Principles
of
Project Management

Introducing principles, subjects and methods for managing projects
Introduction

This document introduces key principles, subjects and methods related to the professional discipline of project management. It will be useful for those joining or working with project teams and also for anyone wishing to obtain the Association for Project Management’s ‘Introductory Certificate in Project Management’.

Subjects within this document are presented in five chapters corresponding to key phases in a typical project life cycle. Chapter 1 ‘The Project Context’ addresses subjects and methods applied at the beginning of a project to establish factors driving the need for the project and to be taken into account before developing the business case.

Chapter 2 ‘The Project Concept Phase’ covers the concept phase of the project during which the idea for the project is developed at high level to obtain commitment from those who may have an interest and obtain some benefit from the project. The output from this phase is the business case which enables the project stakeholders to evaluate the value of the project and make the decision to undertake the project. This chapter also covers important subjects related to people working in projects.

Chapter 3 ‘The Project Definition Phase’ covers the definition phase of the project during which the project management plan is developed to explain how the project is to be undertaken and provide guidance to all those involved in the project until completion. This chapter also covers the use of well established tools and techniques for developing detailed plans for scheduling, resource management, cost control and risk management.

Chapter 4 ‘The Project Implementation Phase’ covers subjects related to project implementation and introduces key methods used in the control of projects including scope, change and configuration management.

Chapter 5 ‘The Project Handover and Closeout Phase’ describes the main activities performed to complete the project and handover deliverables to the relevant stakeholders prior to formally closing the project.
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Chapter 1 The Project Context

Project Characteristics

Projects are one off undertakings intended to bring about revolutionary change rather than small incremental change. Consequently, unlike day to day operations projects are not continuous processes but have defined timescales with set start and end points. Projects also require work to be undertaken by a temporary team who have a capacity to work in uncertain environments and deal with any risks likely to be encountered.

The life of a project begins when a need is identified that cannot be met with any existing product and therefore the development of a new product is required. The need may arise for example: to overcome an existing problem; to meet a new challenge; or take a new opportunity. Since needs are driven by those interested in the project who are generally called stakeholders, it follows that understanding their specific interests and influences will enable the project management team to define specific requirements and develop an appropriate strategy.

The fulfilment of any need can be constrained by many factors. Three in particular are of importance: time, cost and quality (sometimes performance is used in place of quality), and are used for baseline planning and controlling the project. Stakeholders will typically use these parameters as well as the overall benefits arising from the project to judge the success of the project. For this reason they are often called success criteria.

The benefits from a project are provided through the use of the products delivered by the project, which not surprisingly are generally termed deliverables. To produce deliverables the project team will need to plan activities, obtain and apply resources, control and coordinate the work and deliver the products to the users. The users will take delivery of the products and use them to realise the benefit.

Project: a unique, transient endeavour undertaken to achieve a desired outcome.

Benefit: the quantifiable and measurable improvement resulting from completion of project deliverables that is perceived as positive by a stakeholder.
Figure 1 shows how these key elements and characteristics come together to form a project.

In summary, projects are unique, transient endeavours intended to bring about revolutionary change. They are not continuous processes but have a defined timescale with set start and end points. Activities must be performed within pre-defined constraints and stated parameters (success criteria) which are normally expressed as time, cost and quality and should produce a measurable benefit.

**Project Management & Processes**

**The Need for Project Management**

The combination of the characteristics discussed above creates an environment that is inherently unstable and risky, and consequently project teams need to be flexible and adaptable. Largely as a consequence of experience, specific project management methods have evolved to ensure projects are managed effectively throughout their life. These methods generally provide the planning, control and integration needed to ensure that the project objectives are met and the benefits are achieved without adversely impacting on business as usual.
Projects typically cross organisational boundaries and require individuals and groups from different disciplines and backgrounds to work together on a temporary basis. Stakeholder and team integration is therefore an important factor in successful project management. Innovation involves risk and uncertainty which require specific management approaches and can only be accomplished through good communications, co-ordination and control. Each aspect must be integrated into a complete management approach.

A disciplined approach to project management also ensures that projects are integrated within an organisation’s strategic direction, its policies and governance requirements.

**Project Management Processes**

As shown in figure 2, a structured approach would define a number of processes which can be broken down into four generic groups:

- starting and initiation
- defining and planning
- monitoring and controlling
- learning and closing processes.

Together these groups of processes define the project management cycle (note: this is not the same as the project life cycle as will be discussed later). Specific processes will be applied at all levels of a project including phases, stages and work packages.

