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Project Management Manual:  
Outline Guidelines

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Project Management Manual:

Outline Guidelines

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## 1. MANUAL: AIMS

This manual outlines the principal project management processes. It is intended to provide a guide to many project management activities. It is for internal Arup use only, and should not be relied upon by any third party. Each Section outlines procedures, proformas and tools for addressing the issues. Other tools and examples are contained in the Project Management Manual electronic library.

The scope of each section of the manual is noted in Table 1: Summary of Manual Scope.

[Section 2](#) defines the commonly used terms in the manual.

[Sections 3 to 6](#) provide an overview of the Project Manager's role, organisational and communication arrangements, and the documentation and control systems that need to be put in place. These are compiled together in the Project Implementation Plan (see [Section 4](#)).

[Sections 7 to 14](#) provide guidance on typical procedures for specific project management activities.

The principal relationships covered by this manual are those between the Project Manager and:

- The Owner
- Funders
- Designers
- Other consultants
- Suppliers
- Contractors
- The Project Manager's staff
- End users

Its scope excludes liaison activities with third parties, such as local planning authorities, pressure groups or utility companies. For guidance on conducting statutory planning activities within the United Kingdom, the reader is advised to contact Arup Economics and Planning in London.



TABLE 1: SUMMARY OF MANUAL SCOPE

SECTION HEADING	SCOPE
1. <b>Manual : Aims</b>	<ul style="list-style-type: none"> <li>Manual scope, layout and target readers</li> </ul>
2. <a href="#">Definitions</a>	<ul style="list-style-type: none"> <li>Definition of terms used in the manual</li> </ul>
3. <a href="#">Project Manager's (PM's) Responsibilities &amp; duties</a>	<ul style="list-style-type: none"> <li>Overview of the PM's role; primary responsibilities and tasks</li> </ul>
4. <a href="#">Project Implementation/Execution Plan (PIP)</a>	<ul style="list-style-type: none"> <li>Typical PIP objectives and issues covered</li> </ul>
5. <a href="#">Management and Control Procedures</a>	<ul style="list-style-type: none"> <li>Typical procedures for change management, interface management, risk management and value management procedures</li> <li>Computer systems to support project control</li> </ul>
6. <a href="#">Communications</a>	<ul style="list-style-type: none"> <li>Definition of forms of communication</li> <li>Typical processes and systems</li> </ul>
7. <a href="#">Design Management</a>	<ul style="list-style-type: none"> <li>Typical procedures and systems</li> <li>Reports frequently required</li> </ul>
8. <a href="#">Cost Management</a>	<ul style="list-style-type: none"> <li>Definitions</li> <li>Typical systems adopted for managing cost at a project level and reports frequently required</li> </ul>
9. <a href="#">Programme Management</a>	<ul style="list-style-type: none"> <li>Types of programmes</li> <li>Guide to programme content</li> <li>Typical procedures and systems adopted for monitoring and updating programmes and reports frequently required</li> </ul>
10. <a href="#">Information Management</a>	<ul style="list-style-type: none"> <li>Typical procedures and systems adopted to manage the flow of documents and reports frequently required</li> <li>Document archiving</li> </ul>
11. <a href="#">Procurement</a>	<ul style="list-style-type: none"> <li>Developing contract strategies / works package breakdown</li> <li>Pre-qualifying contractors / designers</li> <li>The structure of typical tender and contract documents</li> <li>Tender and assessment process</li> <li>Reports frequently required</li> </ul>
12. <a href="#">Contract Administration</a>	<ul style="list-style-type: none"> <li>Contract Administrator duties</li> <li>Typical contract processes and procedures, and reports frequently required.</li> </ul>
13. <a href="#">Construction Support Services</a>	<ul style="list-style-type: none"> <li>Scope of construction support services and typical procedures and systems adopted</li> </ul>
14. <a href="#">Site Health &amp; Safety</a>	<ul style="list-style-type: none"> <li>Scope of health and safety, compliance with United Kingdom Construction Design and Management (CDM) regulations</li> </ul>
15. <a href="#">Quality Management</a>	<ul style="list-style-type: none"> <li>Complying with the Arup Quality Assurance Manual</li> <li>A guide to auditing contractors and designers quality systems</li> </ul>

## 2. DEFINITIONS

The following terms are used throughout this manual.

### **Project Management**

Project management is the process by which an individual/team initiates, co-ordinates, controls and monitors the design and construction delivery team on behalf of the Owner.

### **Project Manager**

The individual or organisation employed to control the cost and manage the realisation of the Owner's project in co-operation with all the contracted delivery team, such as Design Team, etc.

The Project Manager has no direct involvement in the design, nor the delivery of the project. They are often responsible for ensuring (subject to reasonableness) that the contractual obligations of the delivery team to the client are undertaken satisfactorily, especially in terms of time, cost and quality.

### **Owner**

The individual or organisation commissioning the project. This individual or organisation may, or may not directly employ the Designers, Project Manager, Constructors and Works Contractors. This individual may be called the Client and be the Employer.

### **Designer**

The lead designer organises the design of all the project's elemental parts. The design team may comprise architects, engineers, specialist design consultants and where necessary specialist contractors.

### **Constructor/ Works Contractors**

The organisations employed to construct, fabricate, manufacture, install or supply parts of the project to the designs and specifications prepared by the Designer.

### 3. PROJECT MANAGER - RESPONSIBILITIES AND DUTIES

#### 3.1 Generally

Project management encompasses the process of planning, implementing and controlling a project from the stages of Identification of Need, through Conceptualisation (design) and Realisation to commissioning and hand over (Occupation). Typical project phases are shown in Figure 3.1. There are often overlapping phases. A project management commission may not cover all of these phases.

The Owner maintains control over the project, without relieving the Designer and Project Manager of any of their professional duties or liabilities. The Designer designs, the Project Manager manages and the constructors/Contractors produce the Works. The Owner directs the project for which they alone are ultimately responsible.

#### 3.2 Project Manager's Responsibilities

The Project Manager is responsible for developing a plan, an organisational structure and procedures for achieving the project objectives. This will typically entail developing strategies and procedures covering:

- The overall planning, general management and control of the project from inception to completion.
- Ensuring that the Owner is kept informed on progress, costs and levels of future expenditure; potentially evaluating and issuing variations once they have received the Owner's approval, agreeing interim payments and final accounts with the works contractors and advising the Owner on contractual claims (an additional service).
- Identification of all statutory requirements: advising the Owner of time and cost implications and suggesting alternative methods, if necessary, of meeting these requirements.
- The division of the work into appropriate packages; the procurement of tenders and checking that work contractor's pre-ordering of essential long delivery materials or equipment is undertaken.
- The establishment of a health, safety and security policy for the site.
- Site evaluation and the identification of project support requirements.
- Assessment of the design for buildability (an optional service), compliance with budget costs, programme and value for money.
- Provision of overview advice on project costs and the establishment of cost budgets for the project, which may include lifetime costs (the extent of this service will depend upon the proposed Project Manager's specific duties).
- Administration and monitoring of constructor's activities/ Works Contracts (an additional service).

Examples of the above duties can be found in the Arup legal website.

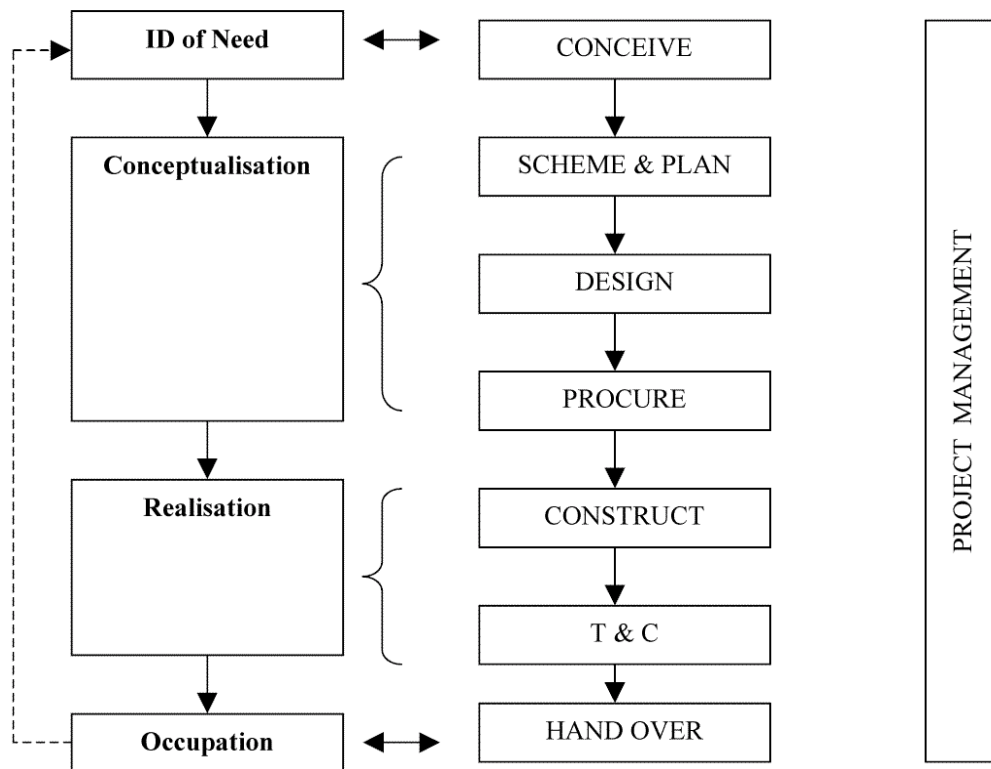


Figure 3.1 PROJECT PHASES

### 3.3 Project Manager's Tasks

The Project Manager's responsibilities will be discharged by the performance of the following schedule of tasks. For ease of reference, these are related to the manual's sections. **The list of tasks is illustrative of a typical project management commission. They will depend upon the individual project requirements.** Many of these duties will be carried out in co-operation with the Designer and other members of the project team. Note the different obligations required by 'monitor', co-ordinate, review, check, develop, evaluate, value and advise.

PM agreements and consultants duties and scopes of services can be found in the Arup legal website. Other documents such as deliverable checklists are contained in the Project Management Manual electronic library.

#### 3.3.1 General management and organisation of the project (Sections 4 to 6)

- Prepare the Project Implementation Plan comprising:
  - (a) Project organisation.
  - (b) Organisational responsibilities.
  - (c) Management processes and control procedures.
  - (d) Communication processes.
  - (e) Meeting schedules.
  - (f) Co-ordination / interface management procedures.
  - (g) Reporting arrangements.

- Design the overall project organisation structure and produce clear descriptions of all the required roles and responsibilities. Check that competent people are employed to fill each role and that they fully understand their responsibilities.
- Co-ordinate and present budget costs and feasibility studies to the Owner.
- Co-ordinate the project team to identify project constraints and opportunities.
- Co-ordinate the project team to identify necessary preparatory works; e.g. service diversions, surveys.
- Monitor the process of obtaining the approvals from statutory authorities.
- Liaise with Owner and Designer regarding the appointment of specialist contractors for design.
- Maintain records of meetings and all other activities.
- In discussion with the project team and the Owner, establish a mechanism for effective industrial relations.
- Produce monthly reports for the Owner providing forecast final costs and forecast completion dates.
- Co-ordinate with the Designer to receive occupation certificates and clearance from Health and Safety and Fire Officers.

### **3.3.2 Design Management ([Section 7](#))**

- In conjunction with the Designer, present and review design reports with the Owner, for agreement.
- Monitor buildability and technical design issues with the Designer and Works Contractors (an optional service).
- Monitor with the Designer the use of project appropriate innovations including particularly the extent of off-site prefabrication.
- Contribute to the preparation and development of the project brief in conjunction with the Designer and issue amendments as necessary.

### **3.3.3 Cost Management ([Section 8](#)) (if within scope of services)**

- Prepare budget costs and present cost studies to the Owner.
- Prepare, maintain and monitor the cost plan.

### **3.3.4 Programme Management ([Section 9](#))**

- Prepare and maintain a project master programme which defines the project milestones.
- Review the Contractor's/ Works Contractors planned construction method(s) including off-site fabrication systems.
- Prepare the Owner's commissioning and equipping programme.
- Monitor progress and prepare monthly status reports.

### **3.3.5 Information Management ([Section 10](#)) (if within the scope of services)**

- Establish and manage an information system, so that everyone involved understand what work they must do, and how it fits into the total project.
- Establish and manage a document control system.

**3.3.6 Procurement ([Section 11](#))**

- Arrange for the Owner to place orders for surveys including soil investigations, structural and other surveys and models.
- Co-ordinate and discuss work packages with the Designer and Specialist Contractors.
- Draw up list of qualified tenderers, identifying resources and labour.
- Send out tender documents. (This may be undertaken by other project team members.)
- Receive tenders and obtain clarifications as required.
- Coordinate/ prepare tender award recommendations the Owner.
- Advice on orders for long delivery components.

**3.3.7 Contract administration ([Section 12](#)) (if within the scope of service)**

- Assemble contract documents, advice on bonds, where necessary, and obtain Owner and Constructors/Works Contractors' signatures.
- Co-ordinate valuations and final account.
- Co-ordinate payment certificates.
- Obtain approval to the cost of variations and claims when the Project Manager's limit of authority is exceeded.
- Co-ordinate variation orders and instructions.
- Co-ordinate with insurance claims.
- Co-ordinate certificates of extensions of time.
- Co-ordinate Practical Completion Certificates.
- Monitor the remedying of defects
- Co-ordinate the issue by the Contractor/ Works Contractors of maintenance manuals and as-built drawings.
- Monitor the Designer, Contractor and Works Contractors in the performance of their duties and the discharge of responsibilities as set out in their respective schedule of duties.
- Issue directions on behalf of the client to Contractor/ Works Contractors where their work does not comply with the contract documents.
- Maintain a site diary to record the progress of the Contractor, each Works Contractor's design, construction delays, weather conditions, site visitors and other significant facts.
- Ensure that the Contractor/ Works Contractors protect the works in accordance with contract documents.

**3.3.8 Construction Support Services ([Section 13](#)) (if within the scope of service)**

- Provide site services.

**3.3.9 Health & safety ([Section 14](#))**

- Discuss health and safety requirements on site and develop and implement appropriate policies. In United Kingdom these should embrace the requirements of the Construction (Design and Management) Regulations (CDM's). In the United Kingdom, obtain the health and safety file.

**3.3.10 Quality ([Section 15](#)) (if within the scope of service)**

- Be responsible for quality control. This duty will involve the whole project team to establish the acceptable standards for works contractors and the subsequent quality monitoring. The responsibility for quality control must be established before consultant and construction contracts are awarded.

## 4. PROJECT IMPLEMENTATION/ EXECUTION PLAN

### 4.1 General

In order to manage a project and reassure the Owner that the project will meet its defined objectives, it is necessary to:

- State the objectives.
- Implement procedures and systems to manage all aspects of the project.

The Project Implementation Plan (PIP), or Project Execution Plan (PEP), states the principle project objectives and sets out the principal procedures and systems to be adopted to control all aspects of the project. At the commencement of the project, the Project Manager should prepare this document.

The PIP assists in co-ordination of the processes undertaken by the Owner, Designer, Project Manager and Contractors/ Works Contractors. It provides a common basis for all parties. The PIP will need to be updated as the project develops. The PIP identifies sub-plans, reports and papers that need to be prepared to progress the project through its various stages.

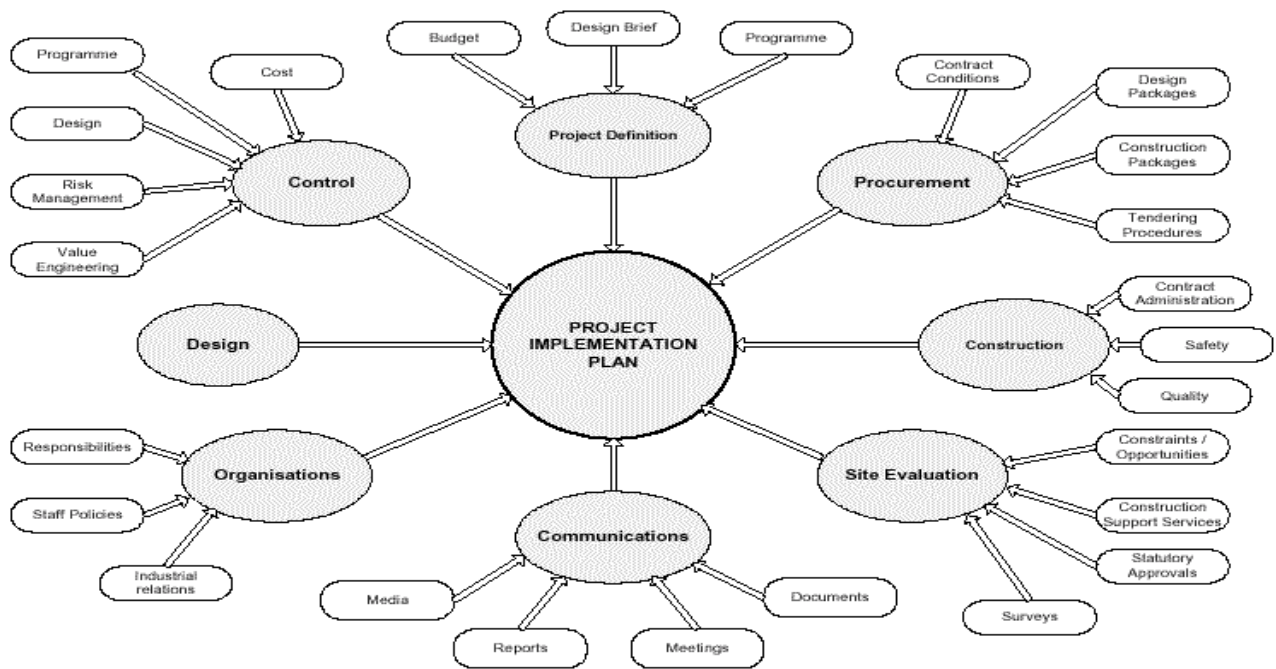
The PIP should be compiled into single document possibly stored in a ring binder, and circulated to all members of the project team as a controlled document.

