



GARTH G.F. WARD

# EFFECTIVE PROJECT MANAGEMENT

GUIDANCE AND CHECKLISTS  
FOR ENGINEERING  
AND CONSTRUCTION

WILEY Blackwell



## **Effective Project Management**



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Guidance and Checklists for Engineering and Construction

*Garth G.F. Ward*

**WILEY** Blackwell

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*To Graham Ritchie who wrote the original list.  
And to my wife Gwyneth who uses lists all the time.*





## Contents

**Preface** *xix*

**Acknowledgements** *xxi*

**Introduction** *1*

### **Part I Projects and Their Management 5**

#### **Section A Project Characteristics and Phases 6**

- 1 Characteristics 7
- 2 Phases 8
- 3 Project Patterns 11
- 4 Reasons for Projects 12
- 5 Project Needs 12

#### **Section B Project Management Characteristics 14**

- 1 Models 16
- 2 Characteristics 18
- 3 Key Management Decisions and Phases 20
- 4 Project Management Patterns 24

#### **Section C Execution Planning Influences 26**

- 1 Project Characteristics, Size, and Complexity 26
- 2 Strategic Decisions 27
- 3 The Historic Nature of an Industry 30
- 4 The Characteristics of the Industry/Business Sector 31
- 5 Phases and Schedule 41
- 6 Execution Planning 41
- 7 Generic Influences on Project Execution 42

#### **Section D The Project Management Role 43**

- 1 Strategic and Contractual 43
- 2 Organizational and Functions 43
- 3 Responsibilities and Orientation 46
- 4 Competencies and Leadership 47

5	Abilities and Skills	48
6	The Project Manager	50
	<b>Section E The Manager of Projects</b>	<b>52</b>
1	Financial Situation	52
2	Scope of Work and Change Orders	54
3	Project Progress and Status	54
4	Health, Safety, and Environment	56
5	Quality Audits and Status	56
6	Risk Management	56
7	Client Relations	56
8	Formal Reviews	56
9	The Project Management Group	57
10	Evaluating a Project Manager	57
11	The Manager of Projects and the Client(s)	58
	<b>Section F The Owner and Client</b>	<b>59</b>
1	Some Fundamentals	59
2	Cost and Planning	61
3	Things to Watch	61
4	Most Important of All – Safety	62
	<b>Section G Achieving Success</b>	<b>63</b>
1	The Project Management	66
2	Alignment of Objectives and Client-Contractor Relations	67
3	Involvement of Users	68
4	Get and Build the Right Team with Clear Roles and Responsibilities	70
5	Clear and Complete Scope Definition	70
6	Thorough Planning of the Work	71
7	Planning Communications	72
8	The Efficiency of the Project Launch Phase	73
9	Change Control	74
10	Effective Decision Making	74
11	Tackle Things Today – Tomorrow They Will Be Bigger	75
12	Conclusions for Success	75
	<b>Part II Programme Management</b>	<b>77</b>
	<b>Section A Programme Management – What’s in A Name?</b>	<b>78</b>
1	Programme Management Conclusions	79
2	Summarizing Programme Management	80
3	Key Roles for a Programme Manager	81
	<b>Section B Business Change Programmes</b>	<b>82</b>
1	Blueprint	82
2	Programme Organization	82
3	Change Stakeholders	83
4	Benefits Realization	83

- 5 Gate Reviews 84
- 6 Project Controls 84
- 7 Terminating the Programme 85

## **Section C Management of Portfolios 86**

## **Part III Feasibility and Contracting 89**

### **Section A Feasibility Studies 90**

- 1 Feasibility Study Plan 91
- 2 Defining the Project 92
- 3 The Feasibility Report 92
- 4 Proposed Execution Plan 94
- 5 The Next Step 95

### **Section B Contracting Strategy Considerations 96**

- 1 Business Strategy and Stakeholder Alignment 96
- 2 Regional and Local Factors 96
- 3 Market Intelligence 97
- 4 Prequalification Processes 97
- 5 General Contracting Issues 98

### **Section C Issuing an Enquiry 103**

- 1 Enquiry Preparation Phase 103
- 2 Tendering Phase 106
- 3 Evaluation Phase 106

### **Section D To Tender or Not to Tender 109**

- 1 The Tendering Decision 109
- 2 The Tender Decision Analysis 110
- 3 The Final Tendering Decision 113

### **Section E Tendering and Proposal Phase 115**

- 1 Tendering Preliminaries 115
- 2 Developing the Tender or Proposal – In-house Work 117
- 3 Coordinating with Third Parties 121
- 4 Coordinating with the Client 121
- 5 Commercial 122
- 6 Reviewing the Tender or Proposal 124
- 7 Before Submitting the Tender or Proposal 125
- 8 After Completion of the Tender or Proposal 125
- 9 Proposal Team Presentation 126
- 10 Possible Client Questions for the Proposal Team 129

### **Section F Contracts 131**

- 1 Starting Work 133
- 2 Awarding Contracts 134
- 3 Contract Document 134
- 4 Contract Awarded 136
- 5 Contractual Issues 137

- 6 Some Contractual Reminders 138
- 7 Discharge of a Contract 138

## **Part IV Project Execution 139**

### **Section A Project Launch 140**

- 1 Project Checks 142
- 2 Project Objectives 143
- 3 Scope Launch 144
- 4 Team Launch 144
- 5 Execution Launch 145
- 6 Launch Controls 145
- 7 Hold Kick-Off Meeting 146
- 8 Kick-Off Meeting Agenda 146
- 9 Kick-Off Schedule 148

### **Section B Establishing An Office 150**

### **Section C Getting Organized 152**

- 1 Setting up the Project Infrastructure 152
- 2 Controlling the Documents 154
- 3 Responsibilities 155
- 4 Procedures 156
- 5 Project Execution Plan 156
- 6 Formalities 157
- 7 Project Insurance 157
- 8 Some Advice 158

### **Section D Mobilization 159**

### **Section E Client Relations 161**

### **Section F Scope 163**

- 1 Scope Documents 164
- 2 Changes to the Scope 164
- 3 Work Packaging 164

### **Section G Estimates and Budget 166**

- 1 Establishing the Estimate(s) 167
- 2 Trend Programme 167
- 3 Allowances 168
- 4 The Budget 168

### **Section H Accounting 170**

- 1 Looking after the Finances 170
- 2 Bonds 172

### **Section J Planning and Scheduling 173**

- 1 Getting Organized 173
- 2 Planning 173
- 3 Scheduling 174

**Section K Project Controls 176**

- 1 Setting Up 177
- 2 Progress and Reporting 178
- 3 Cost Progress and Control 179
- 4 The Critical Path 179

**Section L Variations/Changes/Claims 181**

- 1 Trend Base Estimate 182
- 2 Trend Meetings 183
- 3 Potential Trends 184
- 4 Claims for Changes 184
- 5 Managing Claims 186
- 6 Resist Change 187

**Section M Reporting 188**

- 1 Reporting Cycle 188
- 2 Visibility 189
- 3 Progress Reporting 190
- 4 Progress Report 191
- 5 Cost Reporting 192

**Section N Project Meetings 193****Section O Design 195**

- 1 Getting Organized 195
- 2 Reviewing the Design 196
- 3 Some Specific Design Ideas 198
- 4 Construction Issues 198

**Section P Procurement 200**

- 1 Getting Organized 200
- 2 Evaluating Suppliers 201
- 3 Expediting and Inspection 202
- 4 Some Specific Procurement Ideas 202
- 5 Payment Terms 204

**Section Q Installation and Construction 205**

- 1 The Key Staff 205
- 2 Construction Planning 207
- 3 Work Packaging 210
- 4 Construction Site Work 210
- 5 Some Specific Construction Ideas 213
- 6 Establishing Authority 214

**Section R Subcontracting 215**

- 1 Questions to Ask Before Subcontracting 215
- 2 Contracting Checks 216
- 3 Management Issues 217
- 4 List of Some Subcontracts 217

**Section S Commissioning and Setting To Work 219**

**Section T Contract Completion - Close Out 222**

- 1 Handover of Documentation 222
- 2 Handover of Equipment 223
- 3 Clean Up 223
- 4 Disposal of Surplus Material 223
- 5 Closing Contracts 224
- 6 Financial Matters 225
- 7 Close Out 225

**Section U Post Project Activities 227**

- 1 Completing the Records 227
- 2 Post-project Appraisal – Internal Performance Review 227
- 3 Project/Client Review Meeting/Lessons Learned 228
- 4 Historical Report 230
- 5 Client Follow-up and Marketing 230
- 6 Internal Projects Benefits 231

