gantt chart produced by 4c	489
30.1	Project closure notice with checklist	493
30.2	Build schedule sheet	499