Typically the PIP contains sections covering:

- Project definition; in terms of objectives, requirements and acceptance criteria, site evaluation (if required).
- Management and control procedures and processes.
- Organisational responsibilities and arrangements.
- Communication procedures and arrangements.
- Procurement strategy.
- Design management.
- Contract Administration
- Appendices containing the project directory, meeting log, organisational charts. It is advisable that the appendices contain the components, which will need to be updated during the project.

Figure 4.1 illustrates the content of the PIP. Examples can be found in the Project Management Manual document library under development management or using the full electronic library using key word search under "[Project AND Execution AND Plan.](#)"





**PROJECT IMPLEMENTATION PLAN**

**Figure 4.1**

## 4.2 Project Definition

The PIP defines the project in terms of the Owner's business and physical requirements, the programme and allocated budget.

### 4.2.1 Functional Requirements – The Facilities

These should be concisely communicate to the project team the fundamental purpose and aesthetic needs of the Owner. This information could be contained in a strategic brief. More detailed information will be described in the project brief. This will include the location of the project, a general description of the buildings, their intended usage, and any other relevant data to describe the scope of the project. Acceptance criteria should be stated.

Strategic statements should be included to define:

- Quality - indication of general standards, environmental control standards, acceptable life to first maintenance.
- Approvals - all approvals required including statutory approvals.
- Planning - factors known to have a bearing on implementation such as site availability, vehicle access, existing services, environmental concerns, neighbours .etc.
- Flexibility - adaptability, expansion.
- Phasing.

Examples are held in the Project Management Manual document library under Briefing /Scope Management within Development Management or in the full electronic library under keyword search "Briefing", "Project AND brief", "Strategic AND brief", "Scope AND of AND Work".

### 4.2.2 Programme

The PIP contains an outline project programme, indicating the Owners principal requirements and approval processes.

Typically the programme identifies the following project phases:

- Start date
- Feasibility
- Design - Design of works to the standard required for procurement and the project.
- Surveys - Topographic, geotechnical etc.
- Tendering - Preparation of tender documents, bills of quantities and other information required for the selection of suppliers and contractors. Selection by negotiation or competitive tendering, evaluation of bids and completion of contract document.
- Construction - Supply of materials, fabrication and testing of elements, project and installation on site.
- Commissioning -Test of the complete project section by section. Adjustment of all plant and equipment to optimise overall performance. Staff training, start-up and monitoring over first phase of operation.
- Completion dates - Phased requirements.

See also [Section 9](#). Examples are held in the Project Management Manual document library under programme and resources or in the full electronic library under keyword searches for "programme", "relocation AND schedule" and "migration AND schedule".

#### 4.2.3 Budget

The PIP contains an outline project budget subdivided into major elements, together with an indicative cash flow forecast. The limitations and assumptions should be clearly stated.

Examples are in the Project Management Manual electronic library under keyword search Design Cost Control.

#### 4.2.4 Site Issues and Evaluation

The PIP notes parameters/ constraints regarding:

- The physical condition of the site and it's implications on the project.
- The need for additional ground surveys / investigations.
- The need for environmental measures.
- Service provisions / requirements for the site.
- Site availability.
- Access arrangements to the site.
- Requirements for enabling and construction support services.

### 4.3 Organisational Arrangements

The PIP sets out the organisational arrangements for the project team in terms of responsibilities, reporting lines, staff policies and project culture. Often a project directory is included in the appendix.

#### 4.3.1 Responsibilities

The responsibilities of each of the project organisations need to be clearly defined.

A Summary of each organisation's primary tasks during each phase of the project should be stated. Any gaps in services provided should be noted and addressed with the Owner. Each party's responsibilities will depend upon the project scope and their service duties.

It is recommended that a "signing-off" procedure is implemented by the Owner at pre-determined stages during the project.

#### 4.3.2 Reporting Lines

An overall project organisation diagram showing the principal project participants in the project is required. This diagram illustrates the reporting lines and hierarchy of the various organisations and their contractual relationship with the Owner. Figure 4.2 shows a typical arrangement.

Organisation charts for each project organisation should also be included so that the responsibility and authority of individuals can be identified. A brief description of the key players and their roles should be provided. The design team organisation chart should note the role and relationship of any specialist consultant. An organisation chart for a Project Manager's organisation for a large project is shown in Figure 4.3.

#### 4.3.3 Staff Policies, Project Culture

Particular requirements of the owner with respect to staffing should be noted in the PIP. Particular methods of working such as non-confrontational, partnering approaches will also be identified.

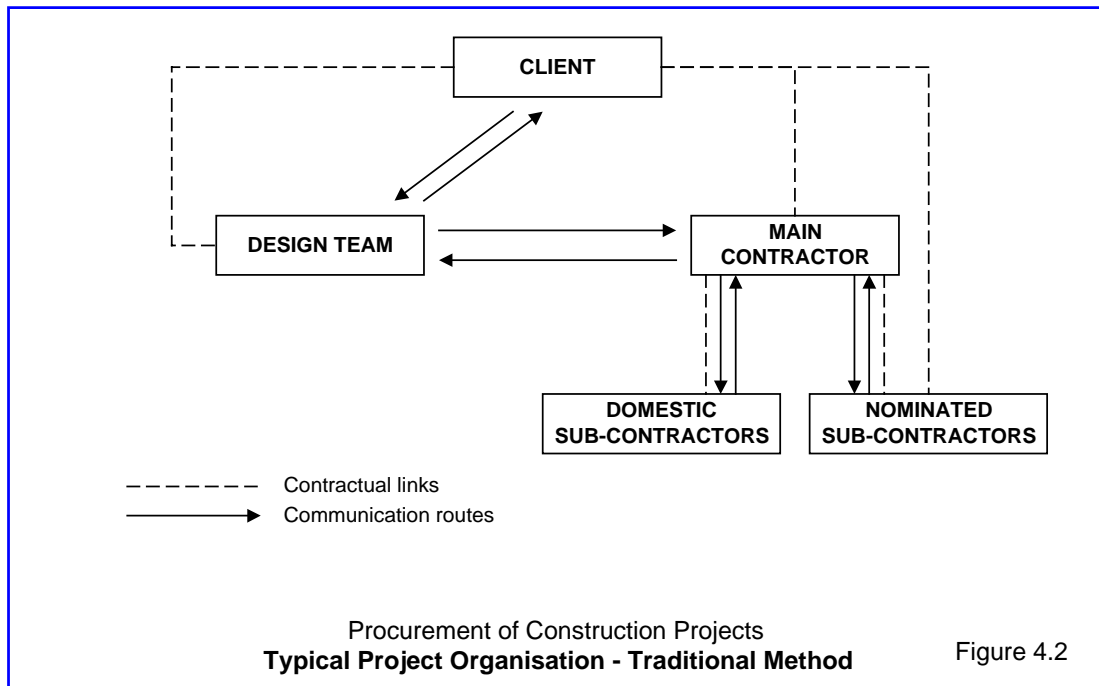


Figure 4.2

**Figure 4.2**

For organisational diagrams of other procurement routes, search in the project management manual document library under contract management or in the full electronic library under “procurement AND strategy”.

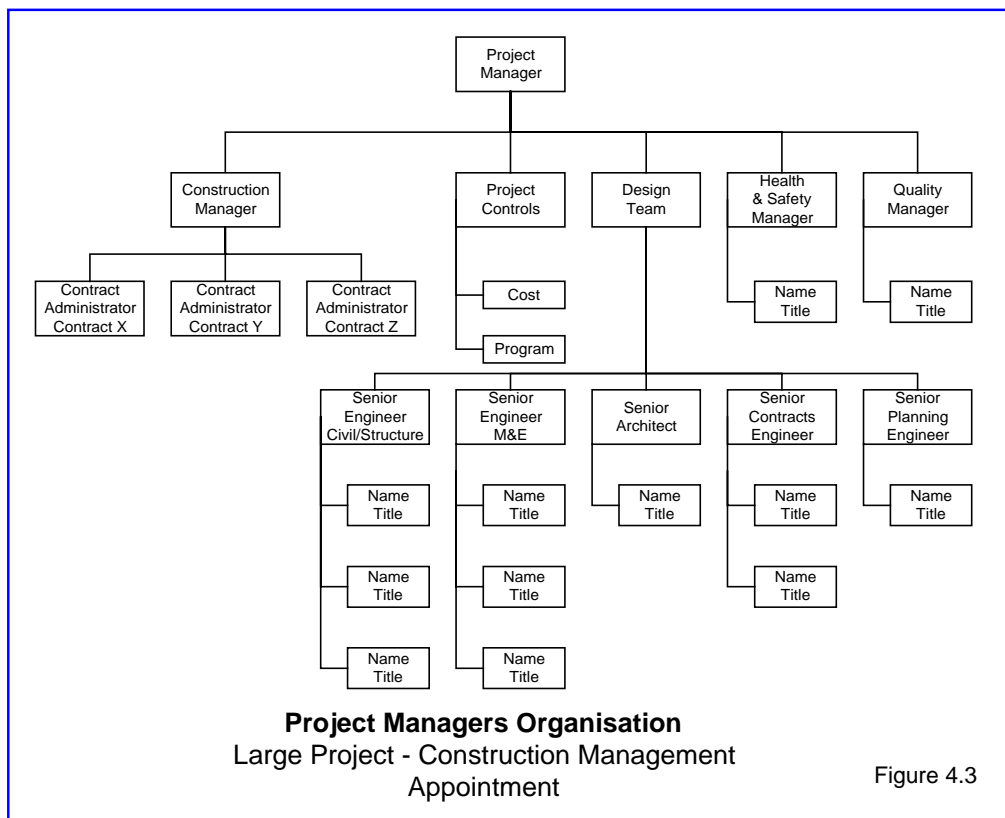


Figure 4.3

#### 4.4 Management and Control Procedures

The PIP identifies the procedures and systems to be adopted for monitoring the aspects of the project.

- Design.
- Approvals.
- Procurement.
- Costs.
- Programme.
- Interfaces.
- Construction.

The control procedures need to cover changes in cost, specification or programme. Where changes are identified they should be subject to a formal authorisation procedure so that all the implications are identified.

The procedures should also include application of the following techniques at appropriate points during the life of the project:

- Risk management.
- Value management and engineering.

The PIP should identify when it is proposed to apply these techniques. Further guidance on this subject is given in [Section 5](#).

#### 4.5 Communication Procedures and Arrangements

The PIP defines, in principle, the lines of communication to be adopted for the project, the frequency of project meetings and the type, style and format of reports to be prepared.

The PIP identifies the CAD and IT systems to be used and measures to ensure data exchange compatibility. Further guidance on these subjects are given in [Section 6](#).

#### 4.6 Procurement Strategy

The PIP identifies the main parameters for the project procurement strategy. The strategy is likely to include descriptions of:

- Alternative consultant (if applicable) and construction organisations and payment terms that could be adopted.
- Identification of critical issues including long lead items that need to be ordered ahead of other elements on the procurement strategy.
- The principles underlying arrangements / procedures for the pre-qualification, tender and award of construction and consultant contracts.

Further guidance on procurement is given in [Section 11](#). Guidance for choosing a procurement strategy can be found using the [Arup legal website](#) and in the Project Management Manual document works under [contract management](#) or using the full electronic library using the keyword searches on “[procurement](#)” and “[terms AND contract](#)”.

#### 4.7 Design Management

The PIP identifies the principal processes to be adopted for developing the detailed scope and design of the project facilities.

The PIP should also identify:

- The procedures for reviewing and controlling the design process.

- Studies to be undertaken to optimise the design and construction process, for instance the scope for modularisation and pre-fabrication.

Further guidance on this subject is given in [Section 7](#), and within the design management section of the Project Management Manual document library.

## 4.8 Contract Administration

The PIP identifies the parameters to be used to establish the administrative and supervisory arrangements for the management and control of the Contractor/ Works Contracts.

It will identify the authority of the Contract Administrator, their reporting arrangements and the types of procedures that will be used to monitor and control progress, cost and quality.

Further guidance on this subject is given in [Section 12](#).

## 5. MANAGEMENT AND CONTROL PROCEDURES

### 5.1 General

This section outlines guidance on the application of:

- Change management.
- Interface management.
- Risk management.
- Value management and value engineering.
- Computer tools.

### 5.2 Change Management

A fundamental principle of project control is that design or construction of proposed changes should not be initiated until formal approval and sign off has been received from the Owner. The only exception being during the construction phase of the work, when a change is deemed necessary to alleviate an immediate safety hazard.

For an effective change control system to operate, a series of agreed benchmarks must be acknowledged, namely:

- An approved detailed project brief and signed off design/ project proposal.
- Agreed definition of what constitutes a change.
- An approved control budget based on the project brief.
- An agreed mechanism for identifying and quantifying the effects of proposed changes, together with mandatory response times for authorisation to proceed.
- Regular reporting of the status of change requests with cumulative cost and programme implications.
- An individual responsible for implementation of the process. This is may be the Project Manager.

The PIP with the Strategic Brief provides the initial bench mark for assessing change.

A simple change review and approval process is shown in Figure 5.1. Once a change has been approved, the Project Manager issues a formal instruction, which will initiate the formal update of project budgets and other data.

The efficiency with which changes are reviewed and dealt with is dependent on:

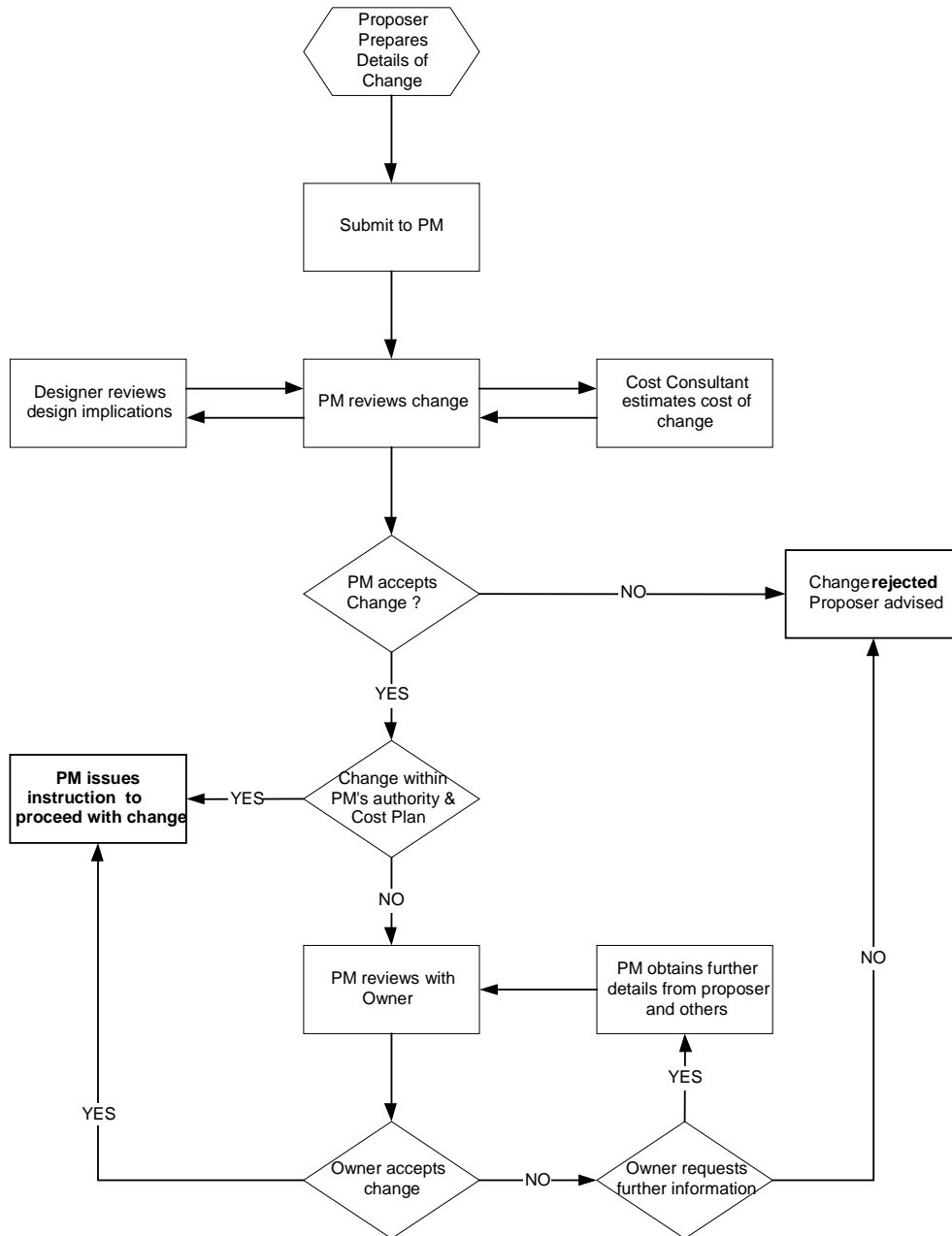
- The judgement of the Project Manager in determining whether the change is essential.
- The completeness of the documentation supporting the change proposal.