**Part V Specialist Topics 233**

**Section A Completed and Inspected Work 234**

- 1 Completed Work 234
- 2 Inspecting Work 236

**Section B Coordination Procedure 238**

- 1 Basic Organizing Information 238
- 2 Coordination with the Company 239

**Section C Cultural Issues 243**

- 1 Some Definitions of Culture 243
- 2 A Seminal Grouping of Cultures 244
- 3 Some Cultural Issues to be Aware of 244
- 4 Management Style 246

**Section D Documentation 247**

- 1 Contractor's Own Documents and Drawings 247
- 2 Vendor Drawings and Documents 249

**Section E Estimating and Contingency 250**

- 1 Types of Estimate 250
- 2 Estimate Planning Sequence 252
- 3 The Estimating Process 253
- 4 Estimate Information and Content 255
- 5 Contingency Estimation 259

**Section F Filing and Archiving 261**

- 1 The Filing System 261
- 2 Archiving 263
- 3 Master File Index: Recommended Minor Categories and Suggested Subjects 264

**Section G Financial Appraisal 270**

- 1 Cash versus Profit 270
- 2 Simple Project Appraisal Methods 272
- 3 Payback 273
- 4 Discounted Cash Flow Techniques 273
- 5 Internal Rate of Return – IRR 276
- 6 Sensitivity and Risk Analysis 277
- 7 Financial Appraisal Conclusion 277

**Section H Incoterms® 280**

- 1 Rules for Any Mode or Modes of Transport 280
- 2 Rules for Sea and Inland Waterway Transport 281
- 3 Transfer of Risks and Obligations 281
- 4 Sellers' and Buyers' Detailed Obligations 282
- 5 Additional Information 282

**Section J Joint Associations 283**

- 1 Reasons for Joint Association 283
- 2 Documentation and Legal Requirements 284
- 3 Selecting a Partner 284
- 4 Joint Association Risks 285
- 5 Steps to Evaluate Joint Associations 285
- 6 Key Issues for a Joint Association 287
- 7 Steps in Tendering 288
- 8 Control of the Work 289
- 9 Financial Control 289
- 10 Essentials for Success 290
- 11 Why Joint Associations Fail 290

**Section K Performance Appraisals 292**

- 1 Purpose and Preparation 292
- 2 The Interview 292
- 3 Post-interview Actions 293

**Section L Performance Measurement and Earned Value 295**

- 1 Design/Engineering Performance 295
- 2 Procurement Performance 297
- 3 Construction Performance 297
- 4 Practical Performance Details 298
- 5 Linking Deliverables to Programme 299
- 6 Recording and Comparing Data 300
- 7 Earned Value Terminology 302
- 8 Useful Health Ratios or Indices 302

## **Section M Risk and Risk List 303**

- 1 Process Model 304
- 2 Prioritising Risk 306
- 3 Risk List 309
- 4 People and Risk 312
- 5 Country Risk Assessment 313

## **Section N 'S' Curves 315**

- 1 Interpreting the Curves 315
- 2 Change Orders 319

## **Section O Site Checks 323**

- 1 Country Data 323
- 2 Site Data 323
- 3 Local Authorities 323
- 4 Suppliers and Local Contractors 323
- 5 Labour Availability 324
- 6 Non-manual Employees 324
- 7 Housing and Camp 324
- 8 Shipping and Handling 325

## **Section P Surety Bonds 326**

- 1 Types of Bonds 326
- 2 Characteristics of Bonds 328

## **Section Q Selecting and Building the Team 329**

- 1 Selecting the Team 329
- 2 Building the Team 332
- 3 New to the Team 336

## **Section R Team Roles 337**

- 1 Specification of the Eight Team Roles 337
- 2 A Suggestion for a Project Manager 341
- 3 Matching the Roles to the Project Process 342

## **Section S Value Management/Engineering 343**

- 1 VM/VE Process 343
- 2 Group Process 346

## **Part VI Skills Check Lists 349**

### **Section A Communications 350**

- 1 Correspondence 351
- 2 Documents 353
- 3 Electronic Media 354
- 4 Oral 357
- 5 Social 358
- 6 Visual 359



7	Other Communication Tools	359
8	Translators	359
9	A Difficulty	360
10	Some Reminders	361
	<b>Section B Leadership and Motivation</b>	362
1	Consensus to Dictatorial Continuum by Tannenbaum and Schmidt	363
2	The Three S's of Group Communications	364
3	Situational Leadership by Kenneth Blanchard and Dr. Paul Hersey	365
4	Task, Team, Individual – Action Centred Leadership by John Adair	367
5	Leadership and Management Roles	368
6	Management by Walking/Wandering Around MBWA	369
7	Responsibility	369
8	Leadership – More Than a Management Model	370
9	Thoughts for the Day	371
	<b>Section C Managing and Conducting Meetings</b>	373
1	Planning the Meeting	373
2	The Agenda	374
3	Manage the Process and the People	375
4	Control the Discussion	377
5	Construct Decisions and Summarize	378
6	Record and Notify	379
	<b>Section D Negotiation</b>	381
1	Preparation for Negotiation	381
2	Discuss Interests	382
3	Signal	382
4	Propose for Movement	383
5	Package	383
6	Bargain	383
7	Close the Deal	383
8	Agree the Deal	383
9	Techniques and Tricks	384
	<b>Section E Personal Skills</b>	386
1	Planning an Interaction with Others	386
2	The Exchange	387
3	Asking Questions	388
4	Changing Style	388
5	Team Role Style	390
6	Finalizing the Interaction	391
7	Giving and Receiving Feedback	391
8	Dealing with Difficult People	392
9	Being Angry	394
10	Priorities	395
11	Time Management	395
12	Learning	396
13	Motivating Skills	397

14	Some Personal Advice	397
15	Questionnaires	398
	<b>Section F Politics in Projects</b>	399
1	Typical Destructive Behaviour	400
2	Dubious Behaviour?	401
3	How Politics Can Affect a Project	402
4	Some Advice	403
5	Something to Think About	405
	<b>Section G Presentation Skills</b>	406
1	Fundamentals for All Presentations	406
2	Format for a Presentation to Inform/Explain	408
3	Presentation to Influence/Convince	409
4	Presentation Expressing a Viewpoint/Opinion	410
5	Team Presentations	410
6	Your Audience	411
7	Presentation Skills Analysis	412
8	Organizing the Location	413
9	Visual and Other Aids	415
10	Dealing with Questions	416
11	Summarizing a Presentation	417
	<b>Section H Prioritising Techniques</b>	418
1	Group Work Using Flip Charts	418
2	Graphical Plots	418
3	Binary Decision-making	420
	<b>Section J Problem-solving Process</b>	422
1	Define the Problem	423
2	Define the Objectives and Success Criteria	423
3	Analyse the Problem	423
4	Create and Propose Solutions	424
5	Evaluate, Forecast Consequences, and Select	424
6	Recommend, Plan Action, and Implement the Solution	425
7	Evaluate the Outcome and Follow Up	426
	<b>Section K Problem-solving Techniques</b>	427
1	Brainstorming	427
2	Check Sheets	428
3	Pareto and Other Diagrams	429
4	Cause and Effect – Ishikawa or Fish Bone Diagram	430
5	Force Field Analysis	430
	<b>Section L Report Writing</b>	433
1	The Report Objective	433
2	The Reader	433
3	The Material for the Report	434
4	The Report Structure	435

5	The Executive Summary	435
6	Introduction to the Report	435
7	The Body of the Report	436
8	Writing the Report	436
9	Conclusions and Recommendations	438
10	Appendices	439
11	Finalizing the Report	439

**Abbreviations** 441

**Index** 447

**Key to Figures:** Figure: V-E-3

The initial Roman numeral is the book Part number

The middle Capital Letter is the Section of the book Part already indicated

The last Arabic numeral is the sequential figure number for the Section concerned



## Preface

When Graham Ritchie and I were project managers at Bechtel, Graham started writing a book on project management and invited me to be his co-author. Before Graham left to take up the post of director of the MSc in project management at Cranfield School of Management, we developed a large amount of material, probably sixty percent of the book. The reason this book has never been completed is that, after my sixteen years as a consultant lecturer at Cranfield, I realised that the material needed rewriting completely. Since my first book<sup>1</sup> only covered aspects of purchasing, it would probably take at least another two or three volumes to do justice to the whole subject of project management.

During Graham's short time at Cranfield, before he died suddenly of a brain tumour, he turned much of the material into lecture notes in support of the MSc programme. Naturally, when I took over from Graham, I continued to use them during my ten years as the MSc course director. Section A of Part one, Project Characteristics, Advantages and Phases has been revised and is included at the start of Part I of this book. One feature of our book was that each chapter would end with a check list covering the chapter topic. Accordingly, the check lists were also compiled into a handout for the MSc students, and this forms the core of Part IV, Project Execution. This document was so useful for many of the graduates that, years later, they would write to me asking for another copy because theirs was worn out.