**Starting and Initiating Processes**

These processes include obtaining authorisation and kick-off meetings and are typically carried out at the beginning of each project phase, stage or work package.
Defining and Planning
Examples of activities include at the highest level: producing a project management plan; updating the project management plan; producing handover plans, and producing implementation plans such as project network diagrams, Gantt charts, milestone plans, resource schedules, etc. At lower levels it will cover work package definition, activity plans, resource planning, etc.

Monitor and Control
Activities include measuring progress and performance, analysis, corrective action, problem solving and issue management. The project sponsor and project manager will focus on overall performance at the highest level and work package managers will focus more on monitoring and controlling day to day activity.

Learning and Closing
Learning during projects can be almost continuous. However, it is useful to conduct specific ‘lessons learnt’ exercises at important events. For example:

- on completion of a work package
- on achieving an important milestone
- when a major problem is solved

Planning: the process of identifying the means, resources and actions necessary to accomplish an objective.

Monitoring: the recording, analysing and reporting of project performance as compared to the plan in order to identify and report deviations.

Lessons Learned: the identification of activities associated with the project that went well, those that could have been better, to recommend improvements applied in the future and to future projects.
Business and Project Context

Business Context

Business as usual (BAU) concerns the normal, often routine day to day operations and processes undertaken within an organisation. It uses existing products, processes and capabilities to provide products and services to customers and to generate income and profit. These operations tend to produce reliable and consistent outputs on a continuous basis. However, in today’s business context BAU operations will almost certainly decline without the introduction of new capabilities, thus requiring revolutionary change.

Change

Change concerns the organisation responding to changes in its environment to deal with opportunities and threats, and to ensure long term survival. These changes typically involve the development of new products, services and processes that provide improved capability (in effect Innovation). This may be driven by market conditions, economic factors, stakeholder needs, legislation, etc.

Many organisations implement such change through programmes and projects. In essence programmes and projects focus on innovation and are therefore transient whereas BAU operations tend to be more stable and longer lasting. Both BAU and Change provide benefits to the organisation. However, the challenge for most organisations is to achieve the change needed without damaging BAU during the change whilst ensuring that real benefits are achieved in order to sustain BAU in the long term.

BAU operations rely mostly on existing products, services and capability to generate benefits. Generally, benefits include for example, revenue, profit and market
growth which are of direct benefit to the organisation, and others such as the use of
the products, share growth, etc., which benefit external stakeholders.

It is likely that in order to sustain business operations in today’s environment, the
organisation will need to develop new capabilities, products and services. These
may be driven by internal or external needs as shown in figure 3.

Figure 3: Business and Change

The Project Context
The project context is the total environment in which a project is undertaken. It has
two key perspectives:

**internal** as defined by the organisational structure, management, behaviour
and culture

**external** as defined by the business environment in which the organisation
operates, including legislation and regulation, professional and industrial
standards, and market sectors.
Project sponsors and managers need to understand both the internal and external factors that can affect their projects.

**Internal Factors**

Internal factors that typically drive or affect innovation are:

- **Organisational strategy** - the organisation's vision and long term aims
- **Opportunity realisation** – engaging by choice in new ventures that emerge from the environment
- **Competitive positioning** – enhancements that lead to improved competitiveness
- **Business security** – protecting the business from threats
- **Business Continuity** – ensuring the business continues through crises including disasters

**External Factors**

The external environment typically includes a number of influences that may affect the organisation as shown in figure 4. In some cases these will have little or no effect on the project. Sometimes they directly impact on project objectives. For example, new health and safety legislation may require changes to both standard BAU procedures and also to new methods that may be under development through a project.

**Project Context:**

The environment within which a project is undertaken. Projects do not exist in a vacuum and an appreciation of the context within which the project is being performed will assist those involved in project management to deliver a project.

APM BOK v 5
The internal environment includes the working environment in which the project is undertaken. This may be governed by policies, standards and processes that are externally defined and adopted by the organisation such as international, industrial and professional standards. Each project will need to take these many and diverse factors into account when initiating, planning and implementing a project. Many environmental factors will change in the course of the project and consequently there is a need to assess impacts on project objectives throughout the project and its life cycle.