The authority of the Owner's Representative to approve budget changes.

Whenever a change is proposed it is essential that the impact on ongoing work is assessed and the timescale within which the change should be reviewed and decided upon is known.

If a change is considered urgent, or perhaps the need for it is uncertain, the Project Manager should quickly establish the order of cost, programme, risk and health and safety implications associated with the proposed change. The accuracy of cost assessments at this stage are likely to be in the order of +/- 20%. If the Owner is satisfied with the change request implications, they can then either authorise the change on the basis of the estimate, request further information; or reject the request if it is considered unnecessary or too costly.

Examples and further guidance is provided in the Project Management Manual document library under change management in the full electronic library using the key word search “Change AND management”.



**TYPICAL CHANGE MANAGEMENT PROCESS**

**Figure 5.1**



### 5.3 Interface Management

The Project Manager prepares a procedure for interface management, in conjunction with the Designer/ Constructor/ and the design project coordinator (if applicable). This person should identify responsibilities during the design phases, including the production of co-ordination or interface documents. If the Project Manager has responsibility for buildability, they will need to convene meetings throughout the project phases to identify and resolve interfaces and interactions between all the project team.

This procedure should encompass all of the elements of the project, across all design/work disciplines. This includes co-ordination and agreement of design and construction, tolerances between architectural elements such as cladding and internal work with the structural frame, the environmental services, electrical/ power/ communication and fire systems, builders work; environmental services and the owner's process equipment. The description of the interface needs to be sufficiently detailed to allow it to be understood by all concerned. All interface locations need to be clearly marked and possibly designated within an appropriate numbering system.

Formal co-ordination proformas may be instigated for certain interfaces. The designers will be required to confirm that they have co-ordinated their work with others. This process records that each part of the team has conscientiously addressed their design interface with others.

The responsibility for the preparation of integrated co-ordination drawings, particularly services drawings should be agreed. These drawings combine the information of various designers/ Works Contractors onto one format for checking. Construction work areas and methods of work contractors may also require interface review. These reviews also serve a planning and safety function.

### 5.4 Risk Management

Risk management is the planned and systematic process of identification, assessment, control and monitoring of threats to achieving the project objectives. It incorporates risk analysis and uses methods that range from simple qualitative analysis to a complex quantitative approaches, depending on the demands of the functions to be analysed.

The risk management process is not stand-alone. It is closely allied to value management and similar techniques are used for both processes. Thus the systematic examination of the threats to the project objectives often result in new opportunities being revealed.

The risk management process is designed to ensure, that as far as is reasonable:

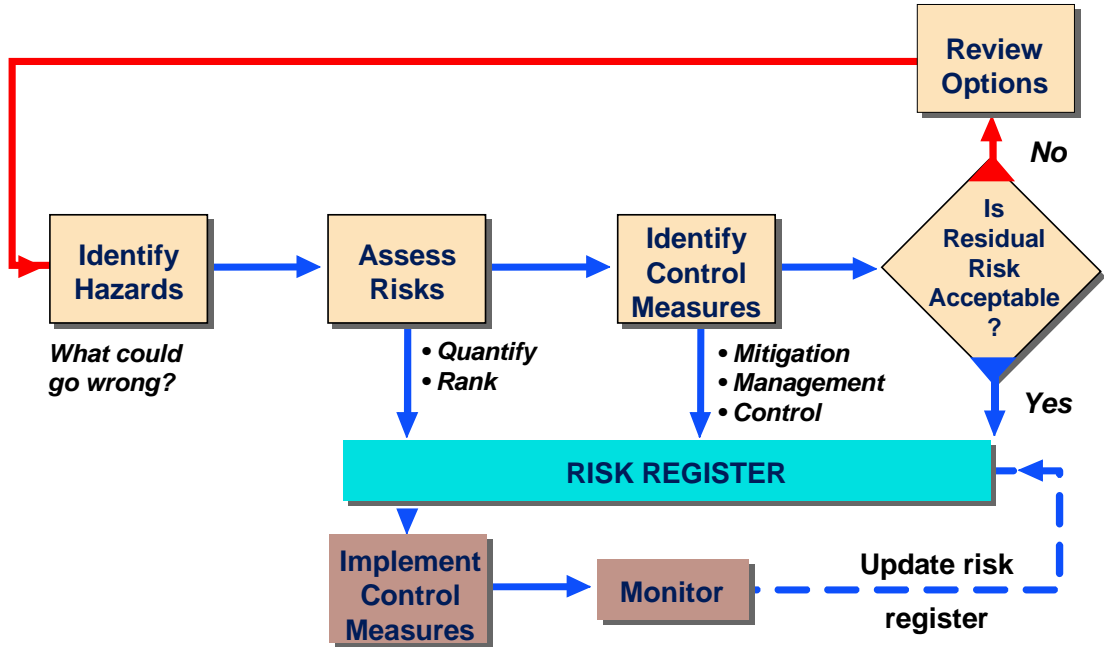
- All significant uncertainties are identified and assessed.
- Opportunities are recognised and optimised.
- Risk exposure is understood and reduced to acceptable levels.
- Cost-effective risk control measures are implemented.
- Risk estimates are prepared for contingency management.
- Contingency plans are developed and reviewed.
- Control measures and risk estimates are reviewed and managed.

The technique is most effective if

- Introduced at the earliest stage of the project and managed throughout.
- It focuses on minimising the most significant risks.

The risk management process includes the preparation of a risk register and the management of the risks for all major aspects of the project including health and safety, cost, programme and owner/ operational concerns.

The risk management process is illustrated in Figure 5.2 and is further described in documents found in the Project Management Manual under risk management and using the full keyword search “risk AND management” and “risk AND analysis”.



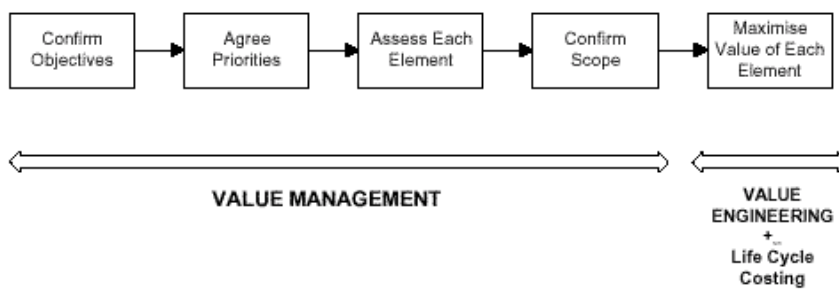
**RISK MANAGEMENT PROCESS**

**Figure 5.2**

## 5.5 Value Management

Value management is a structured approach to the identification and evaluation of project objectives and the means by which those objectives can be achieved over the life cycle of the project. It incorporates value engineering, which is a systematic approach to achieving the required project functions at least life cycle cost while maintaining quality, performance and reliability.

The value management and value engineering methods are illustrated in Figure 5.3 below.



**Figure 5.3**

The emphasis of value management is on achieving maximum value from the resources available, cost savings are nearly always possible. Whilst the savings should more than offset the additional costs of value management, it is just as valuable to confirm that original design proposals are effective as to discover better alternatives.

Value management should be used from the very earliest stages of a project with the Owner and the project team. Facilitated workshops should be held at strategic points in the design process to develop the best value for money solutions. The workshops use creative problem solving techniques. It is necessary to consider a wide range of possible solutions to ensure value for money. The first solution to appear workable does not always provide the best value for money. Creativity and imagination are key ingredients in finding the best value for money solution for any project.

Key features of such workshops are that they:

- Coincide with key decision points in the project process.
- Intervene in the design/project process.

It is anticipated that workshops will be required at the following stages of a project:

- At the earliest appropriate stage, to help identify the key project objectives and constraints, and to evaluate the broad project approach outline design.
- During Conceptualisation - Scheme Design, to evaluate the preferred design proposal.
- During Conceptualisation - Detailed Design, to evaluate design proposals.
- During Conceptualisation and Realisation - procurement and project, to evaluate alternatives offered by the Works Contractors.

Occasionally a client may ask for an independent review of the design to be undertaken by a completely separate team, to confirm that optimum value is being achieved.

For more information, refer to the [value management](#) sections in the document library or use search on the full electronic library on the keywords "[value AND management](#)".

### 5.5.1 Value Engineering

Value engineering studies should be carried out during and at the end of conceptualisation, (the design process) to ensure that economical facility has been produced. These studies aim to ensure that lowest capital cost and possibly the lowest maintenance cost are achieved over the life of the new facility (i.e. least life cost to meet function requirement), and that excessive (i.e. redundant) performance is not paid for by the Owner.

Life cycle management considers each critical element of the project to select design solutions on the basis of least cost over the life of the facility, including the cost of any provisions for safe maintenance and replacement. Life cycle management is a holistic approach involving the Owner, the design team, suppliers, manufacturers and contractors in the procurement stage, the user and facilities managers once the facility is in use. Low capital and low maintenance costs can be achieved by designing explicitly with that intention, but must be balanced with the associated excessive replacement costs due to inadequate or uncertain performance and reduced durability. Where the life of the item is less than the intended life of the building, the design should make suitable provision for easy and safe removal and replacement.

The approach to the process of life cycle management should be based on BS7543, which describes a procedure for dealing with life expectancies and the causes and effects of failures. The steps followed are:

- Agree the project design criteria.
- Define the design life of components and assemblies and agree maintenance levels.
- Complete design life data sheets for each significant element.

- Evaluate the effects of failure and risk control measures.
- Prepare outline performance data plan.
- Prepare financial forecasts of likely expenditure over time with associated cash flows.

Further information could be found in the Project Management Manual electronic library under keyword search for “value AND engineering”.

## 5.6 Computer Tools

A variety of computer based tools are available to support the work of the Project Manager. The list of programme software available to carry out the project management tasks is included in [Section 9.6](#) Cost Management tools are outlined in [Section 8.0](#), and information management in [Section 10](#).

A Project Website (extranet) has benefits to the project team by enabling efficient sharing of information.

### 5.6.1 CAD

The Arup primary CAD tool used is AutoCAD. Arup use an enhanced version of AutoCAD called OvaCAD. This was developed in-house specifically on building engineering projects. It also includes libraries of symbols and typical details for all projects.

## 6. COMMUNICATIONS

### 6.1 General

Sound project management relies on good communication between all the project participants. This requires clear and unambiguous lines of communication between all parties, including both written and verbal communications.

The Project Manager is responsible for defining the lines of communication and checking that they operate efficiently. The Project Manager develops procedures covering the following:

- Project contacts - the project directory.
- Project correspondence.
- Project meetings.
- Reporting formats and requirements.

In addition, a project website may be considered.

The lines of communication will be based on the project organisation structure and the contractual relationship between the various parties. A typical arrangement is shown in Figure 6.1.

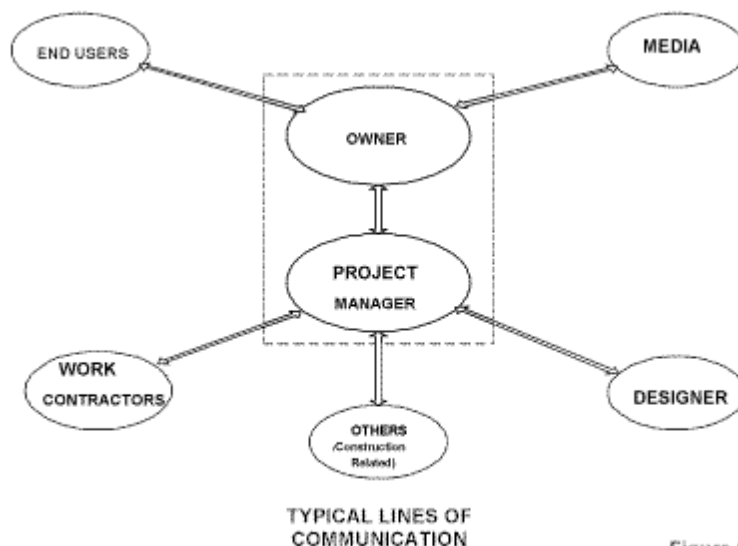


Figure 6.1

### 6.2 Project Directory

The project directory should identify all the principal participants from each project organisation, noting their contact details including names, addresses (postal and courier), telephone and facsimile numbers and email addresses.

The directory should be distributed to all parties involved in the project. It will need to be updated as the project progresses and re-issued, so that the current status is always available for reference.

An example of a typical project directory template can be found in the Project Management Manual document library under “management information systems” and in the full electronic library using keyword searches “project AND directory AND template”.

### 6.3 Project Correspondence

The Project Manager should encourage the efficient flow of project correspondence.

The Project Manager should develop procedures that encompass the following:

- Nomination by all parties of their representatives to whom project correspondence should be addressed.
- Identification of the flow path of documents between parties. For instance the Project Manager may co-ordinate all design documentation from the Designer to a Works Contractor.
- Identification of the distribution list for all project correspondence whether originated by the Project Manager or not. For example, all correspondence and documentation may be copied to the project management office, where the project documentation filing system is maintained.

### 6.4 Meetings

The Project Manager develops a schedule of meetings to enable project progress to be reported, reviewed and discussed. These meetings may also assist in the management of interfaces between project participants.

Separate meetings will be necessary with all the project team and the Owner to discuss:

- Project progress.
- Technical issues.
- Commercial issues.

Co-ordination and interface meetings involve a number of project participants.

A typical schedule of meeting types between project participants is shown in Figure 6.2. Their frequency needs to be agreed.

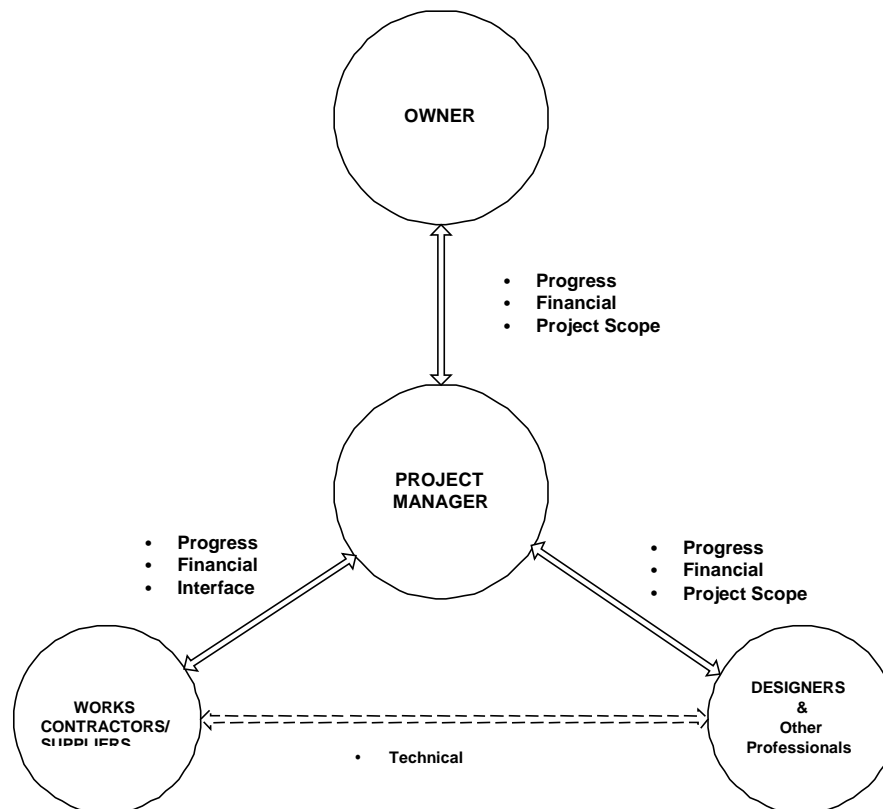
The Project Manager may chair all meetings, prepare and issue all minutes of meetings or nominate other parties to do so.

Meetings should be structured with an agenda that is followed in each successive meeting.

Action lists should be prepared for review at each meeting, and the topics closed-out or carried forward to the next meeting. "Required by" dates for responses to actions should be included.

Notes of meetings must be concise with actions clearly identified. Ideally, notes should be prepared and issued within three days of a meeting.

A meeting schedule should be prepared and updated regularly, showing all meetings that will be held on the project together with a list of attendees.



### TYPICAL MEETING TYPES

Figure 6.2

#### 6.4.1 Meetings with the Owner

Regular meetings should be held regularly (often monthly) with the Owner to review the status and progress of the project. A monthly meeting would be preceded by the issue of the monthly progress report by the Project Manager. Discussions at this meeting would include:

- Deviations in progress from the Master Programme or defined qualitative expectations.
- The anticipated effect of any proposed recovery measures.
- Variations from the Cost Plan, the cash flow forecast and corrective measures to be implemented.

At critical stages of the project, more regular meetings may be required.

#### 6.4.2 Interface Meetings

Co-ordination/ interface meetings should be arranged as and when required. It may be necessary to assemble task forces to investigate and resolve particular issues.

## 6.5 Reporting Formats and Requirements

### 6.5.1 Reports from Designers and Works Contractors

All project participants, designers and works contractors, should submit monthly progress reports.

It is desirable that the format and content of these reports is consistent, possibly as specified by the Project Manager. It should include information which will assist the project management. Reporting requirements should be stated in contract documents whenever possible.