The popularity of the project execution check lists, and their practical application by the MSc graduates in the work environment, has been the reason for developing the original lists and taking the check list concept further.

The inclusion of the Specialist Topics is intended to extend the lists to cover subjects needed for projects of a significant size and complexity. Whereas, the Skills Check Lists have been included to cover the needs of individuals, in all circumstances, regardless of the size of the project.

1 The Project Manager's Guide to Purchasing, Contracting for Goods and Services by Garth Ward. Gower 2008.



## Acknowledgements

I am particularly appreciative of the following people who have contributed to various sections. They responded to my requests for input, despite their busy lives, where their expertise was based on having done it for real. Others kindly gave permission to use existing published material. Some of the contributions have been used with little change and some have had content added. However, I trust that the integrity of the original material has been maintained. All their contributions have enhanced the knowhow of particular topics, broadened the subject base and added usefulness to the book as a whole.

**Professor John Adair:** over the years I have championed the John Adair Leadership Model application to project management and am appreciative of his giving permission to use his copyrighted Leadership Model.

**Martin Arter MSc:** Director of Infrastructure Programme Management at Network Rail brought clarity to the difference between project management and programme management by having done it in reality. His experience has involved managing both major projects, encompassing aerospace, power, and construction, and major programmes. Programmes he has managed have concerned the design and construction of highly complex navy warships and reorganizing track renewal at Network Rail into regions for effective programme management. His breadth of experience gives real authority to the subject.

**Stephen Carver MSc:** I am indebted to my friend and colleague for the concept and story outline of the air traffic control analogy, describing the management of portfolios. Listening to his charismatic and innovative presentations demonstrates that he is the person to demystify any subject.

**Mike Cleaver MSc:** who I always knew would achieve success in project management, is a vice president with CB&I. Mike, having been a manager of projects, as well as a project manager, has provided the essential information that the readers of this book need to be aware of when they are reporting to senior management.

I am especially indebted to **Cranfield School of Management** for permission to use the material that Graham developed for the project management MSc course. In particular, the subject matter that introduces Part I and also the original check lists that form the basis of Part IV on project execution and the foundation of this book.

Once more I must express my gratitude to **Vernon Evenson**, project manager, colleague and friend who was most helpful in providing fresh perspectives and new experiences. As well as validating my own know-how, he performed the invaluable task

of giving me confidence in my own experiences. Vernon's contributions have all been integrated into the text where appropriate.

**Pat McHugh:** one time business unit leader in B.P., at the height of its successes, provided the client's perspective and the valuable section on Contracting Strategy Considerations. I have been an admirer of Pat's project management professionalism ever since we met on a short course for the state oil industry in Thailand many years ago.

**Professor David R. Middleton:** kindly gave me permission to use extracts from his book *Financial Decisions* for the section on Financial Appraisal. This book taught me all about financial appraisal and covers everything that a project manager will need to know about finance. It is published by Longman, fourth impression 1987, Understanding Business Series ISBN 0 582 35401 3.

I indebted to my son **Giles Ward**, who had his west-end film premier on the same hot summers day that England was playing Germany in the European cup, for explaining the differences in managing a theatre production and the making of a film. He is now a director of a building and construction company.

I must thank Nurse Practitioner **Jane A. Williams** for allowing me to cross examine her whilst cruising down the Volga (on our way from Moscow to St Petersburg) in order to identify the differences for a surgical project. This has been validated and added to from my own experience.

I must also, once again, thank **David Wright**. As a well-known beer advertisement said: "probably the best" exponent of contract law in the business. David has provided essential support on courses we have run together, and over the years he has allowed me the invaluable luxury of being able to pick his brains. He provided new material for the sections on contracts as well as expanding some of the material that Graham had developed.

It would be remiss of me not to thank all the lecturers who supported the Cranfield MSc course in Project Management. They were all pre-eminent in their field and shared valuable experiences. All these people provided answers to my many questions and provided me with an excellent education! They have all contributed in some way to this book.

I must not forget involvement from other family members: my son **Gavin Ward**, who is general manager of the UK office of a risk consultancy business. He has worked for a number of oil companies and has always been available to check facts and provide a client perspective.

Also **Dr Guy Ward**, who is the investment manager for a mega-million-pound private family investment trust, performed the invaluable task of reading the manuscript. Guy checked for readability and for those inconsistencies that an author can no longer identify after many iterations of the text.

Finally, I cannot overlook my granddaughter **Emily** who volunteered to do some proof reading and my wife **Gwyneth**, who was occasionally badgered into doing a little.



## Introduction

When I joined the projects department of Shell Mex and BP, I was given a manual titled 'Policy Guide.' Naturally on the first project I was responsible for, I followed the policy religiously. Nevertheless, I was called into my boss's office and rapped over the knuckles and told: "For heaven's sake use your imagination – it's only a guide." Sometime later, on a major project, I had the vehicle maintenance facilities for road tankers redesigned. However, this had consequences for all the other similar projects that were being carried out at the same time. Not surprisingly I was called into the boss's office again, who banged the table and stated firmly "*That's the policy!*" I have always thought that this was brilliant. The skill of project management is deciding when to follow policy and when to do things differently. Consequently, this book is a *policy guide*. It may be good policy to follow the theoretical reasoning that is included, but the checklists will provide a guide to a practical approach.

This book is designed to help project managers achieve success. Its purpose is, to make project management 'boring.'<sup>1</sup> The thesis is that if your project is exciting, then it is in trouble. The book should help experienced project managers as well as those with less experience. Nevertheless, I shall never forget the one occasion (and the only one!) during my career as a practicing project manager when, to my surprise, I found that I had nothing to do. So, I decided to read the company project management manual. I was taken aback when I discovered something I had not thought about and which deserved investigation. I heaved a sigh of relief at my good luck, when the actions I took as a result prevented a project debacle. I trust that this book will provide the reader with some similar luck. Yet, there is no such thing as luck in project management. Luck comes from preparation and planning.

This is a guide to a broad spectrum of basic principles. Nevertheless, project managers also need to be conversant with today's rapidly changing technologies, particularly the information technologies. However, it is a failure to understand and conform to the basic principles that still cause projects to have problems. The knowledge required of a project manager is more than they can possibly know or know how to deliver on their own, and in any case we all make mistakes. Consequently, a checklist provides a system whereby the project manager can be confident that a valid process is being followed. This then enables them to be innovative in their approach to the project with the development of plans or resolution of problems.

<sup>1</sup> I have borrowed this concept from my friend and colleague Stephen Carver.

I am aware that some people have difficulty with checklists. When the original loose-leaf paper organizers were all the rage, there was a sense of having somehow failed if you were not a dedicated user. Consequently, the book format has been chosen to provide people resistant to lists with many areas where the issues have expanded explanations. I am one of those who do not find using lists a natural process. On too many occasions, I would ask Gwyneth, my wife, to fax me some document to a remote part of the country because I had forgotten to take it with me. As a consequence, my son Guy has consistently given me a hard time, and rightly so, for not using a checklist when travelling on an assignment.

Apart from the early sections of Part I and Part II, which are of a more conventional book nature, the remaining structure is a pick-and-mix checklist format to enable the reader to select a flexible approach to those elements that they need. The first sections in Part I deal with some basic characteristics of projects and project management because the better these characteristics are understood, the more effective the management process will be. However, it is difficult to separate projects and project management. For example: the scope is very much part of a project, but it is a project management function to define the scope. One could say it is an objective of project management to complete the scope. Nevertheless, I have tried to separate them.

The book is intended to be highly practical and is based on experience. 'Experience is a truer guide than the words of others.'<sup>2</sup> However, to be truly effective, a project manager needs to be aware of the theory behind the issues concerned. Knowledge of the theory makes the subject interesting by observing how the theory works in practice. It also enables the reader to modify the advice given to suit different circumstances. Further, one can never be sure of people's level of expertise or what they know. For these reasons, brief elements of theory are included in the initial paragraphs of the various sections. It is designed to be as generic as possible and does not promulgate any particular method of working. Additionally, it must be remembered that the principles of project management are the same for all projects.

Rather than just produce a list of *what* activities need to be performed, the book also offers some advice on *how* tasks should be carried out. The challenge has been to cover all the essential elements needed by a project manager, in as concise a manner as possible, without compromising the issues under examination.

I hope that the reader can be like one of my MSc students who made sure that, regardless of how he felt or what he knew, he took away at least one grain of sand from every session, lecture, or assignment. He validated his knowledge, acquired a technique, or borrowed an experience. The result was that at the end of the course, he had a big pile of sand, and I would like to think that as a direct result, he went on to lead one of the major contractors.