There are a number of tools and techniques for establishing the context and associated factors in a project’s context. For example: Environmental Impact Analysis (sometimes called PESTLE analysis due to the factors considered, see figure 4) which is typically undertaken during the Concept Phase of a project to

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Figure 4 Internal and External Factors
determine the impact of such factors on the project; Strengths, Weakness, Opportunities and Threats analysis (SWOT), which considers the organisation’s capability and relationship in terms of strengths and weaknesses to external factors providing opportunities and threats.

**Organisational Roles**

Organisational roles define the accountabilities, authorities and responsibilities to be performed by individuals and groups in a project. Some of these roles are transient due to the nature of projects and it is therefore important that they are well defined and their accountabilities clearly identified and communicated to project stakeholders. The principal roles on a project are shown in figure 5 and described below.

![Figure 5 Principal Project Roles](image)
Corporate Management: the job of corporate management is to confirm the initial idea for the project, ensure the project is linked to corporate requirements and oversee governance of the project.

Project Sponsor (or executive): is the representative of corporate management and project stakeholders on the project. Often termed the Primary Risk taker, the sponsor authorises phases and stages based on the information in the planning documents; provides the link to make sure that relevant information from outside the project is included in plans, and vice versa; owns the business case and is responsible for delivering the benefits.

Project Steering Group (or board): provides overall direction. Usually chaired by the sponsor and consists of user and supplier representatives. If a steering group is not appropriate, the sponsor provides overall direction. The user and supplier roles are described in more detail below.

Project Manager: accountable to the sponsor for achieving the project success criteria (time, cost, quality) and producing the deliverables to enable the benefits to be achieved.

User: an individual or group of people who will use the project deliverables to obtain the benefits. These may include subject matter experts who contribute to defining requirements and acceptance criteria, representatives from BAU activities (i.e. operators), and customers who buy products to use them (i.e. end users).

Supplier: people or organisations that provide the resources. These can be internal and external.

Other important project roles include:

Project Team Leaders and Members: those who do the technical work on the project and report to the project manager. This could include in-house staff, external contractors and suppliers.
External and Internal Stakeholders: individuals and groups with an interest in the project and who may contribute to the ‘fitness for purpose’ requirements for the project.

Project Office: provides support to the project manager and sponsor. It is typically a specialist group that may be located centrally or within the project and may be responsible for linking corporate strategy to project execution. The group often provides a project support function across the project team providing resources and expertise for planning, estimating, cost management and other planning and control functions.

Project Assurance: may report directly to the sponsor or steering group and are responsible for independent monitoring and reporting of the project’s quality and deliverables.

Project Life Cycle
Projects are characterised by a number of distinct phases, each contributing in a different way to the progress of the project. Although life cycles tend to progress through similar phases, there may be differences due to specific requirements of different business sectors and industries. The main purpose of phasing life cycles is to provide structure and direction. The APM generic project life cycle is shown in figure 6 and also shows two key documents that are used throughout the project life cycle: business case and project management plan. These documents are used in conjunction with project reviews, also shown in figure 6. It is obviously important that the project sponsor and manager agree the frequency and number of reviews at the start of the project.

Characteristics of the main phases are as follows:

Concept – the need, problem or opportunity is confirmed and a feasibility study undertaken. The preferred option is selected and the business case produced.

Definition – the preferred option is evaluated, risk reduced, and the design optimised. Usually through a number of iterations, the product and project
criteria are refined and detailed. Plans are produced for the management and implementation of the project. A project management plan is produced and authorised by the sponsor.

**Implementation** – the project management plan is executed, monitored and controlled. The design is completed and the deliverables produced.

**Handover and closeout** – the final phase of the project involves acceptance testing and formal handover of the deliverables to the project sponsor. Closeout involves closing activities, demobilisation of the team, closure of contracts, disposal of equipment, archiving documentation, audits, etc. Finally, a post project review is conducted to establish lessons learnt and recommendations for improvements.

![Figure 6: The APM Project Life Cycle](image-url)
There are two phases after project completion: operation and termination. If these are included in the life cycle, it is called an extended life cycle. During Operation, the project sponsor conducts the benefits realisation reviews to evaluate the performance of the product in service.

A summary of key reviews is as follows:

**Project Evaluation Review:** a documented review of the project’s performance, produced at predefined points in the project life cycle.

**Gate Review:** a formal point at which the expected worth, progress, cost and execution plan of a project are reviewed and a decision made whether to continue with the next phase or stage of the project; effectively the Go/No Go viability check.

**Post Project Review:** undertaken after the project deliverables have been handed over and before final closeout. This review is intended to produce lessons learnt that will enable continuous improvement.