A typical report contains:

- Progress statements with a marked up schedule showing progress relative to programme.
- Expenditure to date.
- Unresolved issues.
- Outstanding information.
- Interface issues.
- Quality issues.
- Health and safety issues.

### 6.5.2 Reporting to Owner

Typically, the Project Manager submits a formal progress report to the Owner on a monthly basis. The purpose of the report will be to satisfy the Owner that his objectives will be met, or if this is not possible, to offer the optimum alternatives. The report should be predictive, indicating the likely completion date and the expected total cost. Any significant variations to the forecast rate of expenditure should also be highlighted.

A typical report contains:

- An executive summary generally describing the status of cost and progress.
- Commentary upon any areas of concern, with recommended actions to address and rectify the situation.
- General description of progress on a contract by contract basis.
- Review of the progress of each contract relative to the master programme, if applicable (principally a contract administrator's duty).
- Statement on cash flow (by reference to other consultant's reports).
- Statement on health and safety issues (by reference to other consultant's reports).
- Statement on quality (by reference to other consultant's reports).

Examples can be obtained by using the key word searches for month report within the project management manual electronic library.

### 6.5.3 Cost Report

A cost report should take into account all known factors at the time of the report, resulting in a project, forecast final cost relative to the budget. Examples can be obtained by using key word searches for "Cost AND Report" within the full Project Management Manual electronic library, or "cost management" in the document library.



## 7. DESIGN MANAGEMENT

The Project Manager, whilst not being directly responsible for the design of the Works' should assist others to put in place a proper structure to manage and control design development processes. Sections 7.2 onwards outline the project manager's tasks in relation to design management.

The designers can use their own procedures provided they are congruent with the project level requirements.

The approach identified in the PIP should be objective, relying on positive assessments of design progress and rigorous forecasting of project costs. The process described should be flexible, allowing tailoring to the needs of the project and owner.

### 7.1 Core Design Management Tasks

Design management provides design teams with the leadership, management systems, support and training to enable the achievement of their aims of real quality, value for money and timeliness.

Effective management enables the design team to work in an efficient and orderly manner. This relies upon the identification of clear design briefs and stages in the design process with agreed review and sign off arrangements, accurate assessment of design progress and rigorous forecasting of project costs.

Design project managers work as part of the design team to provide to design teams the leadership, management systems and support necessary to achieve the Owners objectives. Core tasks of design project managers are outlined below:

#### 7.1.1 Establish and maintain plan of work

- Define team structure ([see Section 4.3](#)).
- Clarify scope of work for project (Owner's brief to the design team).
- Clarify roles and responsibilities of each team/ company member.
- Define interface responsibilities ([see Section 5.3](#)).
- Organise value engineering and buildability studies ([see Section 5.5.1](#)).
- Establish procurement strategy on behalf of the lead designer, (if not defined by the project manager) ([see Section 11](#)).
- Establish master programme (if not defined by the Project Manager) ([see Section 9](#)).
- Define deliverables at each project stage.

#### 7.1.2 Establish and implement project procedures

- Communications ([see Section 6](#)).
- Meeting structure ([see Section 6](#)).
- Change control ([see Section 5.2](#)).
- Document control/ information flow ([see Section 10](#)).
- IT and CAD systems.
- Quality management ([see Section 15](#)).
- Reporting ([see Section 6.5](#)).

#### 7.1.3 Manage development of brief/ scope and approvals procedure (with Owner and Statutory organisations)

- Development of the project brief, (if within the scope of service of the designers).
- Liaison with Project Manager.
- Manage signing-off procedure.

- Change management procedure.
- Tracking all approvals and Owner decisions.

#### **7.1.4 Facilitating co-ordination and liaison between all members of the project team**

- Regular communications, with meetings as required.
- Information requirements defined ([see Section 5.3](#)).
- Information flow agreed.

#### **7.1.5 Monitoring and regular reporting**

- Regular progress measurement ([see Section 9.5](#)).
- Recovery plans.
- Organise design reviews.
- Regular progress reports.
- Change reporting.
- Key action points defined.

## **7.2 Design Team Organisation**

The design team prepares and maintains an organisation chart that describes the structure and reporting lines within the design team and relationships with other project team members. It should be accompanied with a narrative stating the responsibilities of all the posts shown on the chart.

The Project Manager should satisfy themselves that the designer has the resources available to meet the programme.

## **7.3 Design Stages and Reviews**

To facilitate review of the design by the Owner, the Project Manager should ensure that the design process is broken down into an appropriate number of stages. Formal sign off of each stage should occur before proceeding to the next stage. Typical stages comprise:

- Inception – part of Identification of Need.
- Feasibility – part of Identification of Need.
- Outline Design, Scheme Design – part of Conceptualisation.
- Tender Design – part of Conceptualisation.
- Detail Design – part of Conceptualisation.

The stage recommendations/ conclusions often form the basis for the next design stage and also the reference document for assessing changes.

## **7.4 Reviews of Contractor's Design Submissions**

The Project Manager co-ordinates the document review procedures for each stage of a contractor's design. This procedure applies throughout the design and delivery phase of the project and should include any documentation, samples or equipment submitted by Works Contractors.

The role of the designer in reviewing contractor's submissions should be identified.

All documents submitted for review via the Project Manager, or the Designer, who should control and record the status of all documentation.

## 7.5 Document Management

The Project Manager checks there are clear procedures in place covering the control and distribution of design information. Guidance on appropriate types of procedures can be found in [Section 10](#).

## 7.6 Design Change Management

The Project Manager should check there are clear procedures in place covering changes to the design. Guidance on appropriate types of procedures can be found in [Section 5](#).

## 7.7 Deliverables and Progress Monitoring

The Project Manager checks that procedures are in place requiring designers and contractors to:

- Produce and maintain a schedule of design deliverables.
- Update deliverable schedules on a regular basis.
- Produce and status regularly a design programme which reflects the requirements of the project master programme or contract requirements, should they differ.

These schedules form the basis for monitoring progress. The schedules should contain due and forecast dates for tasks and/or deliverables at each stage of the design process.

See [Section 9](#) for more information.

## 7.8 Co-ordination and Interfaces

The Project Manager must check there are clear procedures in place covering the co-ordination of design interfaces.

Interface meetings should be held regularly to review interfaces between different design organisations, notably between building services and the structure and building services and the process equipment. See [Section 5](#) for more information.

Examples of processes and procedures can be found in the Project Management Manual document library under [design management](#) and using the full electronic library under keyword search “[Design AND Management](#)”.

## 8. COST MANAGEMENT

### 8.1 General

Successful execution of projects depends upon effective cost management.

Typically the project team is concerned with the capital cost of the project, their fees and associated land and transaction costs. Some projects, particularly ones which involve the management of the new facilities once constructed, are concerned with the whole life cycle costs. As part of value engineering processes life cycle costs should be reviewed. (see [Section 5.5.1](#)).

The Project Manager should check that appropriate procedures and systems are in place to create and monitor the following:

- Project cost plans.
- Cash flow forecasts.
- Authorisation of expenditure.
- Budget changes.
- Forecast final costs.
- Cost reports.

An effective cost management system should be deployed.

Systems for cost administration of individual works contracts are addressed in [Section 12](#).

### 8.2 Project Cost Plan

A cost plan is a breakdown of the Owner's project budget. The budget may have been prepared and authorised by the Owner prior to the appointment of the Project Manager.

The Project Manager is responsible for co-ordinating with the Quantity Surveyor and ensuring that the cost plan is maintained by the quantity surveyor in order to control the project costs.

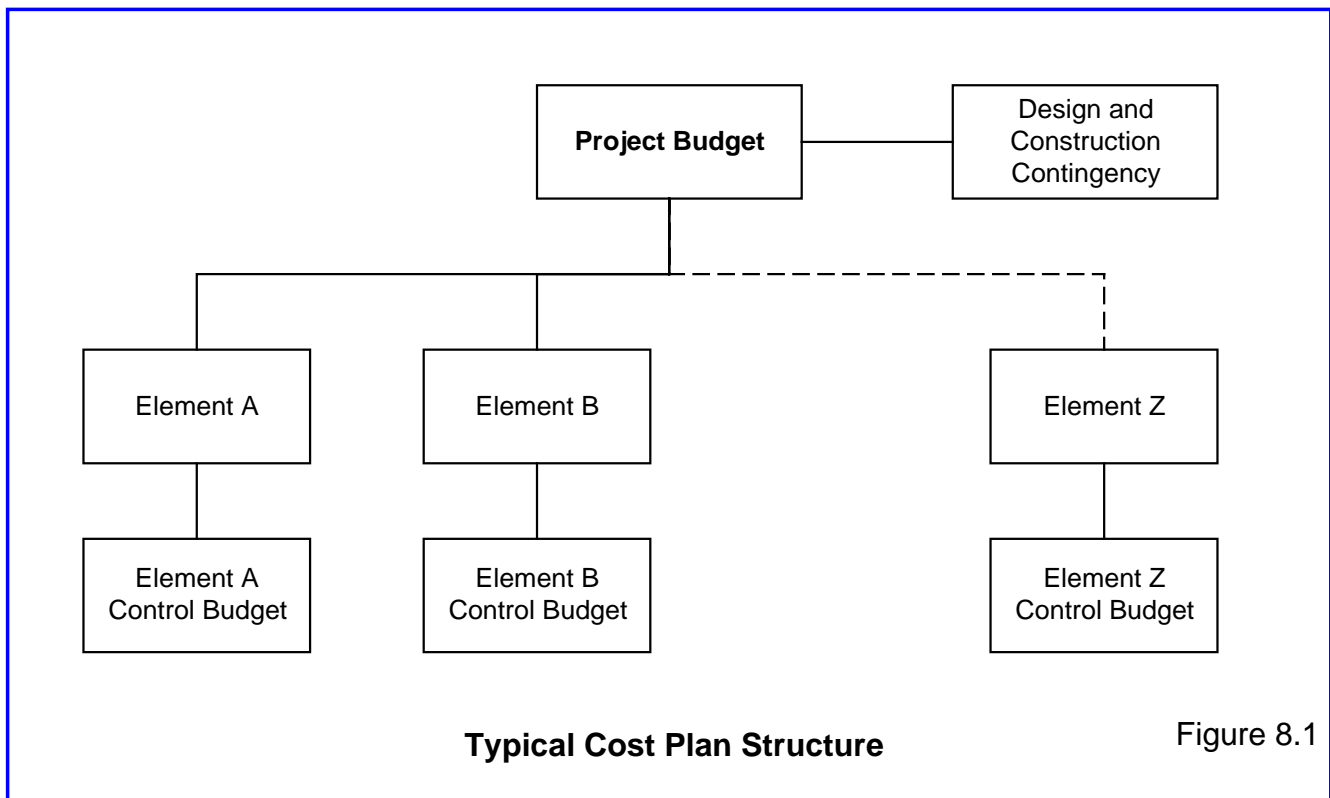
The basic typical structure of a cost plan is shown in Figure 8.1.

A cost plan should be prepared for each of the design stages of the project; typically in:

- Identification of Need – Inception and Feasibility
- Conceptualisation – for Scheme, Detail Design and prior to the initiation of the main tender processes.

Examples of cost plans can be found in the Project Management Manual document library under "[cost management](#)" and within the full electronic library using the key word search "[cost AND estimating](#)".

The accuracy and detail of the cost plan will reflect the quality and the extent of design information available.



At the conclusion of each design stage the cost plan defines the control budgets for the next design stage.

The Project Manager should agree with the quantity surveyor procedures for identifying and dealing with deviations from the agreed control budgets. Where deviations are identified the following actions are normally considered:

- If an estimate of the cost of a proposed decision exceeds the allowance in the control budget, the decision should be reconsidered, to find a cheaper, satisfactory alternative.
- If an estimate falls significantly below the control budget, the saving should be referred to the Owner, and may be transferred to contingency.
- If it is impossible to contain costs within the project budget, the Owner must be asked to increase the budget or accept amendments to the design brief.

It may, in some cases, be possible to effect budget transfers between different element control budgets without affecting the overall project budget.

The cost plan should include a contingency allowance consistent with the status of the design. There should be a draw down on this contingency amount, by budget transfers, where actual costs exceed the allowance in the cost plan.

The project budget is the overall financial target for the project. It is not unreasonable to expect some deviation up and down to individual elements. It may be prudent to place part of any savings into the design and construction contingency / design reserve fund to cater for possible overspends in other elements. These transfers should be agreed with the Project Manager, quantity surveyor and the Owner.

Search on in the Project Management Manual document library under “cost management” and in the full Project Management Manual electronic library using “cost AND plan” for typical examples.

### 8.3 Cash Flow Forecast

A cash flow forecast should be prepared for the project based on the Project Master Programme and the current cost plan. This should be updated at intervals to reflect:

- Progress of the works.
- Amendments to the cost plan.
- Authorised variations during construction process and value.

Search on Cash AND Flow AND Forecast in the Project Management Manual electronic library for typical examples.

### 8.4 Authorisation of Expenditure

Levels of authorisation of expenditure should be established.

Changes in the design brief, which affect cost levels, should be authorised by the Owner. This is described under Section 5.2.

The Owner should authorise the Project Manager and the lead designer can issue variations up to a predetermined level, either for each variation or up to a financial ceiling in a given period, for example a month.

### 8.5 Budget Changes

There are three occasions when a budget change may be implemented:

- Transfer of an amount from one cost element to another.
- Increases or reductions in the project budget.
- Transfers from contingency.

A register of authorised budget changes should be maintained. Generally this is maintained by the quantity surveyor.

### 8.6 Forecast Final Cost

It is essential that the Owner is kept apprised of the forecast final cost of the project. All those responsible for a budget should be required to submit cost commitment records to the Project Manager on a monthly basis. These would be incorporated into a monthly cost report to the Owner, which demonstrates how targets are being achieved relative to the control budgets.

The forecast final cost should be calculated on an elemental basis to take account of orders placed, orders not placed, agreed variations and estimated variations. The Project Manager should check that the quantity surveyor and the constructors/ contractor(s)/ work contractors are regularly agreeing variations so as to keep the final cost accurate and to minimise the length of time taken to finalise the constructors accounts once construction is complete.

### 8.7 Cost Reports

Typically a cost report is prepared by the quantity surveyor and submitted to the Owner on a monthly basis. This shows the forecast final cost of the project relative to the budget. More specific reports may also be prepared, as required.

Search in the Project Management Manual document library under "cost management" and in the full Project Management Manual electronic library using the key word search "Cost AND Report" for typical examples.



## 9. PROGRAMME MANAGEMENT

### 9.1 General

A primary responsibility of the Project Manager is to monitor project progress against the plan.

To co-ordinate and plan all the activities that make up a project the Project Manager must develop a Project Master Programme. Later in the project process, this programme may be developed by a Construction Manager. Aspects of this plan are outlined in this Section, followed by a description of progress monitoring.

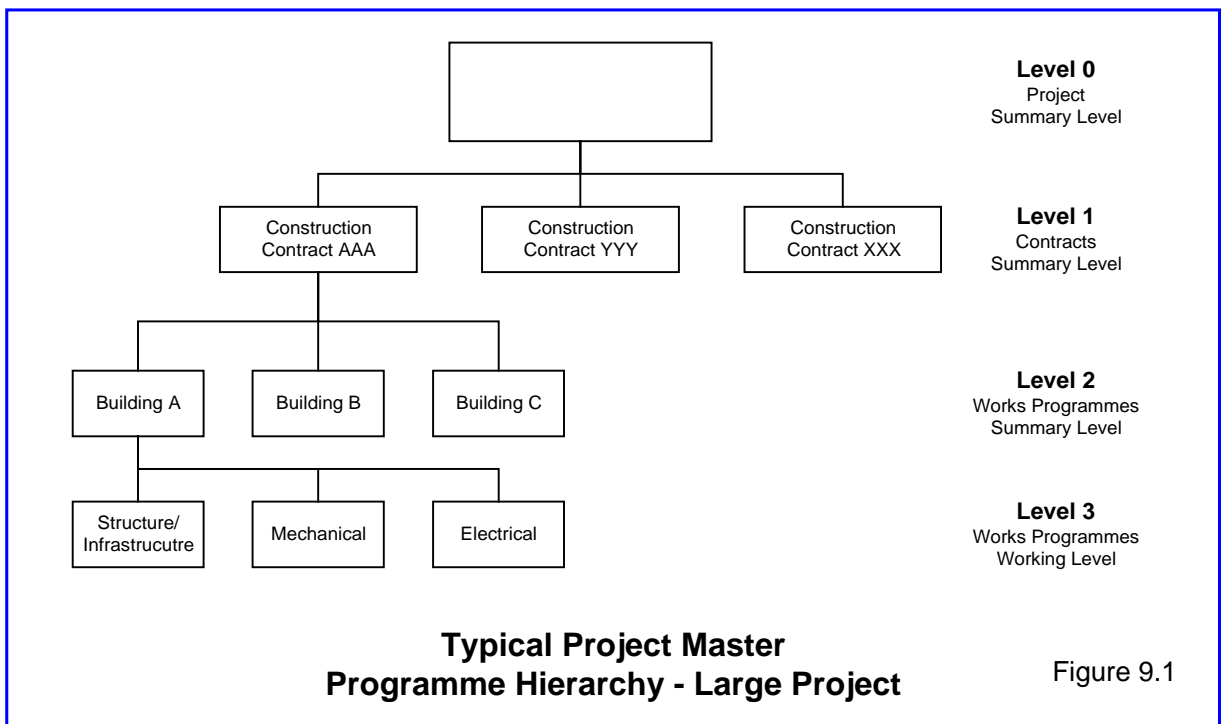
### 9.2 Project Master Programme

The Project Manager develops a project master programme (PMP) at the project commencement. Ideally this should be a comprehensive critical path network (CPN) programme in precedence diagram (PDM) format covering all significant activities relating to the planning, design, procurement, project and commissioning of the project.