The book is written primarily from the perspective of the project manager of the organization performing the work – the contractor. The term *client* is used to define the organization requesting the work. Accordingly, I have tried not to forget that a contractor performs the client role for their subcontractors and suppliers. In the text, substitute 'management approval' for 'client approval,' for different contract situations.

There is no set format to the individual sections. Each section varies according to the requirements of the topic. A few issues may appear in more than one list due

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2 *Thoughts on Art and Life* by Leonardo Da Vinci.

to the structure of the lists. Some are more process-oriented, whereas others are more subject-focused. For example, 'obtain a project cost code' is part of the *project launch process*, but it is also part of the subject of *project control*. This emphasizes the importance of the issues concerned and ensures that they do not get overlooked. Where the same issue is discussed in a different context, a cross reference is provided.

Everything is described in a manual format on the basis that any computerised electronic system will still need to replicate a manual process. This book does not address the software that is available in the marketplace.

For completeness I have included a list of abbreviations in use within the project management world. Nevertheless, I trust that the terms I have used are self-evident in their own context. I have avoided academic debate over the meaning of terms,<sup>3</sup> and where I have used terms that are different from a norm, I have explained my reasons. For example, the Association for Project Management (APM) has specific definitions for projects, programmes, and portfolios, some of which one might wish to express differently. I could, for example, explain the term *programme* in two ways: firstly, to describe large projects such as the Olympics, Crossrail, or the space shuttle programme; and secondly, describing a smaller portfolio of miscellaneous business projects in an organization or an equipment maintenance programme. However, these explanations might not conform to the specifics of the APM definitions. Nevertheless, the important thing is that, in summary, the APM states 'the concept of projects, programmes and portfolios should be thought of as just points on a gradual scale of managing effort to deliver objectives.' Good, it is still project management!

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3 See the Association of Project Management 'Body of Knowledge' for a Glossary of Terms.



## **PART I**

### **Projects and Their Management**

## Section A Project Characteristics and Phases<sup>1</sup>

Projects can be anything: a capital facility, an information system, a piece of research, a company merger, an organizational change, launching a product, or decommissioning a facility, and so on. They can range from capital intensive technological and infrastructure investments to labour-intensive health care. All projects types need a description, a scope, and the associated specifications for the quality required, and they cannot be realized without a team of people to develop them. The fundamental characteristic of all projects is that they create and cause change. As such, they come up against resistance. Consequently, leadership is needed in the form of a project manager, and a project management process is required to control them. (See Section B.)

There is a hierarchy to projects determined by their size, complexity, and the inherent risks (see Figure I.A.1). At the lowest hierarchical level are the *routines*, tasks that are so common and so well developed in a function that methods of working have ironed out all the difficulties. Next in the hierarchy are those frequently occurring packages of work – small projects that are very similar and can be developed without too much specialized management and theoretically do not present any significant risks. There are lots of them in an organization and they can be performed without any real difficulty. These are called the *runners*.

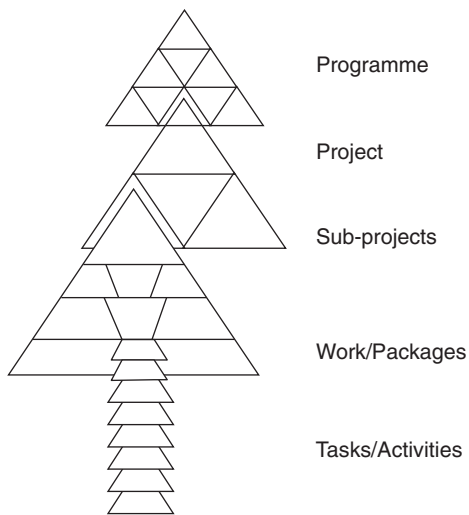


Figure I.A.1

At the next level of the hierarchy are larger projects that the organization performs reasonably regularly; they are very similar or replicate previous projects. Naturally, they are called *repeaters*. The development of repeaters has become more specialized, less routine, and more individually project-focused. As a consequence they have a higher risk of failure. They need someone experienced in project management because the real risk with them is that people assume they are repeats. The reality is that they have differences that, if ignored, could cause project failure. Then come the projects that

<sup>1</sup> This section is based on Graham Ritchie's first Cranfield lecture note 'Project Management Characteristics and Advantages' and a second note 'Project Phases'.

are infrequent and more unusual, they become *strangers* to an organizations normal method of working. They are large projects and are high risk projects as far as the organization is concerned. As a consequence, they need someone to manage them, who is skilled and experienced in project management. Finally, the mega project, the first of a kind, the once-in-a-career opportunity are the *aliens*, consisting of a programme of large projects. (Part II addresses programme management).

'Every project begins on paper as an ideal, as a vision of perfection and quickly becomes mired in the confusion of budget, size and opposition of NIMBY's'.<sup>2</sup> Consequently, the best way to start a project is to carry out a feasibility study that results in a clear brief and statement of the requirements (see Part III). Nevertheless, there are features that are common to all projects regardless of size.

## 1 Characteristics

### 1.1 Unique Non-repetitive

A primary characteristic of projects: a product, a development, a task, or a deliverable is that they are unique and are non-repetitive.

### 1.2 Phases

Secondly, because projects start with a unique idea or concept, they go through a series of growth phases in order to achieve an outcome.

### 1.3 Risk

Projects are risky due to the very uniqueness of their nature. The risks are then compounded by the changes that can occur during the project's development. The severity, impact and consequences of the risks incurred are related to the hierarchical position of the project, as described above.

### 1.4 Business Objectives

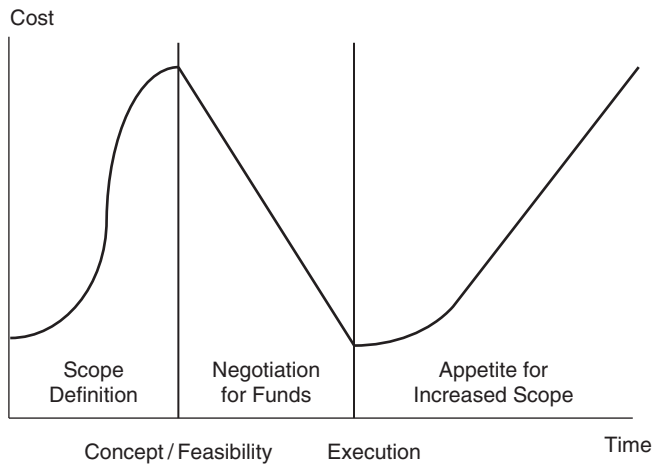
Projects come into being because they will provide benefits to an owner and a return on their investment; they have a purpose. The business requirements of a project become the owner's objectives. They then get translated into specific objectives for the management of the project (see Section B).

### 1.5 Liable to Changes

Projects almost invariably change in scope, often by very large factors, due to changing business requirements and market conditions.

It is typically necessary to reduce the costs involved in order to make the project financially viable and to make the business case acceptable. This will usually mean reducing the scope or specification of the project – see Figure I.A.2. Everyone creating a project has big ideas, but when the budget can't get any bigger, the ideas have to get smaller.

<sup>2</sup> Slightly adapted (project for 'House'), introduction to *House of the Year* programme 2016 by Kevin McCloud, TV Channel More 4.



**Figure I.A.2**

### 1.5.1

Clients may have limited funds and reduce the budget, but they do not reduce their ambition. In reality, there is no such being as a client who does not make changes. Thus, once the project is approved and has got the go-ahead, there is a natural tendency to want to put back all the features that were removed. These changes are then likely to cause failure of the business objectives. Sometimes it can be almost impossible to match the requirements with the money that has been allocated to a project. This often occurs in the public sector. The correct approach is to deliver the essentials and, if there is anything left in the budget, add the 'nice to haves' when the essentials have been completed.

## 2 Phases

### 2.1

The development of a project is modelled by a series of phases or stages. Sometimes the phases they go through are carried out sequentially, but more often they overlap significantly. There are three basic project stages:

Thinking – (Planning) – Doing

#### 2.1.1

The conceptual, creative, thinking phase is a natural process; people enjoy it. The same is true of doing. People like to design, make, and construct – doing is also a natural process. This is not true of planning. Planning is not a natural process. It is imposed on a project's development by the management process. The trouble is that people's natural desire is to jump straight from the thinking stage to the doing stage. If this occurs, project disaster is guaranteed. It is not a flaw in the characteristics of projects; it is a failure in a project's management.



### 2.1.2

For more complex situations, these basic phases are broken down into more detail. Between each phase, there is an opportunity to assess the viability of the project and decide if one wishes to proceed to the next phase. The objective of breaking the project into phases is to enable one to plan and control the work at the appropriate level of detail.