**Benefits Realisation Review:** a review undertaken after a period of operation to assess performance of project deliverables against the planned benefits.

**Benefits of the Gate Approach**

A Gate approach provides several benefits. These may be summarised as follows:

**Effective Control** – gates provide high level check points to examine the validity and viability of the project against the business case and strategic aims.

**Risk Management** - allows risks and uncertainties to be evaluated thoroughly at gates

**Structured Approach** - provides manageable chunks and realistic objectives to ensure greater focus and motivation

**Stakeholder Engagement** - enables wider stakeholder involvement at stage gates rather than during phase and stages which may be disruptive – for example, users can review the product development against their requirements
**Rolling Wave Planning** – details for near term, outlines for later stages to reflect uncertainty profile. This eliminates nugatory work whereby detailed plans are likely to require extensive rework at stage gates.

**Estimating Accuracy** – estimating accuracy should improve as the project progresses through the life cycle phases. However it is often difficult to produce estimates during phases when work is in progress. Gates enable estimates to be produced against a more static baseline.

**Continuous Improvement** – gates provide an opportunity to review lessons learnt and plan improvements into follow phases and stages.

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**Programme & Portfolio Management**

Programmes, portfolios and business as usual co-exist as shown in figure 7, to enable the organisation to function on a day to day basis whilst innovations are undertaken to sustain the business in the long term.

![Figure 7: Programme, Portfolios and BAU Elements](image-url)
Programmes
Programmes are typically long term, high profile and strongly linked to strategic objectives. They can be carried out across organisations or within portfolio divisions. Projects in a programme are often interdependent and benefits are typically delivered incrementally as the products from each project enter service as shown in figure 8.

Programmes are not just large projects. A large project that has a clearly defined objective could be managed as a single project. In such cases the scope can be defined, albeit not in complete detail at the start. In contrast, a programme may have a defined end goal but it may be difficult if not impossible, to define all of the work at the start or even a clear strategy for achieving it. Programmes are therefore more ambiguous than projects and need to be managed in different ways compared to projects.

Programme management is the co-ordinated management of related projects which may include BAU activities that together achieve a beneficial change of a strategic nature for an organisation.

Portfolios
A portfolio is generally used to describe a collection of similar things. In organisations it can have various
meanings. At one level, a portfolio may represent a division of the organisation’s business into similar projects, products and business as usual as shown in figure 9. At another level it may mean a collection of projects under the management of one person.

These groupings are beneficial since there are common aspects that may lead to efficiencies and greater effectiveness. For example, a ‘Highways’ portfolio could share common resources or facilities that are specialised in building roads to provide efficiency and develop specific experience. Contractual arrangements may also be common and portfolios may be linked to common customers and management authorities, such as the Highways Agency which controls work on most major roads in the UK.

Portfolio management concerns the management of the strategic link between projects and the corporate strategy. Portfolio managers are also able to ensure that programmes and projects undertaken within the portfolio do not impact adversely on BAU. They can also ensure that programme and project objectives are reviewed and changed whenever new opportunities arise that may be beneficial to the portfolio.

In general, whereas programme management is concerned with longer term objectives, portfolio management provides benefits on a day to day basis and are
directly related to business as usual efficiency and effectiveness as well as longer term needs. For example, prioritising resources, addressing capacity bottlenecks, deciding time priorities and managing risks across the portfolio.

**Stakeholder Management**

Stakeholders are groups and individuals that have an interest or role in a project. It also includes groups and individuals that may be affected by the project and its products. Some may be using the project as a means of investment and be anticipating a return on their initial investment. Others may have regulatory interest, or represent public bodies.

Stakeholder Management (figure 10) establishes the individuals and groups with a vested interest in the project, and prioritises their relative importance in terms of interest (needs) and power (degree of influence) on key decisions and activities. It may also prioritise stakeholders according to the degree they are affected by the project or its outcome. Finally, appropriate strategies are defined for engaging each stakeholder in the project to enable them to contribute effectively.

Stakeholders may have varied interests and influence on the project. Some may be opposed to the project whilst others are for it. Some stakeholders may introduce threats and others provide opportunities. Stakeholders’ involvement may be passive or active. For example: active environmental lobbyists and demonstrators. It is therefore becoming increasingly important to recognise and manage the way stakeholders participate in projects in order to reduce negative impacts and enhance opportunities.