The PMP will describe a hierarchy which reflects the scope and complexity of the project, the number of participants and the reporting requirements of the Owner.

The PMP must be capable of being summarised at a number of levels of detail to assist in the management of the project.

A typical hierarchy for a PMP is shown on Figure 9.1.



The level of detail provided in the programme increases as the level number increases. The content of the various levels of the PMP is typically as follows:



Level	Description	Content
0	Project Summary Level	Summary level programme in bar chart format showing all major components of the project for presentations and reports.
1	Contracts – Summary Level	Summary of all contracts forming the project showing major dates and interfaces.
2	Works Programme – Summary Level	Summary of individual elements of a constructors work/Works Contract in sufficient detail to determine completion, stage or interface dates for tender purposes. Programme by individual cost centres or major components.
3	Works Programme – Working Level	Detailed programme with a maximum activity duration of 4 weeks. This would be the level of detail expected in a works programme.

The format of some CPN programmes does not provide sufficient flexibility in format styles to support high level presentations and reporting. To overcome this deficiency a separate bar chart summary programme to the PMP is often prepared using more graphically based software.

The work breakdown structure (WBS) and coding arrangements for programme activities must be carefully considered at the outset. This will ensure that programme information can be summarised in a form required.

The programme structure should be sufficiently flexible to allow the development of separate programmes or reports covering the following:

- Individual organisations.
- Individual works contracts.
- Individual structures / facilities.
- Individual systems.
- Resource utilisation.
- Costs.

The programmes' structure should also encourage the production of graphical representations of progress for incorporation in progress reports.

The Project Manager will develop a set of procedures to manage the development of the project master programme, its control, monitoring and updating to take account of progress and new information or requirements.

## 9.3 Design Programmes

### 9.3.1 General

The Project Manager develops a level 2 programme which identifies major phases/ project stages, deliverables and due dates for design contracts.

Designers develop the level 3 design programmes, splitting the design process down into a detailed list of tasks and deliverables for individual facilities and disciplines. This enables identification of possible programme risk areas, the development of strategies to overcoming these problems and progress monitoring.

Review and verification of the programme interfaces are useful to assist smooth progress of the work.

The amount of programming effort required depends on the size and complexity of the project, however the programmes should be in sufficient detail to identify design interfaces and critical path(s).

### 9.3.2 Design Deliverables

The schedule of deliverables prepared by the designer includes studies, reports, specifications and drawings. The schedule should be regularly reviewed and updated.

## 9.4 Construction Programmes

### 9.4.1 General

The Project Manager or the construction manager (if applicable) develops a level 2 programme to include the pre-qualification, tender, contract award and a general construction programme. This should be used for tendering of construction and all Works Contracts.

Following award of a construction contract/ work contract, the Contractor is normally required to submit the following details that describe their work:

- Construction works programme.
- Design programme.
- Interface programme.
- Testing and commissioning programme.
- 3-week rolling programme (Lookahead schedule).

The timing and format of programme submissions should be stated in contract documents. The design, interface and testing programmes may be sub-networks of the main works programme.

### 9.4.2 Contractor's construction works programmes

Following award of a Construction Contract/ Works Contract, the Contractor provides a detailed level 3 works programme together with a programme narrative and method statement giving details of assumptions used in preparation of the programme to the Owner and Project Manager. This should be reviewed for compliance with all the Contract dates and interface requirements and for the provision of adequate resources. The Project Manager/ or Construction Manager updates, where necessary, the Project Master Programme to reflect the logic and sequence of each approved works programme.

For more information search on the key words "[Reviewing AND Works AND Programmes](#)".

### 9.4.3 Contractor's design programme

This part of the Constructors/ Works Contractor's programme describes any design work, design interfaces and supplier approvals required by the contractor and identifies requirements for offsite factory inspections of equipment.

### 9.4.4 Contractor's Interface Programme

This part of the Constructors/ Works Contractor's Programme describes the construction interfaces between the contractor and other works contractors or other parties.

This programme should assist the Project Manager to monitor project interfaces.

### 9.4.5 Contractor's Testing and Commissioning Programme

This part of the Constructors/ Works Contractor's Programme describes the testing and commissioning phase of the project. This includes the production of operation and maintenance manuals.

The programme should assist the Project Manager to define arrangements for witnessing tests by specialist personnel and the Owner's staff.

#### **9.4.6 3-week rolling programme (Lookahead Schedule)**

This should be a detailed programme showing all activities that are in progress or due to start within three weeks of the issue date.

Contractors should submit look ahead schedules on a weekly basis. A Lookahead Schedule should be used to monitor daily progress and manage interfaces.

## **9.5 Progress Monitoring and Reporting**

### **9.5.1 Design Progress Monitoring**

Progress of the design should be assessed against the planned activities at regular intervals, typically monthly or fortnightly. Regular, objective and systematic measurement of progress enables delays to be identified at the earliest possible time and remedial measures introduced. Progress should be reviewed at progress meetings.

The method of progress measurement will relate to the type of work being undertaken and the project phase. It can range from a simple gathering of progress estimates on given tasks from individual designers in relation to the activities planned for the period in question, to a summation of individual progress estimates for each identified deliverable.

Productivity should be assessed at the end of each reporting period according to the actual manpower input and progress made. This information should be used together with any agreed changes to revise future projected progress forecasts.

Examples of progress monitoring methods can be found in the Project Management Manual document library under "Project Monitoring" or using the keyword search "progress AND monitoring" within the full Project Management Manual electronic library.

### **9.5.2 Construction Programme Monitoring**

Throughout the construction period the Constructor should regularly, normally monthly, record progress against all aspects of their Works Programme and provide the Owner with forecasts for completion and interface dates. Recovery plans should be proposed to overcome delays.

The Project Manager should monitor the Project Master Programme (PMP) regularly, and recording progress based on the reported status of the works programme or his own assessment where this differs from that of a Contractor/ Works Contractor. PMP updates should be supported by schedules of milestones showing the planned and due date for achievement of major activities. The status of each activity should be established on a monthly basis.

Deviations from the programme should be identified and assessed by the Project Manager to determine the need for remedial measures or advancing construction.

#### **Offsite Activities**

The Project Manager/ or Construction Manager should monitor the status of off site activities by periodic visits to fabrication yards and manufacturing workshops. The status of these activities can thus be verified directly, and any necessary actions can then be taken to ensure that deliveries to site meet the programme requirements.

### 9.5.3 Task Lists

It may be helpful for the Project Manager to prepare task lists to show those tasks, which must be completed by each party - Owner, Designer, and Contractor by the beginning of each month. There should be a specific completion date for each task. These should be organised so as to be limited to 4 - 8 tasks to be achieved each month. All overdue tasks should be reported as such until they have been completed. The Project Manager should check the status of tasks on the task lists each Monday. Thus no participant should lose more than 1 week on the programme without knowing they have done so and therefore considering how they can correct the delay.

### 9.5.4 Progress Reporting

On a monthly basis the Project Manager should ensure that all the project team produce a progress report which summarises the current status of each activity against their part of the Project Master Programme.

The report should identify the due date, the current status and the forecast completion date of all major components of the project. The report should identify the current critical path and any problem areas and propose corrective measures.

The report should consist of bar charts, histograms, schedules and narrative to describe in as succinct a manner as possible progress of each contract and the overall project.

Examples of progress monitoring methods can be found in the Project Management Manual document library under "Project Monitoring" or using the keyword search "progress AND monitoring" within the full Project Management Manual electronic library.

## 9.6 Programme Software

Arup have a number of proprietary software programmes available namely:

- Primavera P3 Project Planner.
- Primavera Suretrack.
- Project Scheduler.

All of these packages have the following basic capabilities:

- Can identify critical paths.
- Allow the project to be broken down into works packages.
- Allow the programme to be sub-divided into sub-programmes.
- Allow the project to be summarised in a number of ways.
- Allows interfaces between design and construction contracts to be identified.
- Allow project progress to be monitored.
- Allow the impact of delays to be assessed.
- Can be linked to provide information on costs and resources.

Selection of the appropriate software depends on the size and complexity of the project and the Project Manager's familiarity with the software.

To facilitate the exchange of programme information between project participants it is desirable for all project participants to use the same or compatible programme software.

## 10. INFORMATION MANAGEMENT

### 10.1 General

Although the majority of information is now created electronically, for legal and convenience reasons, paper is still the preferred method of communicating and using such information.

The complexity and scale of many projects, together with requirements for Quality Assurance necessitates the implementation of good information management practices.

Each distinct piece of project information (such as drawings, reports specifications and written correspondence) can be conveniently termed a "document".

The components of an information management system encompasses:

- Clear procedures and responsibilities of team members for issuing and receiving documents.
- Means of recording details about project significant documents (this definition may not include written correspondence, facsimiles, memoranda).
- Filing and document storage.
- Principles and responsibilities for the archiving of project documentation.

### 10.2 Document Management Systems

A system used to record information about documents and their movements is called a "document management system". Such a system will include procedures for:

- Distribution and recording of documents issued and received by the project organisation.
- Efficient labelling of all documents.
- Storage and retrieval of data about documents.
- Tracking of documents and monitoring follow up actions – see example.
- Document archiving – see example.

Examples can be found in the Project Management Manual document library under "management information systems" or within the full electronic library using the key word search "Arup AND Document AND Control AND System".

Accurate and informative reports about the status of documents are also required. An electronic database is frequently used to record this information. Typical reports describe:

- What documents have been issued and received, when and to whom.
- The status of information issued.
- Lists of documents planned to be issued.

Each project has its own particular needs which influence the format of the document management system. Many of the requirements will be clear at the start of the project, others will evolve as the project develops. During project 'Conceptualisation' the key issues to be addressed are:

- What documents need to be tracked. On a large project it may be felt necessary to log all incoming correspondence, or correspondence from a particular source. It is likely that all significant design documents relating to construction and each works contract (if applicable) are tracked.
- How documents are referenced. A document numbering system needs to be developed for all project documentation, irrespective of origin.
- The document attributes to be used for document control. These are likely to attributes such as design discipline, works contract number, status, originator, etc.
- Document registers and transmittals requirements.

### 10.2.1 Arup Document Control System (DCS)

The Arup Document Control System (DCS) system fulfils the basic requirements a document management system. A standard set-up is provided with DCS. The standard set-up includes:

- Standard reports and typical forms. These forms can be extended to include instructions etc.
- Transmittal slips, transmittal registers & document registers.

The Arup DCS set up includes standard attributes, although other attributes can be created. These 'standards' include:

- Standard discipline codes.
- Standard status codes and revision suffix.
- Standard document type.
- Standard document media.
- Standard media sizes.

## 10.3 Issue and Receipt of Documents

Document management systems are only effective when they are operated consistently. Procedures for inputting documents into the document management system must be communicated to all organisations working on the project. These should encompass:

- How incoming documents are to be processed, including procedures for recording the arrival of documents and circulating them within an organisation and to other members of the project team.
- How outgoing documents are to be recorded in the project database, and how documents are to be issued and circulated.

It is recommended that the procedures are set out in a written and flow chart form. They should define the flow of information through the organisation with distribution lists, and individual responsibilities.

## 10.4 Filing and Storage of Project Documents

### 10.4.1 Documentation Identification

Dependent upon the type and size of the project, it may be advantageous to implement a project wide standardised document identification system, which is used by all parties.

### 10.4.2 Documentation Format

Dependent upon the type and size of the project, it may be advantageous to implement a project wide common layout of documentation.

### 10.4.3 Existing Data

The data to be used by all project parties during the design and delivery of the project should be identified, recorded by each project organisation. This data is likely to include surveys of all kinds including boundary surveys, topographic surveys, geotechnical data, utility surveys, surveys of adjacent structures.

It may be agreed that this data is centrally stored as part of the project management function.

## 10.5 Archiving of Project Documents

Procedures should be developed for the archiving of documents.

## 11. PROCUREMENT

This section on Procurement encompasses:

- Guidance on deciding how project proposals will be implemented, in terms of the sub-division into design and construction work packages – the procurement strategy and contract strategy.
- Selecting appropriate firms for tendering.
- Preparing, issuing and assessing tenders
- Consideration of the project insurance arrangements following tender.

### 11.1 Procurement Strategy – Strategic Choices

The strategic choices taken within the construction implementation strategy are the determination of the:

1. Organisation method(s).
2. Contract form(s).
3. Selection/ tendering procedures.

Since each project, or series of projects is unique, different emphasis is placed on each of these issues to reflect the context within which the project is being developed.

In the United Kingdom, the organisational solution which best matches the project mission, objectives and parameters is likely to be a permutation or combination of the following generic contractual arrangements which prevail:

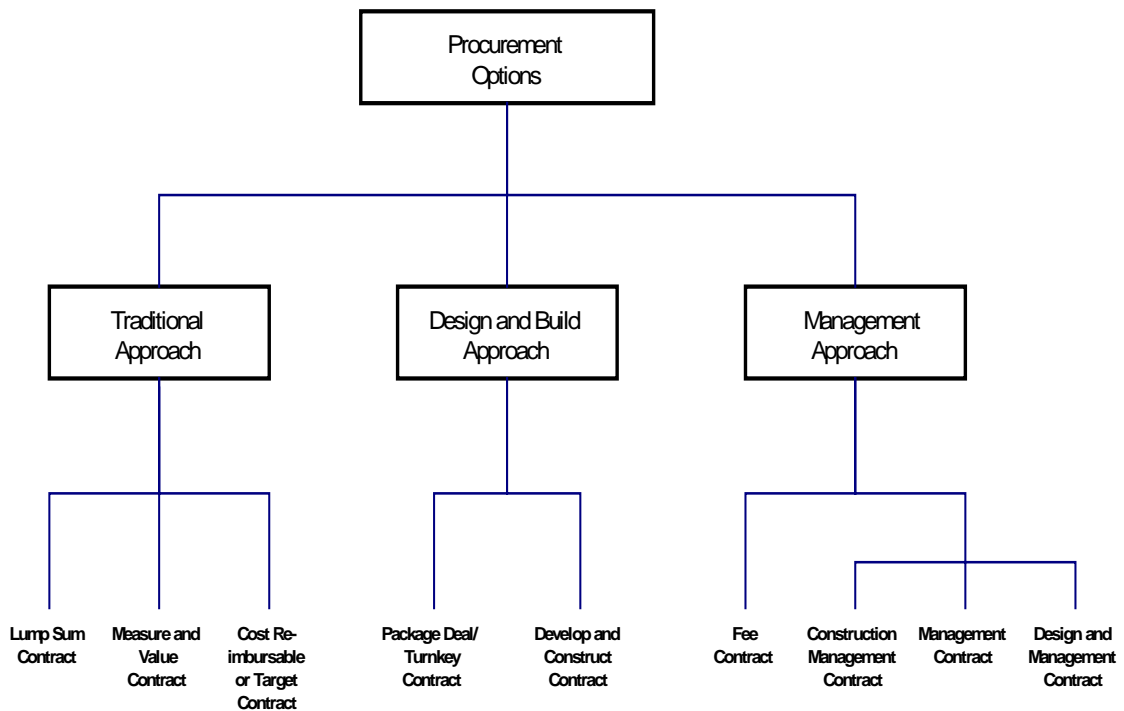
- Traditional contracting - these contracts do not include design services. The latter is largely complete before the construction works are let.
- Design and build contracts – lump sum contracts within which the client is expected to be relatively un-involved in developing the project design.
- Management contracts – used where there are a large number of specialist trade contractors and/or clear advantages to letting them sequentially to suit the design development and construction programme.

There are numerous variations on each of these three types. Some of the variations are noted in Figures 11.1.

Each contract arrangement is characterised by a different contractual hierarchy between three of the main players within the project; the client, the designers and the constructors. The various contributing organisations take on different levels of liability for their work, according to their position in the hierarchy and the details of the contract forms employed. This also reflects the distribution of the risk in terms of time, cost and quality.

Often the match between the project context and available contract arrangement is imperfect. Thus where the mismatches exist additional measures may be required, for example contract amendments.

The style of these contractual arrangements are noted in the following sections. Different contract arrangements may be appropriate for different elements or phases of a project.



**Figure 11.1 Procurement Options**

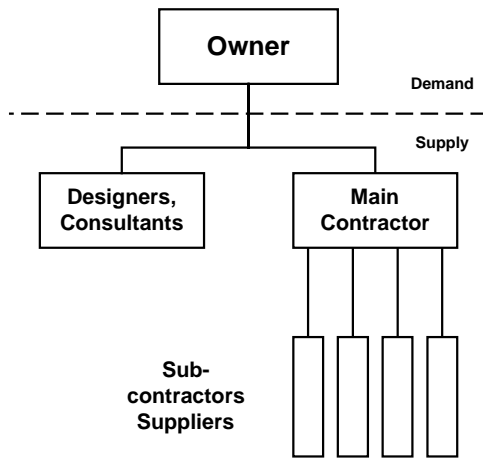
### 11.1.1 Traditional contracts

These contracts do not include design services, which are largely completed before the construction works are let. The Joint Contracts Tribunal 1998 (JCT 98) is one such example. Provisional sums can be included in the contract documents to allow for construction works that are not designed at the tender stage. The contract is let as a lump sum, and any variations valued using the basis described in the tendered bill of quantities.