## 2.2 Phase Details

The following Figure I.A.3 is a basic model of a typical project, showing the state of development for each phase of the project. These phases are typical for technological projects such as the process and power industries<sup>3</sup>, but it is also intended to be generic:

- Concept: a company, government, or some other body determines that there is a requirement for a new facility, plant, or product.
- Feasibility: the concept is examined in detail to see whether it is a realistic, viable business proposition. This selection and definition phase is one of value creation.
- Planning: if it is viable, an execution plan is developed.
- Basic design: before major funds are committed, the basis of design is carefully agreed.
- Design: once the basic 'recipe' is firm, detailed drawings for each element or component are produced.
- Procurement: all the necessary services, materials, and equipment are purchased.
- Construction or production: the facility or product is assembled from the materials and equipment, using the drawings already prepared.
- Commissioning or setting to work: the plant or product is thoroughly tested to ensure that it satisfies the requirements of the project.

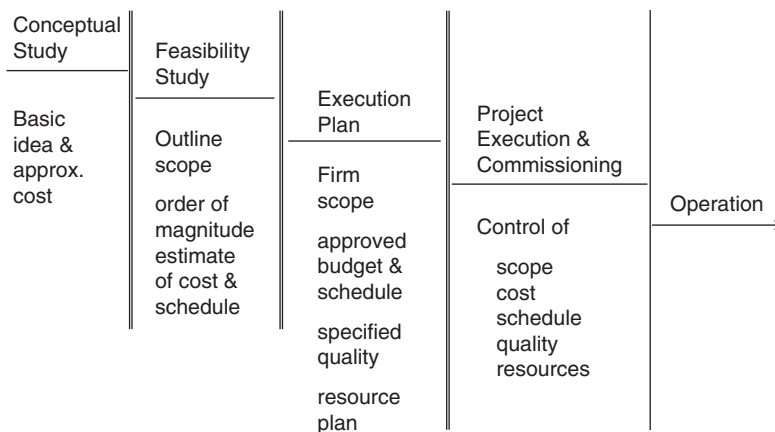


Figure I.A.3

3 The RIBA Plan of Work 2013 comprises eight stages 0–7, detailing tasks and outputs required.

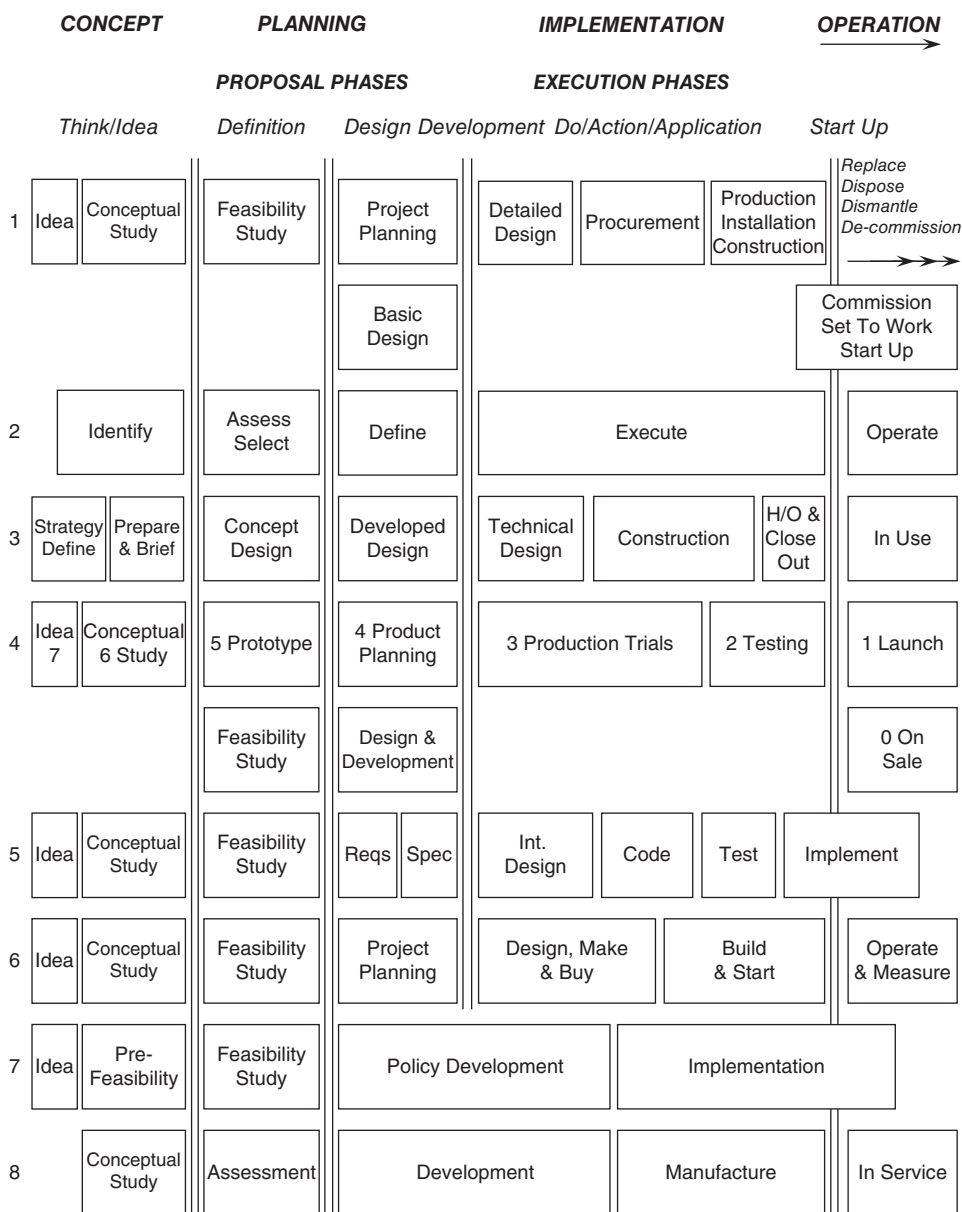


Figure I.A.4

2.2.1

Figure I.A.4 shows the different terminology and phase definitions used in different business environments:

- Line 1 is a generic model for technological industries – process and power.
- Line 2 is the owner/client perspective of line 1.
- Line 3 is an architect-driven building project.
- Line 4 represents product development.

Line 5 represents information technology.

Line 6 represents manufacturing.

Line 7 represents The Civil Service 'Policy' project life cycle.

Line 8 represents the Ministry of Defence smart acquisition process.

### 2.3 Purchasing and Contracting Phases

There are three positions in the development of the phases where the owner may contract with someone else to perform the work in subsequent phases:

- At the end of the conceptual study and start of the feasibility study
- Prior to the development of the basic design and planning stage
- Prior to the execution phases of the project

The purchasing options available to the owner mean that the stages in Figures I.B.3 or I.B.4 involved in the contracting process have to be integrated into phases shown in Figure I.A.4.

## 3 Project Patterns

There are important patterns that depend on the phases of the project and give a clearer understanding of the way a project develops.

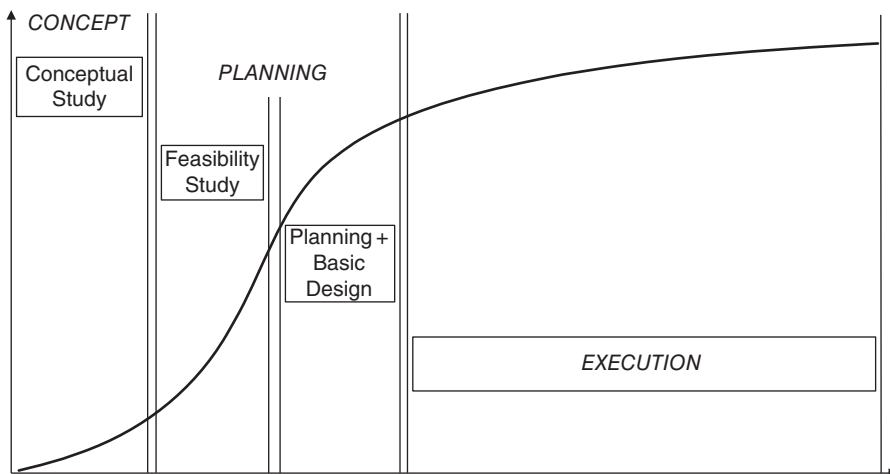


Figure I.A.5

### 3.1 Cost Impact of Decisions

During the feasibility study, alternative types of projects are being examined, and by the time the final study is accepted by management, the cost of the work is known to within a reasonable margin. Assuming the basic concept does not change, it is extremely difficult and often impossible to make more than a 15 per cent saving. In other words, 85 per cent of the cost impact has been determined during the front end phases (See Figure I.A.5).