Stakeholder Management can also be regarded as the management of ‘people risks’ and should consider external and internal stakeholders at all levels in the project. Certainly stakeholder analysis can provide important inputs to effective project management.
Stakeholder Analysis
Stakeholder analysis is a pre-requisite for many planning activities including integration, communication, information management and risk management, and should be undertaken at the beginning of the project and updated frequently since stakeholders and their interests change.

The various interests and power levels may be evaluated in order to establish the potential effect on the project. Stakeholders may be prioritised to show those with greater power or interest in the project. This analysis helps with response planning and in particular communication management.

Interest may be positive or negative. Potential negative interests may be viewed as possible risks. The level of interest can be scored using a simple qualitative scale for example ‘High’ or ‘Low’. Figure 11 shows a simple framework for stakeholder analysis.
Since the composition and influences of project stakeholders continually change as the project progresses, more significantly at the boundaries of key phases and stages, the process is therefore applied continuously throughout the project.

**Responses**

A complete analysis would typically lead to appropriate actions to involve stakeholders positively in the activity, or in the case of negative interests, to apply counter-measures to eliminate or reduce any possible threat. There are many ways to manage stakeholders. In some cases good communications and up to date information may be required, for others greater involvement in decision making processes may be necessary.

**Project Success & Benefits management**

**Success Parameters**

The APM describes the parameters of success in four ways:

- **Benefits** – obtained as a result of the project
- **Success Criteria** – targets for accomplishment of the project
- **Key Performance Indicators** – measures of success
• **Success Factors** – enablers of success

These are discussed in more detail below.

**Benefits**

It is important to define and quantify benefits during the development of the business case. Examples of benefits may be:

- increased capability
- increased sales
- increased market share
- increased profitability
- improved customer satisfaction

Benefits are realised mainly after the product has been delivered to users. The management of benefits is defined in a benefits realisation plan which specifies who is responsible for achieving the benefits, and how the benefits will be measured and controlled.

**Project Success Criteria**

Success criteria are the specific parameters that will be used to judge how well the project execution was performed. They provide an important focus for project stakeholders, and are used to control project performance up to handover and closeout. They should be measurable and unambiguous to avoid conflict between stakeholders. They should be realistic and therefore achievable by the project team within the constraints placed upon the project. They will be unique to the project and derived from the stakeholders needs. Effective success criteria will be:

- Defined as part of the business case
- Reviewed at the end of each phase
• **SMART (Specific, Measurable, Achievable, Realistic and Time bound)**
• **Agreed between the Sponsor and the Project Manager**
• **Include a tolerance**

Typical Success Criteria are: Cost, Time and Quality (see figure 12). Quality usually relates to the quality of the work performed and also the performance of the finished product. Some organisations prefer to use the term performance in place of quality. Other Success Criteria may be safety levels, reputation, or any other criteria defined as important by the project stakeholders.

It is also important to understand and manage the relationship between success criteria. For example, for some projects time may have the highest priority and others quality or cost. These priorities will affect decisions taken to address variances, risks and changes.

**Key Performance Indicators (KPI)**

These are measures that are used to monitor performance against success criteria. For example, comparing the current forecast completion date with the plan will indicate how likely the planned date can be achieved. Similarly, cost and technical Key Performance Indicators will show how well a project is achieving its cost and performance success criteria.
Success Factors

Success Factors are elements of the project context (environment) and management processes that will enable success – or reduce the chance of failure. For example:

- senior management support
- clearly defined goals
- good communications
- team motivation

Research has shown that the absence of such factors is likely to lead to failure and therefore, the project sponsor and manager should identify and address any weaknesses, and build on existing strengths.

Success Factors:
Factors that when present in the project environment are most conducive to the achievement of a successful project. The success factors that if absent would cause the project to fail are sometimes called critical success factors.

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Chapter 2 The Project Concept Phase

The main output of the Concept phase is the business case. The following sections describe the key components and responsibilities involved in the business case.

**Business Case**

The purpose of the Business Case is to provide the justification for the project and is supported by the project strategy and information demonstrating the feasibility of the project. It is produced during the Concept phase and used throughout the life cycle as the high level baseline for the project. It provides a control baseline for corporate management, relevant stakeholders and the project sponsor.

The Business Case explains the requirement for the project, the benefits to be achieved and the proposed technical and management approach.

**Use of the Business Case during the Project**

The business case is used during the project as a baseline and to give direction to the project team. After handover, the business case supports Benefits Realisation Reviews to check that the planned business benefits are being achieved. It is also used to support lessons learnt reviews and make recommendations on future projects and their management (see figure 13).