Over the past 15 to 20 years in the United Kingdom it has become rare for contractors to have all the necessary construction skills within their own organisation to complete the construction works. Thus activities are sub-contracted. Likewise the detailed, as installed, design information for many trades, such as structural steelwork, external wall cladding and communication switches may not reside with the designers. Thus sub-contracted companies will carry a certain design responsibility which must be explicitly noted.



Figure 11.2 - Traditional Contracting

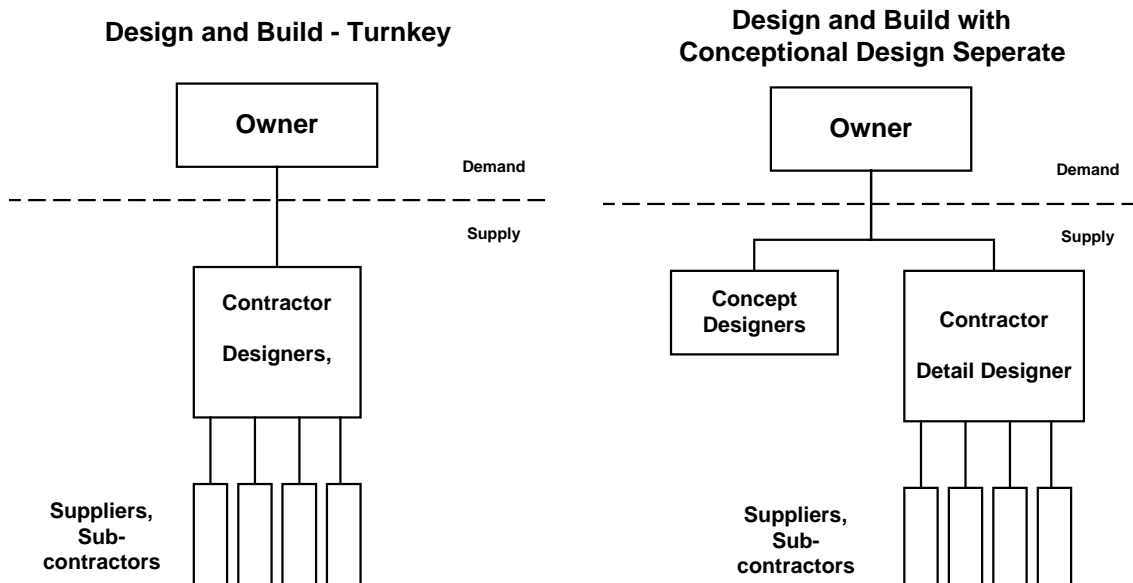


### 11.1.2 Design and Build Contracts

In these lump sum contracts, the Owner is expected to be relatively un-involved in developing the project design, compared to the other forms of contract. They are often used for projects where the form and technical detailing is well understood by all concerned so that the contractor can price the project and the risks associated with design development. Examples include simple structures, such as masts and pylons, warehouses and speculative offices, provided these are being developed to a formula known to the Owner, designers and contractors.

For more complex buildings, a variation of this form involves the appointment by the Owner of designers to complete the conceptual stage of design. The contractor is then appointed on the basis of this design, with the designers' contracts then novated to the design and build contractor.

Figure 11.3 - Design & Build Type Contracting



### 11.1.3 The Management Approach

There are two basic approaches to this form of procurement. They are both applicable when:

1. A large number of trade contract packages are involved, and/ or
2. There are clear advantages in letting them sequentially to suit the design development and construction programme.

This enables the contract to be arranged, before the site specific design solutions are detailed. To achieve this, it must be acceptable to the client that the cost certainty of all of the works will not exist when the contract is signed.

#### Construction Management

With this system, the Owner appoints designers separately from the manager of construction. The scope of the work is then divided into specialist work packages (trade packages) which are let individually. The construction manager will then procure and manage all these trade contracts, which will be between each trade contractor and the client.

The trade packages are designed and procured gradually, generally for lump sum prices, to suit the design and construction programme and site works commenced in advance of all the lump sum prices being obtained.

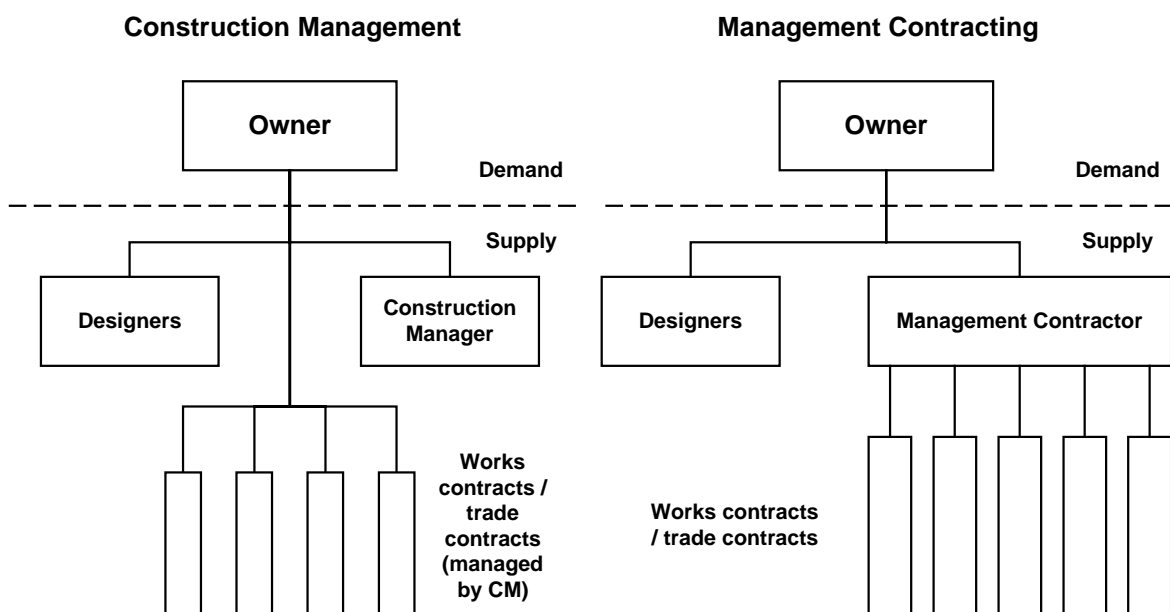
The main task of the construction manager is to manage the interfaces between trade contractors, run the site set-up, and assists the Owner in dealing with administrative duties associated with a large number of individual contracts.

#### Management Contracting

Under management contracting, the arrangements are similar, but with trade contractors in contract with a management contractor rather than the Owner. As a result, the administrative involvement of the Owner is reduced.

The management approach described above are generally used when the form of the project and its technical detailing requires significant development by specialist contractors and suppliers.

Figure 11.4 - Management Type Contracting



## 11.2 Organisational Method

The organisational method determines the hierarchy of organisation's interactions and timing of their inputs. This includes consideration of:

1. The number and type of construction jobs (projects) to be undertaken within a defined period by the Owner, and the most effective process for implementing them within the particular construction market. Section 11.5 outlines work package breakdown options, should sub-division of one construction project into its many elements be proposed.
2. The degree of involvement by Owner in the project process.
3. The degree of desirable separation of the concept/ design from the design and management of the assembly and installation process.
4. The desirability of reserving the Owner's right to alter the specification and the individual project parameters including the project timing, scope, volume of work, construction duration and methods.

## 11.3 Contract Form

The contract form incorporates the provision for payment, allocation of risk, and legal liabilities. This includes:

1. The degree of cost certainty required during the project process.
2. Consideration of the use of incentives to progressively improve cost and time performance over a number of projects or successive projects.
3. The clarity of Owner's contractual remedies should the work not be undertaken as planned.
4. The balance of risk between the Owner, designers and construction contractors.

Each contract type has a different risk distribution between the Owner and the contractors (who may be designers or constructors). The relative proportion of project risk assumed by each of the parties is shown graphically in Figure 11.5. Some contract risks can be retained by Owner. In general the more risk assumed by Owners, the lower will be the original forecast construction cost of the project. However, if this procurement strategy is adopted, it is vital that adequate contingency sums are built into the capital cost plan to ensure that sufficient funding is in place to secure the satisfactory completion of the project.

### 11.3.1 Terms and Conditions

Selection of the appropriate contract terms and conditions is an important task of the Project Manager. Selection will depend on the type and size of project or supply and the country in which the works are being carried out or purchased.

It is not within the scope of this manual to provide detailed guidance on contract forms, their terms and conditions.

There are a number of organisations producing standard forms to choose from, including the following:

- FIDIC.
- ICE.
- ECC.

- JCT.
- PACE

In addition some clients have their own terms and conditions or special requirements which would be incorporated as contract amendments. This is particularly common for management contracts.

Specialist advice should be sought from the Arup Legal group. Examples of contract forms can be found on the [Arup Legal Website](#).

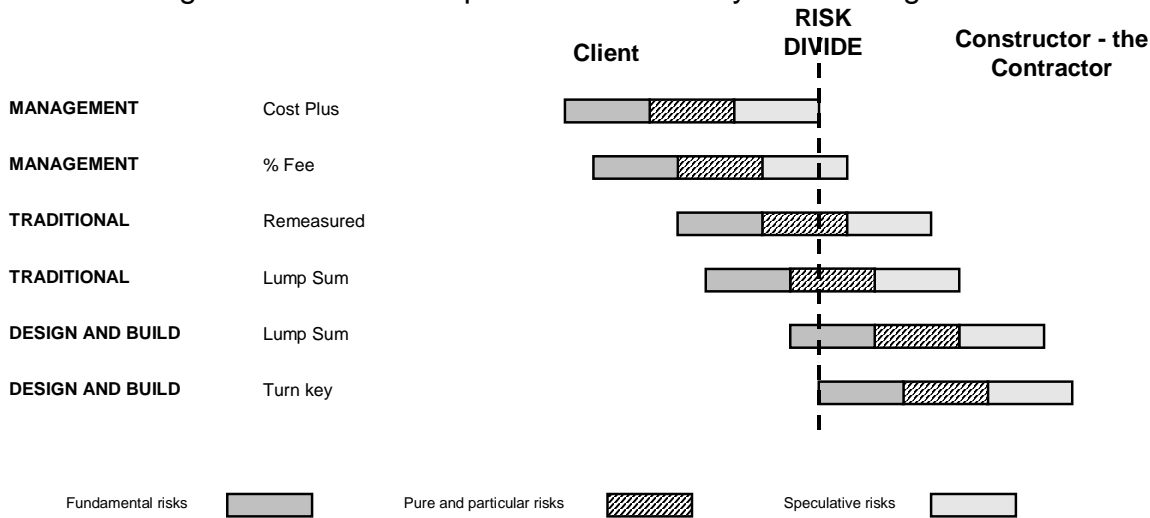
### 11.3.2 Payment Methods

The degree of risk assumed by the contracting parties depends upon which payment method is selected:

- Lump sum - fixed price, low risk.
- Re-measurement - medium risk.
- Cost reimbursement - higher risk.

A summary of the advantages and disadvantages for each contract type extracted from the CUP Guidance Note 36 “Contract Strategy Selection for Major Projects”(June 1992) is shown in Table 11.6 below. We have provided below a summary of the advantages and disadvantages for each contract type extracted from a central government publication<sup>1</sup>. Generally, however, the appropriateness of the contract is not as clear-cut as indicated here.

Figure.11.5 - Risk Proportion Assumed by Contracting Parties



Fundamental risks: War damage, nuclear pollution, supersonic bangs.

Pure and particular risks: Pure - fire damage, storm, particular risks - Collapse, subsidence, vibration, removal of support.

Speculative risks: Ground Conditions, inflation, weather, shortages and taxes, errors in stated assumptions.

Table.11.6 Appropriateness of Contract Strategy in Meeting Project Objectives

Parameter	Objectives	Traditional	Construction management	Management Contracting	Design & Build
Timing	Early Completion following approval of scheme design.	✗	✓	✓	✓

<sup>1</sup> CUP Guidance Note 36 “Contract Strategy Selection for Major Projects”, June 1992. ICUP Note: This table is for guidance only.

Cost	Price certainty before construction start	✓	✗	✗	✓
Quality	Prestige level in design and construction	✓	✓	✓	✗
Variations	Avoid prohibitive costs of change	✓	✓	✓	✗
Complexity	Technically advanced or highly complex building	✗	✓	✓	✗
Responsibility	Single contractual link for project execution	✗	✗	✗	✓
Professional Responsibility	Need for design team to report to sponsor	✓	✓	✓	✗

## 11.4 Relative Success of Differing Forms of Construction Contracts

A number of research studies have been carried out on performance in terms of out-turn cost and programme in comparison with planned parameters, with the objective of assessing the relative effectiveness of differing procurement approaches. The consensus of these studies indicates that other factors, have such a strong influence as to mask any differences which may be inherent in the procurement approach. These factors include the attitudes, experience and ambitions of the project team, the complexity of the project and the experience and attitudes of the client and the alchemy between individuals in the project team.

This should not be taken to indicate that the form of procurement and contract is unimportant. Identification of the most important procurement route and form of contract should be seen as prerequisite to success, but not as a guarantee of it.

In the Egan's Construction Task Force paper, "Rethinking Construction", the task force concluded that radical change was required within the construction industry, involving a totally new approach to project delivery to achieve a successful project outcome. The Movement for Innovation was launched in November 1998 to facilitate the culture change required and help develop new ideas on specific projects throughout the country. The principal lessons learned are:

1. Involve the right people at the right time.
2. Obtain early input of specialists.
3. Design right first time.
4. Adopt an open book approach.
5. Involve the Contractor in the design of details.

Few if any of these lessons are new, but have simply been forgotten during the last twenty years of confrontation in the industry.

More details regarding the "relative success of different forms of procurement" can be found within the Project Management Manual document library within the "contracts and procurement" sections for Realisation and using this specific key word search on the electronic library.

## 11.5 Work Package Breakdown

Typically a project will be sub-divided into individual work elements; the work packages. This can be by:

- Geographical area/ different buildings.
- Design discipline.

This breakdown is often used to assist the programming cost estimating. It is likely to form the basis for a document management system and a component identification system.

Typically, within building construction the construction works packages are sub-divided by:

- Element/ System – such as heating and ventilating, lighting and power.
- Product - such as piling, curtain walling.

This should assist in the identification of specialist design involvement.

Key factors affecting the selection of work packages are:

- Project type and size.
- Site geography.
- Owner's requirements: Objectives and parameters including the project's financing strategy.
- Project programme.
- Available design information.
- Specialist technology required.

## 11.6 Procurement Process

Figure 11.7 outlines the typical procurement process for the appointment of a contractor for a traditional contract.

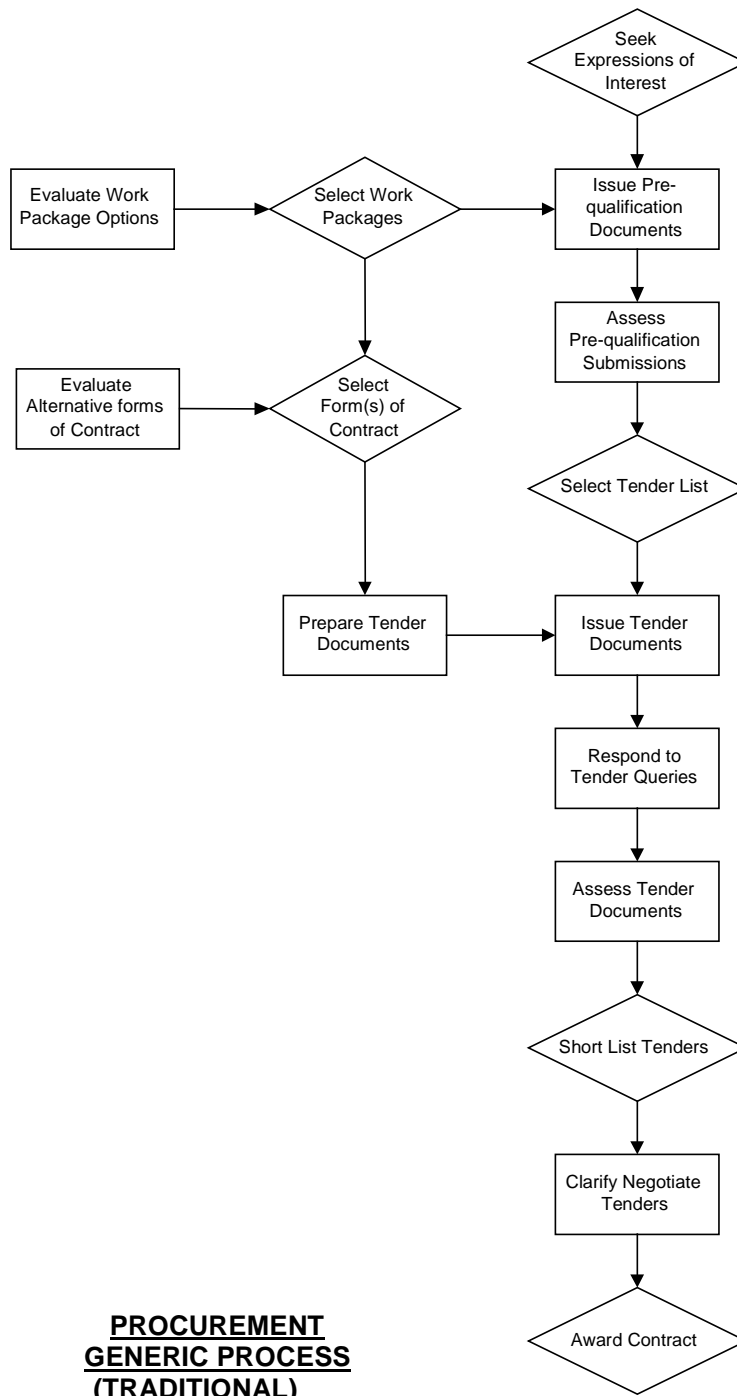


Figure 11.7

## 11.7 Selection Processes

The selection process should acknowledge:

1. Reasonable, fair and ethical procurement procedures. Current best practise procedures involves appraisal of tenderers to an agreed weighting, so that the process is accountable, with a clear audit trail.
2. If the work is publicly funded it may be necessary to advertise all appointments in the EC Official Journal and follow these procedures.
3. The decision making and accountability processes anticipated within the Owner or a funder's organisation to approve selections.