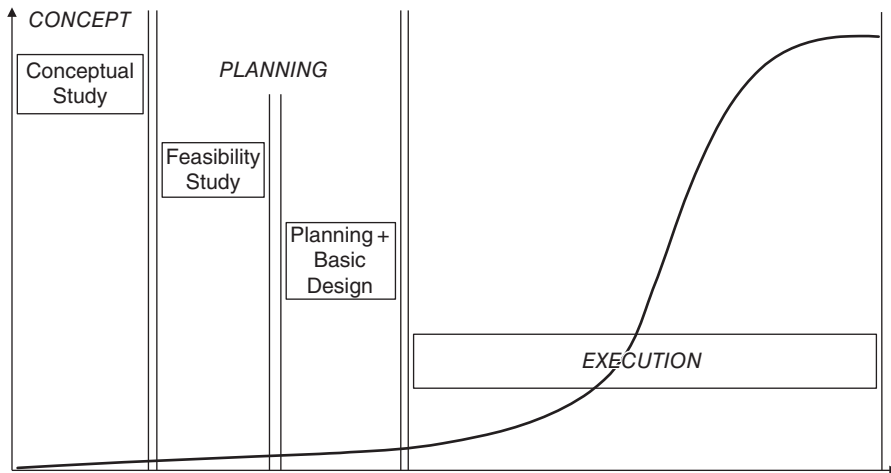


Figure I.A.6

### 3.2 Commitments

The financial commitment in the early stages of the job is very small compared with the costs once production work commences. It is much cheaper to totally change the approach to the project during the feasibility study phase when all that is involved is a new report than to make a change later when major equipment has been bought and work has started on site. This illustrates why it is important to have the best brains available during the early phases of the project (See Figure I.A.6).

## 4 Reasons for Projects

There are five reasons for doing projects:

- Return on investment – only known after the facility is operating.
- Achieving strategic objectives – both the public and private sectors.
- Complying with legislation – safety, environmental, financial, and so on.
- Political and social reasons or critical needs – question their validity.
- 'Ego/Vanity' projects – particularly dubious internal projects wanted by a senior manager. If you can spot them, avoid them.

## 5 Project Needs

Projects cannot accomplish anything on their own. To survive they have needs that must be met. Namely:

- They need clear objectives and complete definition.<sup>4</sup>

<sup>4</sup> Software and business change projects need clarity of what is to be achieved, not necessarily their definition.

- b. They need reliable finance.
- c. They need political stability and certainty.
- d. They need the shortest execution programme.
- e. They need competent, capable, and experienced project managers.

## Section B Project Management Characteristics

At one stage during my time at Cranfield, I thought that it would be a good idea to research the definition of project management. I decided it would not be a difficult task since books on the subject would either provide a definition in their introduction or in chapter 1. Consequently, I looked up all the project management books in the Cranfield library and, to my amazement, they were all different!

For a brief time, as chairman of the Association of Project Management (APM) education and training group, I was involved in the development of the original APM body of knowledge, an excellent document that defines *what* the various subjects are that a project manager needs to know.<sup>5</sup> There was another definition. On a quick glance at the U.S. Project Management Institute, I discovered that they define *how* project management subjects should be performed, with yet another definition. Too many definitions are complex (trying to cover every aspect of project management) and mix up projects and project management. This was when I decided that I needed to provide a definitive definition and, consequently, modified something that I came across in the paperwork in my office.<sup>6</sup>

*Project Management is the multidisciplinary process of achieving a satisfactory end result.*

The 'multidisciplinary' part (people working together as a team), creates complex relationships and a matrix organizational structure. It is what distinguishes project management from the individual functional disciplines. It is a *work process*. It is not a bunch of tools and techniques. The finite end result is the project, is always unique, and can be anything. Finally, successful project management does not have to produce the best; it just has to create something that is good enough, namely, satisfactory and on time and to budget. The purpose of this book is to help project managers achieve the necessary satisfactory end results.

Project management turns bright ideas into reality and is the means to achieving the end result and not the end in itself. Commitment to the project management concept is vital for the success of the project. Making things up as you go along is a route to financial disaster. Project management is the essential discipline that turns senior management's concepts, visions, goals, and strategies into practice. In June 2000 a survey in *Fortune* magazine showed that the single commonest reason for the failure of chief executives was their failure to implement their plans.

The challenge for the project manager is to manage complexity, ambiguity, uncertainty (risk), and urgency. In order to achieve success, a major effort must be mounted by all involved parties in the front-end planning of the work. Unless studies are carried out thoroughly and unless the planning is comprehensive and competent and unless

<sup>5</sup> The CIOB has a *Code of Practice for Project Management for Construction and Development*, setting out everything that a multi-institute task force, with representatives from RICS, RIBA, ICE, APM, and CIC, has determined should be performed on a project. Published by Wiley-Blackwell, 2014. ISBN: 978-1-118-37808-3.

<sup>6</sup> I have adopted a 'back to basics approach' rather than getting into detailed definitions which are covered by various ISO Standards, e.g.: ISO 21500:2012 Guidance on Project Management. There are similar standards for programme management and portfolio management.

the organization conforms to the standard requirements of the project management process, it is extremely unlikely that the project will be a success.

Language is the first barrier that deserves mention in the project management business. The project world uses the same words but applies them quite differently (see Section A, paragraph 2.2.1; Figure I.A.4). For example, I use project launch for the start of a project since the term *start up* is used in the process industries for the stage when their facility is set to work. However, in the product development business, *product launch* is at the end of the project when the product is being introduced into the marketplace. Similarly, I used *implementation* for the stage when the bulk of the work was carried out, but the information technology world uses implementation for the setting to work stage. Consequently, *execution* has been used for the carrying-out/doing stage. I avoid the use of the word *development* since it tends to bridge the last stage at which the project can be abandoned. (See paragraph 3.2.1 in this part and Figure I.B.5).

The second barrier in the project business is a cultural barrier. This cultural barrier is not just that between the French and the English, but it is between the various project management industries, where there is a reluctance to borrow good methods from each other. There is also a barrier between companies in the same business environment. One company will be design-dominated, another project management-focused, and another will be experienced in pharmaceuticals or in offshore work. Then there will be the companies that are the favourites of a particular client. If that lot is not bad enough, there is the cultural barrier within companies – the different mindset between the front end creative people and the practical back-end applicators. It is now recognised that project management is an attitude of mind, and this is what makes it more of an art than a science.

There is a potential third barrier that requires skilled project management. In the project management process, there are interfaces where conflict can occur quite naturally, namely, between:

- Client and contractor
- The main functional departments of design engineering, procurement, and construction
- The individual design groups
- The line functions and the task force

There are two components to achieving the successful end result. Firstly, the hard subjects, the 'hardware' of project management:

- a. Strategy, contract and organizational
- b. Financial analysis
- c. Planning and scheduling
- d. Control techniques
- e. The four techniques that are the science of, and special to, project management:
  - i. *Product and work breakdown structures* (P&WBS) should, on the whole, always be done manually as a team process.

- ii. *Critical path method using network analysis.* The simple time analysis can often be done equally well manually, owing to the intricacies of the multitude of software packages. However, once the network is over a certain size it is safer to use a computer owing to people's ability to add. However, a computer will always be needed for serious project management if the real benefits of iii) are to be achieved.
- iii. *Resource analysis and allocation.* Each type of resource (people, materials, money and so on) requires a different 'calendar' (working hours, shift patterns, shipping times, holidays and so on). Consequently, a computer is required for the complex analysis involved.
- iv. *Progress measurement using earned value and 'S' curves.* This is the sophisticated part of project management and is avoided by many people. Further, owing to the effort required to implement the process it can often be compromised by simplification. (See Part V Section L).

Secondly, the soft skills, the 'software' of project management:

- a. Teambuilding
- b. Leadership
- c. Communication skills
- d. Presentation skills
- e. Motivation
- f. Influencing
- g. Negotiating

These elements have all been borrowed from the toolbox of general management. As we can see, there is a conflict. Is project management an art or a science? The skill of the project manager is to decide where to put the emphasis – onto the hardware or the software – and how to integrate the two. I have absolutely no doubt that the more one is involved in project management, the more one is surprised at the power of these soft skills. Without the software, the hardware will achieve little. However, without the foundations of some of the hardware of project management, the efforts of the software is dissipated, and failure will result.

The clever part of project management is that, as well as modelling the project (the phases), it uses models of the various processes. This enables the project manager to evaluate different options before having to commit to specific actions with their associated costs.

## 1 Models

### 1.1

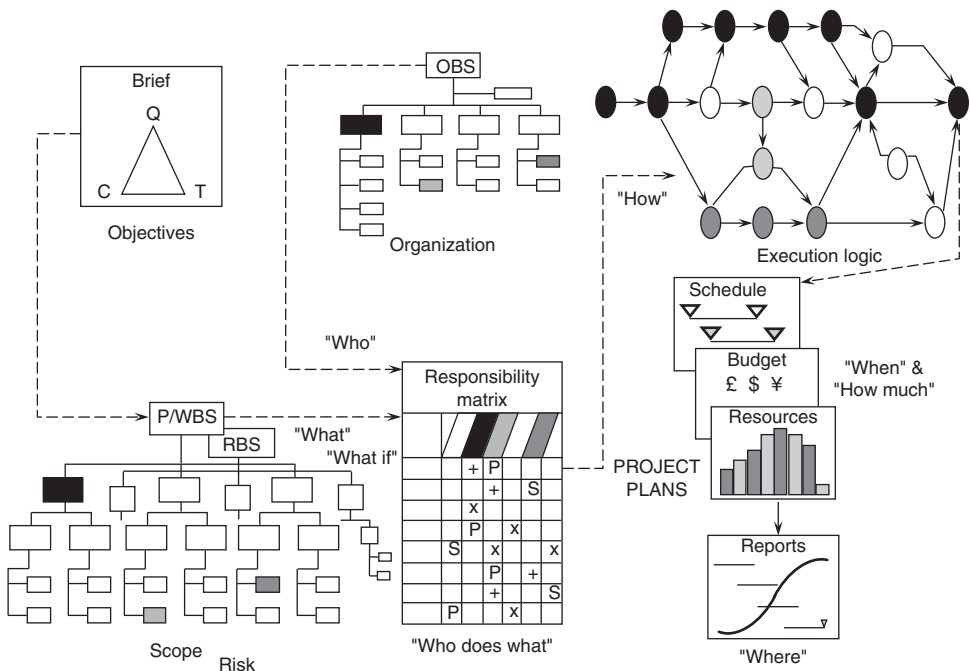
The overall project management process is broken down into the discrete project management fundamentals and modelled, using whatever management tool is appropriate.



<i>Process</i>	<i>Model</i>
Defining the scope and scope of work	Product & work breakdown structures (P&WBS)
Identifying the risks	Risk breakdown structure (RBS)
Fitness for purpose	Specifications
Risk and responsibility allocation	Agreement or brief
Forecast of costs	Estimating
Effect of changing variables	Risk and sensitivity analysis
Time value of money	Net present value (NPV)
Execution plan	Critical path network
Timing of activities	Bar charts
Project team	Organization structure (OBS)
Leadership	The project manager

## 1.2

As well as these individual models, there is an overall project management model (see Figure I.B.1)<sup>7</sup>:



**Figure I.B.1**

7 The original version of this model was given the title 'The Project Model,' by Stone & Webster. I have developed it further and correctly described it as 'The Project Management Model'.

### 1.2.1

As can be seen, the model is composed primarily of the hardware techniques; all of the software being in the organization breakdown structure, with the communication links shown by the dotted lines.

## 1.3

In the model the *Brief*, or contract, defines the requirements and objectives of the project in terms of cost, time, and quality and determines which aspect will dominate the decision process.

## 1.4

The *What*, the scope of work, is defined by means of the product and work breakdown structures in order to identify manageable packages of work.

## 1.5

The *What if* identifies the risks using a risk breakdown structure developed using the product and work breakdown structures.

## 1.6

*Who* will lead the project, and who will form the team? The organization breakdown structure, is achieved by matching the requirements of the project and the abilities of the individuals.

## 1.7

*Who does what* transfers ownership and responsibility to the team (for example: full time – X, part time – P, support function – S) and communicates this through the responsibility matrix.

## 1.8

*How* the work should be performed is created through a team consensus for the execution plan and the relationship between the work elements.

## 1.9

*When & how much* is determined by the control documents that will provide the data (schedule, budget, and resources) from which trends and deviations from the plan can be identified and reported.

## 2 Characteristics

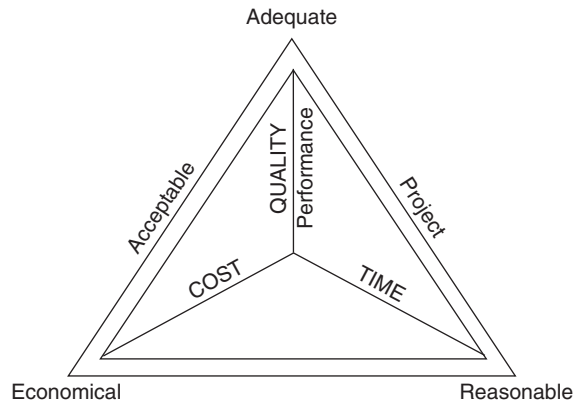
The project management *process* has certain characteristics, which differ from conventional management systems and brings with it certain advantages.

## 2.1 Project Management Objectives

The project management process takes the owner's or client's business objectives and translates them into specific objectives (Figure I.B.2) for managing the project (scope):

- By a specified time
- Within a specified budget
- To meet a specified standard of performance, which must include safety, other aspects being quality, value, and benefits

Figure I.B.2



Since the prime objective is to complete the scope safely within the constraints of cost, time, and quality, some people put safety and scope at the centre of the triangle.

The natural instinct of owners is to ask for the lowest cost, the client project manager wants the shortest schedule, and the users want the highest quality.

All three of these extremes are not possible all together. The client should be asked to put an 'x' within the objectives triangle to show where the balance is. Do not accept an 'x' in the centre.

An insufficient budget or running out of money or missing schedule targets means that the scope of the project is compromised or cut. This results in a project that fails to achieve its objectives, and the consequence is dissatisfied users.

## 2.2 One Leader with Responsibility and Authority

A seminal requirement for any endeavour is that there is *one* person in charge; a single point of contact. Thus, senior management delegates the responsibility for managing the project to a project manager. The project manager is responsible for client relations and represents the client within their organization, and represents their organization to the client, as well.

In spite of this, in many organizations, senior management often says: "But we will make the decisions." In these circumstances, you have to ask who is managing the project: you the project manager or senior management. Consequently, you need to manage upwards – "May we have a decision by day x? Otherwise it will cause a delay to the project."

## 2.3 Multidisciplinary Teamwork

The primary characteristic that distinguishes project management from 'ordinary' management is that it is multidisciplinary. The difficulty is how to get these different disciplines to work together as a team. If it is achieved, there are two significant results:

a. Teamwork.

The personnel on the project are more motivated and communication is greatly improved.

b. Synergy.

The use of people with different skills, expertise, and experience to solve complex problems results in greater efficiency and innovation than ordinary groups could achieve.

## 2.4 Matrix Organization

Because of the temporary nature of projects, a matrix organization is necessary to:

a. Reassign personnel

b. Carry out long-term personnel planning

c. Audit the quality of the work

Organizations vary from the functionally organized with a project coordinator (a weak matrix) to the task force with a project manager (a strong matrix). See Section D, subsection 2.

## 2.5 Control

Project management achieves control of a project by ensuring that meticulous attention is paid to every aspect of the job.

# 3 Key Management Decisions and Phases

There are a number of key management decisions relative to the project phases.

## 3.1

Firstly, the owner may need to purchase additional expertise or resources at different stages (the phase breaks between feasibility, planning, and execution – Figure I.A.3) to perform portions of the work, as mentioned in Section A paragraph 2.3.

### 3.1.1

The first purchasing/contracting option is to negotiate with a contractor. This will have the minimum impact on the project duration (See Figure I.B.3).

### 3.1.2

The second purchasing/contracting option is to invite competitive tenders for the performance of the work.