The example of construction contractor selection is outlined below. Similar processes apply for the appointment of project consultants

### 11.7.1 Contractor Pre-qualification and Selection

To check that Contractors meet the Owner's objectives for quality, safety, cost and timing, it is necessary for contracts to only be awarded to properly pre-qualified contractors. This is likely to be achieved by implementing a formal pre-qualification procedure within which specific information is requested.

A pre-qualification procedure also provides advance information to potential tenderers on the scope of the project and the tendered works. This should enable a shorter tendering period and a quicker mobilisation time.

Depending upon the scope of work and other circumstances, the procedure could be in one or two stages.

- The initial list of potential tenderers should be prepared from knowledge of the scope of work and the availability of contractors known to do the type of work in the project locality.

For the first stage, each contractor may be requested to send information on their financial status and work experience.

- Following an evaluation of the first submissions, a preferred list of contractors should be requested to submit further detailed information on personnel, resources, quality systems etc.

A further evaluation should take place and a report submitted which should provide a short list of selected contractors to be invited to tender for the works.

Typically for a pre-qualification, potential tenderers are issued with

- A letter explaining the procedure.
- The project description.
- The tender package description.
- A pre-qualification questionnaire.
- Further detailed information may be requested on particular aspects of the work or the company.

The submissions from the contractors are then reviewed and evaluated. It would be suggested that a weighting factor is allocated to the various criteria, and an example is shown below:



Selection Criteria	Maximum Score	Percentage Score
Structure/Organisation	40	10%
Financial Statement	40	10%
Resources: Personnel	80	20%
Plant	80	20%
Product Assurance	80	20%
Similar Experience	60	15%
Additional Information	20	5%
<u>SUM</u>	<u>400</u>	<u>100%</u>

Examples of the evaluation process can be found in the Project Management Manual within the document library under “Contracts and Procurement” or using a key word search on this subject in the full electronic library:

## 11.8 Tender/Contract Documents

Tender documents should have a consistent format. Typically they follow the framework noted below, modified to suit the Owner’s specific requirements:

- Invitation to tender.
- Tender instructions.
- Project description. For construction work this is likely to include the scope of work as described in the technical specification, design drawings, programme parameters, preferred construction methodology and construction arrangement, defined interfaces.
- Outline of project procedures; project quality assurance statement and health and safety statement.
- Form of tender.
- Contract agreement.
- Conditions of contract.
- Technical requirements for submissions.
- Pricing schedules.

It is important that any requirements for compliance with specific project procedures are noted in order that any cost and time implications can be incorporated in the Form of Tender.

### 11.8.1 Invitation to Tender

Invitations to tender should be issued simultaneously to all the tenderers.

The covering letter shall clearly state the requirements for:

- Number of copies of the tender to be returned.
- Place, time and date for the submission.
- Sealed tender requirements.

Examples can be found in the Project Management Manual document library within “Contracts and Procurement” section, and in the electronic library using key word searches on Invitation AND to AND tender.

### 11.8.2 Tender Instructions

The tender instructions should explain exactly what is required from the tenderer. Typically they include:

- Arrangements for site inspections.
- Arrangements for responding to questions on the tender documents. A mid-tender meeting may be proposed.
- The method of pricing.
- Approach or method statements.
- Programming or planning statements.
- Issue of tender bulletins, if required.

Tenderers should be given the opportunity to tender on identical information.

## 11.9 Revisions to Tender Documentation

During the tender period, it may be necessary to issue to all tenderers:

- Revised or additional documentation.
- A revision or clarification to the documentation, following tenderer's questions.
- A Tender Bulletin regarding the tendering process.

These changes have a contractual status.

## 11.10 Tender Submission Requirements

Typically tenderers are required to submit tenders in a predetermined format. Tenders may comprise separate technical and commercial submissions.

Alternatives may be submitted separately, provided a compliant tender is also presented.

Tender forms may be prepared to ensure consistency of submissions. Typically, for construction works these include:

- Pricing section.
- Lists of construction equipment to be used.
- Manpower schedules/resume of key personnel.
- Lists of subcontractors, sub-consultants to be used.
- Proposed method statements.
- Temporary works to be undertaken.
- Statement of interface with existing or preceding construction activities.

## 11.11 Tender Assessment and Recommendation

As noted in Section 11.7 above, tender assessments should be undertaken under controlled conditions. This includes nomination of a committee to open all tenders at a predetermined time and place. This group records on a Tender Opening Record Sheet the participants, the tenders returned, whether they appear complete and the tender prices. The Tender Opening Record Sheet and the original tender, bound if necessary, shall be locked in a safe place.

Copy tenders are used for assessment purposes. These are made available to nominated reviewers only. Arrangements may be made to review the technical and commercial sections separately. Unauthorised inspections is to be avoided.

Evaluation forms should be prepared to cover all submissions required from the tenderers as stipulated in the tender forms, instructions to tenders, and technical requirements. It is recommended that

evaluation of both the technical and commercial submissions use a tabular format to enable the submissions to be reviewed and compared. This assists to identify any errors, omission or anomalies.

Any aspects of tenders can be evaluated on a point scoring method. Alternative proposals by tenderers can be similarly evaluated. The Owner should be informed of any non-compliant tender. This tender may be rejected, or reviewed with a view to removing the non-compliance.

Tender review meetings shall be held with the most likely contractors to confirm the scope and discuss any potential errors, omissions or anomalies.

A tender report is prepared which summarises the tendering process and all the evaluation activities. Typically this includes a comparison of technical and commercial submissions, statements concerning any deviations or non-compliance still unresolved, and an evaluation of proposed alternatives. Generally this report concludes with a contract recommendations in order of preference. Occasionally a re-tender has to be proposed.

Examples can be found in the Project Management Manual document library within the “Contracts and Procurement” section, and using a key word search on “Tender AND Evaluation AND Report”.

## 11.12 Award of Contract

Typically a meeting is arranged between the Owner and the recommended contractor to confirm all the commercial details and commencement arrangements. The meeting will be noted, and these agreed and signed by all parties. All final agreements should be incorporated into the contract documents.

If appropriate, other members of the project team may be invited to attend.

Often three identical sets of the complete contract documents are prepared and bound. A letter of acceptance prepared and a contract signing ceremony arranged. The Owner and the constructor/contractor sign all three sets of documents, also initialling each page/drawing. The documents are then issued to the Owner, the Contractor, with one set held within the project filing system.

The unsuccessful tenderers are notified at this time.

Examples of tender award letters and the agenda for the pre-contract meeting and pre-site commencement meetings can be found in the Project Management Manual electronic library using a specific key word search.

## 11.13 Formal Contract Agreement

The Project Manager or the Contract Administrator prepares the contract agreement for signature by the contracting party. This may be the Owner, the lead constructor, the Contractor, or the Designer.

## 11.14 Contract Insurances / Bonds

The Project Manager or the Contract Administrator advises the Owner on the scope of insurance to be provided for the project.

The Contract Administrator collects and reviews all bonds to be provided by the constructors/ works contractors under the terms of their contract.

The Contract Administrator checks the scope and validity of all insurances to be provided under the terms of the contract by the constructors.

If the Owner has a project global all-risks insurance policy the Contract Administrator probably manages any claims made by the project on this insurance.

## 12. CONTRACT ADMINISTRATION

### 12.1 General

Each construction contract/ works contract requires the appointment of a Contract Administrator to act on behalf of the Employer (Owner) under the contract. The role of the Contract Administrator is to see that the constructor/ works contractors fulfils his obligations under the contract, and that the Owner is provided with the intended facility. This requires a good understanding of the Owners requirements and a sound knowledge of the terms and conditions of the Works Contracts. Typically the contract places obligations on both the Owner and the constructor.

**For the purposes of this Section, a distinction is made between the Contract Administrator and the Project Manager. The Contract Administrator is assumed to have responsibilities for particular works contracts from the point of award by the Owner. It has also been assumed that they take direction from the Project Manager acting on behalf of the Owner.**

The Owner's obligations include the timely provision of design information and approvals of submissions, the making of payments on time and the timely issue of instructions and certificates. The constructor's obligations are to complete the Works to the required quality, programme and cost. The Contract Administrator endeavours to see that both parties meet their obligations. This is best achieved by a proactive rather than reactive approach to events.

The precise responsibilities of the Contract Administrator will be defined in the project contract. Their level of authority to issue instructions under the contract should be advised to the constructor/ works contractors and the contract administrator by the Owner.

The authority of the Contract Administrator to issue any Completion Certificate under the Works Contract without the agreement of the Designer is decided by the Owner.

The principal issues to be dealt with by the Contract Administrator are discussed in this Section. They include:

- Insurances / bonds.
- Issue of drawings, specifications and other documentation.
- Review and response to submissions and queries from the Works Contractors.
- Documentation control.
- Site records.
- Meetings.
- Approval of sub-contractors and suppliers.
- Issue of instructions and variations.
- Dayworks.
- Valuations and issue of payment certificates.
- Disputes and claims.
- Programme and progress.
- Contract Administrator's monthly report.
- Commissioning.
- Operations and maintenance (O & M) manuals.
- As built drawings.
- Guarantees.
- Completion and defects liability periods.

To undertake the above tasks on a large project the Contract Administrator needs the support of a team of personnel. The size and composition of the team varies from project to project but must encompass all necessary skills. A typical example is shown Figure 4.3.

## 12.2 Issue of Drawings, Specifications and Other Documentation

The Contract Administrator, Project Manager or the lead constructor or Construction Manager establishes the programme for issue of all drawings specifications and other documentation to the works contractors.

The Contract Administrator maintains a record of all drawings, specifications and other documentation issued to the works contractors and their status.

## 12.3 Contractor's Submissions and Queries

The Project Manager, lead constructor, or Contract Administrator establishes a document review procedure for the contract. This formalises the review of any documentation, samples and equipment to be submitted by the constructors, works contractors or contractors.

All documents submitted for review should be through the Contract Administrator who record the status of all such documents.

Typical submission reports on submissions are:

- Document received and not returned.
- Status of contractor's documents received and reviewed.

## 12.4 Documentation Control

The Contract Administrator may develop and maintain the project information system. This includes all significant correspondence, design documentation and drawings, and site generated documentation and records. Guidance on this subject is provided in [Section 10](#).

## 12.5 Site Records

The Contract Administrator is responsible for ensuring that accurate records are kept of the progress and construction of the works. These records are often in the form of site inspector's reports, diaries, surveys, test results and photographs.

These records would be used, in-conjunction with all other material, for evaluating claims and disputes and in checking as built records.

Examples can be found in the Project Management Manual electronic library under the key word search [Site AND Record](#).

## 12.6 Meetings

The Project Manager/ Construction Manager / Contract Administrator draws up and maintain a meeting schedule for the contract. This includes:

- A pre-construction meeting.
- Safety meeting.
- Progress meetings.
- Technical meetings.
- Commercial meetings.

### 12.6.1 Pre-construction Meeting

Typically the Project Manager convenes a pre-construction meeting with the lead constructor / works contractors to:

- Introduce all parties and individuals of the project.
- Review applicable project procedures.
- Clarify the Works Contractor's site establishment requirements.
- Emphasise the health and safety requirements and quality standards.
- Request the contractor's submissions under the terms of the contract.

Examples can be found in the full Project Management Manual electronic library under the search for:

[Pre-site AND Commencement AND Meeting AND Agenda](#)

### 12.6.2 Progress Meetings

The Contract Administrator may chair and minute regular meetings, normally monthly, with the constructor(s)/ works contractors to review progress and payments. This is not the forum for the debate of all the contentious issues on the contract. This meeting provides an overview of the current status.

Typically the works contractors include a statement of progress which has been previously agreed with the lead constructor/ Contract Administrator, relative to the master programme. The meeting concentrates on key issues such as:

- The current forecast for completing the works, or sections of the works.
- Major problems faced by the constructors/ work contractors, with a discussion in principle on how the problems may be solved.

Detailed discussions are referred to separate meetings.

### 12.6.3 Technical Meetings

Meetings are held regularly, typically weekly, together with the site supervision team to review technical topics and the progress of submissions and site queries. Designers attend as necessary.

The meeting reviews all technical aspects of the scope of work, and discussions should be held to resolve questions and problems. It may be necessary to refer some topics to a specific meeting to address that topic in depth.

### 12.6.4 Commercial Meetings

Meetings are held regularly, typically monthly, to review commercial and contractual items. The basis for the monthly valuations will be agreed in these meetings. Discussions take place on any work in dispute with a view to reaching agreement. Instructions and variations are reviewed to reach agreement on the associated costs. Generally the constructor/ contractor compiles the monthly application for payment and forwards it to the quantity surveyor for review two days prior to the required date. This process should be stated in the preliminaries section of the construction contract.

## 12.7 Sub-contractors and Suppliers

The Project Manager or Contract Administrator develops a procedure for the review of sub-contractors and suppliers proposed by the lead constructor.

This includes a review of the company's technical and financial status, together with an appraisal of their quality and safety standards.

## 12.8 Variations and Instructions

The Contract Administrator issues all variations and instructions under the contract. These will be subject to any limitations on financial authority.

### 12.8.1 Variations

A variation normally alters the scope, specification or timing of the construction contract/Works Contracts and has cost implications. The construction contract(s) normally define what constitutes a variation.

Any variations exceeding the Contract Administrator's authority are subject to approval by the Project Manager / Owner prior to implementation. Typically approval will be via a change order procedure as described in [Section 5.2](#).

The variation format depends upon the form of contract. The Contract Administrator issues and keeps a register of all variation orders /instructions.

### 12.8.2 Site Instructions

Site Instructions usually clarify the scope, specification or timing of the Works.

Site Instructions are issued during the construction period to contractors to clarify and modify the construction works. The Contract Administrator issues and keep a register of all site instructions

Examples can be found in the Project Management Manual document library within "[cost management](#)" and in the full electronic library using the key word search "[Site AND Instruction](#)". Also refer to [Arup legal website](#).

## 12.9 Dayworks

Where work is to be carried out on a "Daywork" basis, the Contract Administrator issues a Daywork Order.

The Works Contractor submits a work force account report on a daily basis, listing all labour, plant and materials used on each Daywork Order.

The Contract Administrator checks and agree these records. They will form the basis for the evaluation and reimbursement of the work.

## 12.10 Valuations and Payment Certificates

The Construction Contract documents will define the method and timing of payments to the contractor. It is the Contract Administrator's responsibility to value and certify payments in accordance with the contract. This responsibility may be delegated to the quantity surveyor.

The Contract Administrator, or the quantity surveyor on their behalf, carries out regular valuations of work completed under the contract. Typically they are monthly.

The Contract Administrator issues a Certificate of Payment authorising payment by the Owner to the constructors/ works contractors. The Contract Administrator agrees a procedure for this activity with the Project Manager / Owner. The procedure complies with the time scales stated in the contract.

The method of valuation depends upon the payment terms of the particular contract. Typically these could be either:

- Re-measurement.
- Measure and value - Percentage of element completed.
- Stage payments based on key events /milestones.

- Add and omit against a schedule of works.
- Reimbursable on a "cost plus" basis.

The Contract Administrator is responsible for agreeing the final statement of account with the constructor/ works contractors/ contractor.

Procedures developed by the Contract Administrator relating to payment should ensure that any prerequisites for payment, such as bonds or guarantees, have been received and are acceptable.

Examples of certificates can be found in the Project Management Manual electronic library using key word searches under certificate and statement AND of AND retention:

## 12.11 Disputes and Claims

The objective is dispute avoidance. This should be part of the project strategy developed by the Project Manager, in conjunction with the Owner, the lead Designer and Contract Administrator. This can involve the following:

- Creation of an alliance between all parties.
- Frozen design.
- Changes of Scope to be clearly instructed
- Clear planning requirements should be given.
- Variations should be priced before work commences.
- Changes to be agreed fairly to achieve a "win-win" agreement.
- Incorporation of an adjudication process into the contract documents, where it does not already exist.

The Contract Administrator assists in the evaluation of all contractual claims, and support the Project Manager / Owner on how to proceed.

Examples on dispute resolution can be found in the Project Management Manual electronic library using keyword searches for Contract AND Management – Contractual AND Dispute AND Defence and Dispute AND Resolution. Also refer to the Arup legal website.