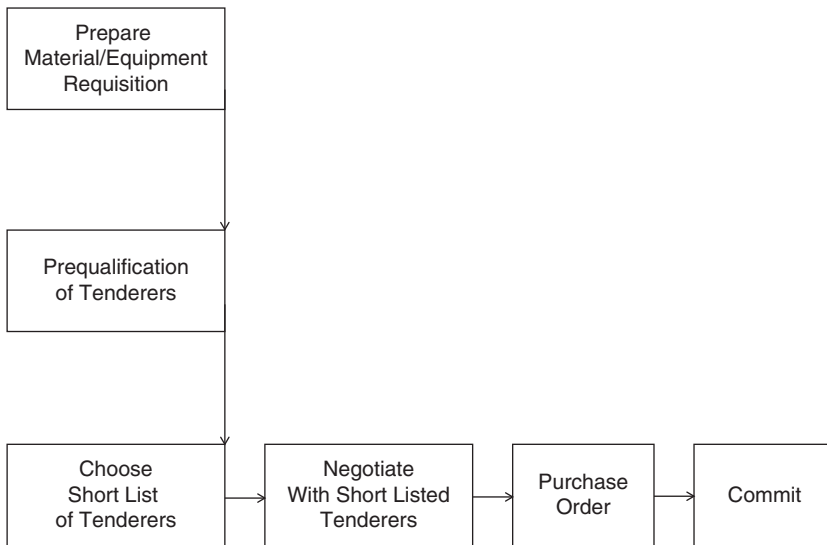


Figure I.B.3

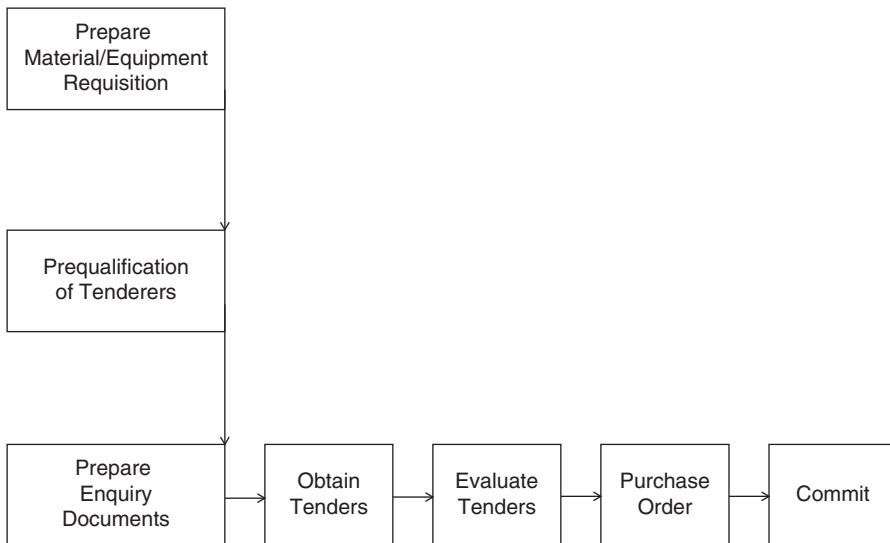


Figure I.B.4

### 3.1.3

The client may wish to retain complete control over the work by approving the deliverable outputs from each of the stages in Figure I.B.4. Consequently, an *owner approval* stage must be scheduled at the end of each stage. This option will significantly extend the project duration.

### 3.1.4

The owner/client may use the same contractor for every phase/stage or, alternatively, may use one contractor for the basic design and planning phase and then be tempted to invite competitive tenders for the execution phases. It is crucial for the contractor to maintain good relationships if they are to survive the transition from one phase to the next.

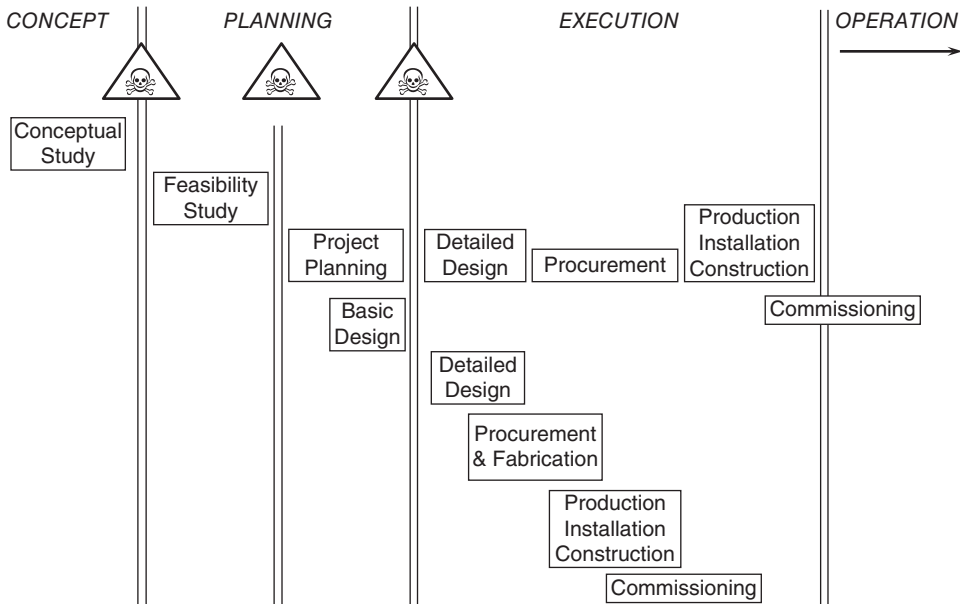
## 3.2

Project management (as well as deciding the contracting strategy in the early phases), must satisfy the criteria to move from one phase to the next phase, namely:

- Is the project still appropriate to the company business plan?
- Is the financial model still viable?
- Will the project work technically?

### 3.2.1

The first two sets of vertical lines in Figure I.B.5 indicate where there is a natural break between the phases and an opportunity to stop the project. At the third set of vertical lines, the break is less natural, and the project can drift into the execution stage without proper evaluation. If the project cannot pass these 'decision gates' the project should be killed off. This is one of the most important decisions a project manager has to make and one of the most difficult to implement.



**Figure I.B.5**

### 3.2.2

Product development introduces more and more formal senior management gate reviews before the start of each numbered phase shown in Figure I.A.4.

### 3.2.3

For a client or sponsor, the gate review process starts at the identification of a business opportunity, and the most important gate is the one before any contracting arrangements are implemented. The last gate is a review of the project's success and the lessons learnt.

## 3.3

Thirdly, at the end of the planning phase, project management must decide how quickly to move into the execution phases and how much overlap of the phases there should be.

### 3.3.1

Starting the next phase before the previous phase is complete, *fast tracking*, means that rework will be required. The client may perceive this as contractor inefficiency, and yet the client is the person to benefit from an earlier completion date.

## 3.4

The last key decision is when to start construction. Just because the programme says one should be starting does not mean that one should start if you are not ready.

### 3.4.1

Some simple rules of thumb:<sup>8</sup>

- a. Construction can't start until engineering has reached 30 per cent.
- b. Construction can't achieve more than 30 per cent if engineering has not reached 90 per cent.
- c. Between 10 per cent and 90 per cent complete construction can achieve 1 per cent progress per week. Less than this means that something is wrong. More than this means the key people in the project's management are deluding themselves. Ask what special plan or short cuts are being implemented, for example, pre-ordering of long lead items, extended working, using dedicated shipping, and so on.

### 3.4.2

Once construction begins, the construction people start demanding information, often in a different order to that which the home office is working. This must be controlled. Construction must be reminded of how they said they were going to work when their representative was involved in the design process (see Part IV, Section Q Installation and Construction, paragraph 1.3). Otherwise chaos will result.

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<sup>8</sup> Vernon T Evenson, Project Manager.

## 4 Project Management Patterns

### 4.1 Number of people involved

Projects have a definite start date before which the staff level is zero. The project manager has to find the resources required to get the project going. Consequently, projects start slowly. Conveniently, the number of people involved in the early phases, that is the study and planning phases, is very small compared with those required during the execution phases, see Figure I.B.6.

Once construction or production starts, the number of people rises very rapidly. The personnel build up to a peak and then fall back to end again at zero at project completion.

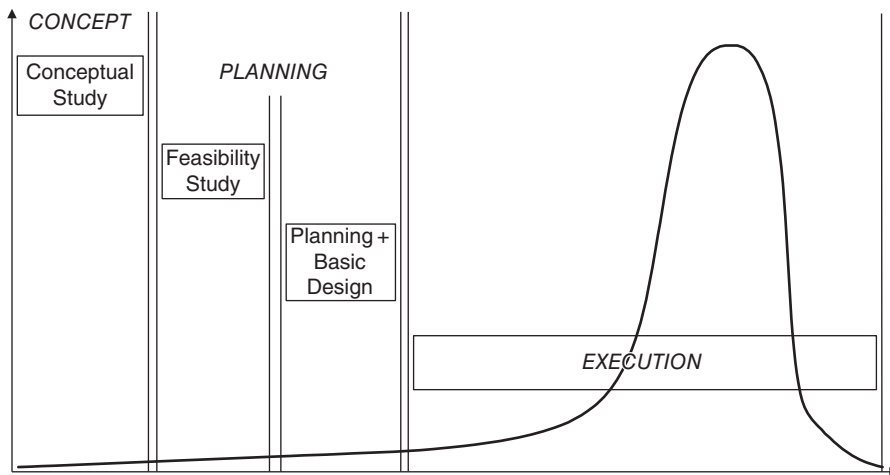


Figure I.B.6

### 4.2 Increase in costs for one week's delay or cost of accelerating project by one week

If the project is delayed for any reason, the cost of a delay during the early phases is relatively less expensive because fewer people are involved and few, if any, commitments have been made. If the job is delayed when the workforce is at its peak and a major part of the investment has been committed, the cost of a week's delay is very high, see Figure I.B.7. Thus, if a major design error is found, which involves rework, the cost impact can be serious. This highlights the importance of good design quality assurance.