## 12.12 Programme and Progress

The contract documents will define programme and progress submissions to be made by the contractor. It may be the Contract Administrator's responsibility to review and assess these submissions. Typically these submissions would include:

- Initial works programme.
- Works programme.
- Method statements.
- Weekly schedules/lookaheads.
- Interface programme.
- Testing and commissioning programme.
- Submissions schedule.
- Monthly progress reports.

The Contract Administrator provides designers with a schedule of dates for design deliverables to meet the contractor's programme. This is often called the Information Release Schedule. Progress is monitored to check that the deliverables are issued according the agreed programme requirements.



### 12.12.1 Works Programme

The Contract Administrator reviews the works programme for compliance with the contract dates, the contractor's method statement and interface requirements with designers and other contractors.

### 12.12.2 Weekly Schedules /Lookaheads

The Contract Administrator uses the weekly schedules/ lookaheads to monitor progress of the works. If required in accordance with their schedule of duties, they may use these documents to co-ordinate interfaces with other contractors.

Typically these schedules show all programmed activities and duration for the forthcoming three weeks, plus one week of history. They include explanations for variances to the previous week's schedule. This include all subcontracted activities.

### 12.12.3 Constructors/ Contractor's Progress Report

The Contract Administrator uses the constructor's progress report as the basis for progress discussions at the progress meetings.

The constructors/ Works Contractors submit statements of progress and a statused copy of works programmes showing any changes to completion and interface dates. The report include supplementary charts and diagrams to provide concise data on progress of the Works.

## 12.13 Contract Administrators Reports

The Contract Administrator arranges for reports to be forwarded to the Project Manager on a regular basis; typically these include weekly and monthly reports.

### 12.13.1 Weekly Reports

These are likely to in a tabular and diagrammatic format which has been agreed with the Project Manager. These reports cover progress and quality of the various elements of the Works.

### 12.13.2 Monthly Reports

The monthly report is presented in a concise format agreed with the Project Manager. Typically it comprises the following sections:

- Summary and Comments.
- Progress.
- Programme.
- Safety.
- Quality System and Quality Plans.
- Design Progress and Information.
- Contractual & Financial Matters.
- Interfaces.
- Staff.

## 12.14 Commissioning

Typically the Contract Administrator prepares a commissioning programme based on the contractor's construction programme. This shows the various phases of pre-commissioning which lead to the commissioning phase. A guideline procedure should be prepared for these phases which addresses the conditions necessary to commence the work, the sequence and scope of testing, and document organisation, and test data sheets.

Typically the lead constructor, the Construction Manager or the Project Manager monitors the interfaces between the various works contractors for systems testing. In collaboration with the works contractors they advise the Owner on employee training requirements.

The Contract Administrator advises the Owner on the requirements for spare part holdings, following discussions with the works contractors' equipment suppliers. This stock should relate to the commissioning, initial operation, and full production periods.

Examples of commissioning and records held can be found in the Project Management Manual full electronic library using key word searches "Commissioning", "Records AND at AND Handover".

## 12.15 Operations and Maintenance Manuals

The Contract Administrator obtains the operation and maintenance manuals from the constructors/ works contractors. The due date for the issue and format of these manuals should be specified in the contract documents. These documents should be available, albeit in a draft form, at the start of commissioning.

In the United Kingdom these form part of the health and safety file.

Typically the content list comprises:

- Scope of systems.
- Installation record.
  - Schedules of plant and equipment.
  - Component identification system.
  - Manufacturers literature.
  - Test certificates.
  - Guarantees.
  - Data sheets and performance data.
- Systems operation.
  - Operating instructions.
  - Fault finding.
- Systems maintenance.
  - Preventative maintenance schedules.
  - Maintenance manuals and procedures.
  - Consumables.
  - Spares.

## 12.16 As Built Drawings

The Contract Administrator obtains as-built drawings and records from the constructors/ works contractors. These should be in a common layout and in a specified software format. Typically the Contract Administrator arranges for the Designer and site supervisor to check these for correctness and completeness.

In the United Kingdom, these documents form part of the health and safety file.

## 12.17 Guarantees

The Contract Administrator obtains and reviews all guarantees required from the works contractors under the terms of the contract.

## 12.18 Completion and Defects Liability

The contract documents define the procedure for issue of completion certificates and schedules of defects. It is the Contract Administrator's responsibility to issue these documents. Typically these documents include:

- Practical Completion Certificates. These identify when the whole of the works, or parts thereof, are completed and also the Defects Liability Period.
- Schedule of defects and outstanding works. The list of defects and outstanding works is produced by the party carrying out the site supervision and agreed with the lead constructor/ contractor.

The Owner assumes responsibility for the insurance of the works upon issue of a certificate. The issue of the Certificate may also release retention money previously withheld from progress payments.

The Contract Administrator prepares and implement a contract closeout procedure. Typically this takes the form of a checklist.

## 13. CONSTRUCTION SUPPORT SERVICES

Note: In the United Kingdom in accordance with the Construction (Design and Management) Regulations (CDM), the project health and safety plan incorporates details of the general site arrangements, including emergency procedures and welfare, that may be imposed by the Owner or developed by the principal contractor.

### 13.1 Site Establishment

The Project Manager will be expected to monitor all contractors' facilities within the boundaries of the construction site. It is the lead constructor/ works contractors' obligation to provide information on:

- The allocated area for the works contractor's offices.
- The allocated area for contractor's laydown.
- The provision of utilities including power, water, sanitary, telephone.
- Parking areas for contractors employees, both on and off the project area.
- Standard site working hours. A procedure for notification of working outside these hours should be established.
- A procedure to permit and record contractor's material deliveries to site.

The general cleanliness of the site should be enforced. It is the works contractors' obligation to keep the site safe and orderly

### 13.2 Site Services

Occasionally the Project Manager or the design team is required to provide suitable and adequate site services. This is likely to be in accordance with a schedule provided by the Owner. This schedule may describe the items to be provided and the preferred procurement route.

This may include:

- Consumables including fuel, copying and printing, office consumables.
- Temporary site installations including management offices, catering buildings, first aid rooms, office furniture, computer systems, telephone systems, weatherproof storage areas, secure storage areas, guardhouse.
- Temporary site infrastructure including site roads, fencing, power and lighting systems, water supply, sewage systems, hard standings, parking areas, fencing.
- Site equipment including site transportation, fire fighting equipment, photo equipment, first aid equipment, miscellaneous materials for maintenance.
- Site services including security personnel, site office cleaning, site catering services,
- Waste removal services, driver/maintenance personnel.

### 13.3 Site Security

The Project Manager may be requested to prepare and implement a site security system. Typically this involves organising a contract with a specialist company providing security systems and personnel.

#### 13.3.1 Personnel Access to Site

Only authorised persons are allowed in project areas is a requirement of the Health and Safety Plan under the CDM Regulations.

All personnel working on site wear an identity badge. This includes a photograph, the individuals name, position and employer, and have a unique number. (This immediately identifies unauthorised

personnel on site, identifies contractor's supervisors, and identifies personnel requiring disciplinary action.)

It is suggested that all contractors (designers, constructors) are allocated a unique colour of safety helmets. This allows the construction to easily identify working areas and potential conflicts.

All visitors to site are provided with a temporary visitors badge. They sign in and out and should obtain the signature of the person that they were visiting.

### **13.3.2 Photography**

It is suggested that photography is not allowed on site unless a permit has been obtained from the Construction Management. No photograph may be published without the prior approval of the Owner.

### **13.3.3 Fencing and Gates**

Wherever possible a security fence with manned gates is provided around the perimeter of the construction area.

### **13.3.4 Security Personnel**

It is suggested that all access gates are manned, storage areas patrolled and site patrols carried out during all non-working hours.

### **13.3.5 Vehicle Access to Site**

It is suggested that a limited number of personal vehicles for management staff are allowed on site. These vehicles are provided with a badge to allow them onto site. All vehicles are registered in and out of site.

Visitors' vehicles are recorded in and out of site, and are provided with a badge providing them with temporary access to site.

All delivery vehicles are recorded in and out of site including the recipient and the cargo.

### **13.3.6 Vehicles Leaving Site**

It is suggested that all vehicles leaving site are visually inspected including storage areas.

A procedure is required to allow equipment and materials to be taken offsite. A form listing the articles should be provided and authorised. This is retained by security.

## 14. SITE HEALTH AND SAFETY

### 14.1 Overview

Responsibility for site safety is shared by all members of the project team, not just the constructors/ works contractors. It is important that the system of supervision assists in the provision of a practical site safety policy.

In the United Kingdom, the framework for the health & safety management of projects is generally dictated by the Construction (Design & Management) Regulations, (CDM).

The CDM Regulations require Owners, Designers and Contractors to take a co-ordinated approach such that health and safety is fully integrated into all stages of the project process from conception through design, construction and maintenance.

The CDM process endeavours to strengthen the management of the interface between design and construction through:

- Designers' risk assessments.
- Pre-tender health and safety plans.
- Contractors health and safety plans.
- Assurance of competence of designers and contractors.
- Co-ordination of the parties.

Generally the Project Manager is not responsible for operations on site. The Project Manager's duties will define whether the Project Manager has any responsibility for checking that health and is taken into account during the design.

It is recommended that the Project Manager and constructor/ works contractors develop with the Owner the project specific site safety policy. The requirements of the policy will be reflected in the contract conditions. In the United Kingdom they will also be reflected in the details contained in the Health and Safety Plan.

The principles of the CDM regulations can be applied in all localities, not just in the United Kingdom. It is recommended that they are applied wherever possible. Arup publish, for internal use only, the Arup Health & Safety Handbook. This is attainable from the Arup Safety or the Arup Library.

### 14.2 CDM Regulations

An overview of the principal objectives and directives of the CDM Regulations follows.

The key objectives of the CDM regulations are:

- Early identification of hazards and risks.
- Co-ordination of health and safety across design and construction.
- Improved documentation throughout the life of a project.

The principal mechanisms of the CDM Regulations are:

- Appointment of a 'Planning Supervisor'.
- Appointment of a 'Principal Contractor'.
- Preparation of a health and safety plan.
- Preparation of a health and safety file.

The requirements on the Client are:

- Appoint competent persons as Planning Supervisor, designer and Principal Contractor.
- Ensure that the health and safety plan is prepared before construction begins.

- Provide information to the Planning Supervisor.
- Ensure that the health and safety file is available for inspection.

The requirements on the Planning Supervisor are:

- Give notice of the project to the Health and Safety Executive (HSE).
- Advise on the competence and resource adequacy of designers and contractors.
- ensure that the design meets the requirements of the Regulations.
- Ensure preparation of the health and safety plan and file.

The requirements on the designer are:

- Ensure clients are aware of their duties.
- Avoid foreseeable risks to the health and safety of persons at work.
- Combat at source risks to health and safety.
- Give priority to measures to protect all persons at work.
- Provide adequate information about residual risks.
- Co-operate with the Planning Supervisor and other designers.

The requirements on the Principal Contractor are:

- Develop and implement the health and safety plan.
- Co-ordinate and obtain co-operation between the constructors/ works contractors.
- Manage the implementation of health and safety measures on site.
- Provide the Planning Supervisor with information for the health and safety file.

The requirements on constructors/ works contractors/ contractors are:

- To co-operate with the Principal Contractor.
- To provide the Principal Contractor with any information (including risk assessments) pertaining to health and safety.
- To comply with any directions under CDM from the Principal Contractor.
- To comply with the health and safety plan.

### 14.3 Health and Safety Plan

The Health and Safety Plan must strictly comply with health and safety legislation. Preferably this includes application of approved codes of practice and official guidelines which although not statutory represent good practice.

It is prudent to prepare a Health and Safety Plan, which complies with or follow the guidelines of the CDM Regulations. This documents develops as the project progresses.

For the planning and design stage (Conceptualisation) the Health and Safety Plan includes:

- Description of project and timetable.
- Details of health and safety risks.
- Information to constructors/ contractors to enable them to show they are competent and able to allocate adequate resources.
- Details of site constraints.
- Details of precautionary measures and site rules.

For the construction stage (Realisation) the Health and Safety Plan includes:

- Arrangements for management and monitoring, taking into account risks involve and activities of persons at work.
- Details of welfare arrangements and emergency procedures.
- Details site rules and procedures.
- Details controls of risks.
- Specify arrangements for training, communication and consultation.

Site services must also comply with statutory requirements and good industrial practice.

Safety representatives must be appointed from all parties on site. They have a responsibility to ensure compliance with the Safety Plan relative to their designate responsibility.

The plan may stipulate a mandatory common safety-training programme.

Examples can be found in the Project Management Manual document library under "CDM & Safety".

## 14.4 Responsibility

The lead constructor/ works contractor assume the responsibilities of the Principal Contractor in accordance with the CDM Regulations. As an example the responsibilities of a construction manager are outlined below:

### 14.4.1 Construction Manager's Responsibilities

If the construction process involves a construction manager, they will typically be responsible for:

- Short listing works contractors who may be invited to tender, taking account of their skills in managing health and safety.
- Drawing up the health and safety plan for inclusion in the contract documents with the works contractors.
- Consideration of site safety procedures, guidance notes and codes of practice, which are referred to in contract documents with works contractors.
- Ensuring that work contractors are briefed about the anticipated project methods and the relevant hazards.
- Satisfying themselves that constructors/ works contractors have made plans to carry out the work safely, have the necessary resources and have priced their tenders accordingly.
- Managing health and safety on site by co-ordinating activities, ensuring that planned procedures are implemented.
- Creating a site-wide safety committee involving representatives of management and operatives from all parties on site.
- Arranging site wide procedures for emergencies, safe access and lighting.
- Organising regular co-ordination meetings between the various work contractors to identify and resolve area of interface to maintain safe working conditions.
- The appointment of a health and safety officer.
- Reviewing constructors/ works contractor's health and safety programmes for compliance with the plan.
- Monitoring constructor's programmes and performing audits on the constructors/ works contractors' operations.

## 14.5 Health and Safety Plan Compliance

The Principal Contractor monitors the constructors/ works contractors health and safety programmes and performs audits on the contractor's operations. These audits can include a review of constructors performance undertaking the following activities:

- Accident and injury reporting/accident investigation report.
- Training programmes.
- Job hazard analysis/method statements.
- Medical facilities.
- Safety arrangements at local offsite facilities.
- Record keeping and reporting procedures.
- Enforcement procedures/notice of disciplinary action.



- Permit to work systems.
- Sanitary facilities.
- Fire protection.
- Environmental protection/reporting hazardous materials.
- Emergency procedures.
- Key personnel: emergency telephone numbers.
- Toolbox meetings.
- Safety meetings.
- Appointment of a site safety officer.

## 14.6 Health and Safety File

In the United Kingdom in accordance with the CDM regulations the health and safety file must be prepared. It is a summary document which records aspects of the construction project which have health and safety implications.

For projects outside of United Kingdom any requirement for this document will need to be specified in the duties of the project team.

The health and safety file includes:

- Basic design criteria
- "As-built" structure details.
- Details the construction methods and materials used.
- Information on equipment and maintenance facilities.
- Manuals with schedules of plant.
- Information on emergency and fire fighting systems.

Examples can be found in the Project Management Manual document library under "[CDM & Safety](#)" and using the full electronic library via the keyword search [CDM](#) : or [CDM Planning Supervisor](#) .

## 15. QUALITY MANAGEMENT

### 15.1 Project Manager's Activities

The Project Manager must comply with the requirements of the Ove Arup & Partners Quality Manual. This has been accepted by British Standards Institute as meeting the requirements of BS EN 150 9001.

The Project Manager must prepare a quality assurance plan, and arrange reviews of the tasks and procedures being followed at regular intervals.

### 15.2 Project Manager's Quality Assurance Plan

The Project Assurance Quality Plan records the:

- Principal activities into which the project is divided.
- All parties involved with the project and their representatives responsible for their work.
- Staff responsible for principal activities.
- Briefing documents, surveys, reports and other information on which the project is to be based.
- Planned outputs probably including a programme of the project activities.
- Codes of practice, standards, regulations and controlled references against which the project will be verified and the verification requirements e.g.: the categories of checking, project review and approval to issue.
- Change control procedure.

### 15.3 Quality Assurance Plan – Others

It is recommended that each project organisation prepares and implements their own Project Quality Plan which relates to their specific scope of work and duties. This notes the procedures to be followed. These are likely to include:

- Project control method.
- Change control.
- Document and data control.
- Subcontractors and purchasing.
- Identification of documents.
- Verification and validation.
- Inspection, measuring and test equipment.
- Verification and approval.
- Quality records.
- Control of non-conformances.
- Handling and storage.
- Internal quality audits.
- Training.

The typical report formats for this plan are included in the [Arup Quality Assurance System](#).

### 15.4 Enforcement /Quality Control

Responsibility for enforcement of the project quality control is defined by the Owner. Each organisation should be responsible for establishing their own system of checks and inspections to control quality.

During implementation on site, the lead constructor is likely to have responsibility for site quality control. This organisation will be responsible for inspecting the works to avoid unacceptable work and the use of unacceptable materials and equipment. When many works contractors are involved it is likely that a common set of formats for documentation are used. Documentation includes forms for:

- Submittal.
- Concrete placement check list.
- Request for inspection/witness test.
- Request for inspection/witness test/commission.
- Partial/final inspection report.

## 15.5 Non-compliance

When deficiencies are noted, the constructor/ works contractor will be notified using a Non Conformance Notice. A typical format is included in the Arup Quantity Assurance system.

Action following issue of these reports needs to be monitored, agreed actions implemented and the non-conformances closed out.