**Inputs to the Business Case**

The key inputs required to produce the Business Case are:

- definition of the need
- feasibility study
- project context and strategic fit
- stakeholder analysis
• high level risk assessment
• investment appraisal

A clear description of the need for the project which may be to address a problem, a threat or opportunity, will trigger feasibility studies leading to the development of the business case. The feasibility of a project may be addressed through two important questions:

• Is the project worth doing?
• Can the project be done?

A number of stakeholders will be involved in the definition of needs, the development of the business case, its evaluation and approval. These typically include: project sponsor; corporate management; resource providers including finance; the project manager; technical experts; business as usual operatives; portfolio managers and end users.
Main Contents of the Business Case

A summary of the inputs to a typical feasibility study, activities, outputs and contents of a Business Case are shown in figure 14. Typical contents based on the APM BOK are as follows.

- **Justification** - reason for the project
- **Link** - to the organisations overall strategy
- **Benefits** - a summary of the upside and downside effect on the organisation and project stakeholders
- **Criteria for success** - estimated costs, target schedule and agreed success criteria
- **Risks and uncertainties** - high level business and implementation risk assessment
- **Deliverables** - product requirement specifications for deliverables
- **Investment appraisal** - evaluation of options, including the ‘do nothing’ option
- **High level description** - of proposed project strategy and scope (what is included, excluded, constraints, assumptions and dependencies), supported by analysis of options
- **Impact on the organisation** - including business as usual operations during the project implementation and after project handover.
Benefits Management

Benefits Management is an important activity in the project and is a key responsibility of the project sponsor. It involves the identification and agreement of benefits, how they will be measured, reviewed and managed throughout the project life cycle as illustrated in figure 15.

The definition of the benefits of a project will normally be carried out during the concept phase and formally documented in the business case. These will be reviewed by corporate management and other relevant stakeholders as part of the business case approval. Once agreed they become part of the success criteria upon which the project outcome will be judged.

People In Projects

Leadership & Teamwork

The transient nature of projects and high levels of uncertainty and risk encountered during their execution, produce some of the most significant challenges for any organisation executing projects. Whereas day to day business as usual operations are likely to have stable environments in which stakeholders and their behaviours are understood, methods and decision making processes are well tried and tested,
the opposite is likely in the case for projects. Strong, flexible leadership and high levels of team work are therefore demanded by projects.

The next sections provide some insights into leadership and team working principles.

**Leadership**

The role of Leadership in a project is to promote the project vision, reinforce positive relationships and build an environment that supports effective teamwork. These are essential for creating an environment that will inspire, engage and motivate the stakeholders and team. Attributes commonly associated with good leadership are described briefly below and shown in figure 16.

**Direction and focus** – good leaders provide clear direction and promote the project vision.
**Conflicts management** – good leaders are able to identify conflict, establish its impact on the project its root cause and the people involved.

**Motivation** – good leaders are able to create stimulating environments that motivate stakeholders and teams towards achieving project goals.

**Adaptability** – good leaders are willing and able to adapt their behaviour to suit prevailing conditions and the needs of stakeholders and teams.

**Risk-taking** – good leaders are situationally aware which means they are able to appreciate potential problems and evaluate the options available to make effective decisions.

**Influencing** – good leaders are able to obtain commitment from project stakeholders, including external and internal teams, end-user and subcontractors.

**Problem-solving** – good situational awareness and people skills enable the best leaders to deal with uncertainty and problems effectively.

**Delegation** – good leaders understand the value in developing their team’s capability and use delegation as a means of achieving this.

**Communication** - good leaders recognise the importance of good communications, perhaps because strong communication skills are essential in team work, risk taking, problem solving and influencing.

**Feedback** – good leaders understand the needs of individuals in their team especially in terms of recognition, guidance and support.

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**Action Centred Leadership**

John Adair defined a model for effective leadership called Action Centred Leadership through which he suggests that good leadership requires a focus on three aspects: Task; Individual; Team as shown in figure 17. (Adair J, Action-Centred Leadership, Gower, 1982) Importantly, John Adair has demonstrated that leadership skills are not innate but transferable and can therefore be learnt.

Adair defined five groups of activities performed by effective leaders: Planning; Controlling; Supporting; Informing; and Evaluating. These are all essential
elements of managing projects. The tasks performed in projects that correspond to each area of the Action Centred Leadership model are shown in figure 17.

**Teamwork**

It is likely that everyone has worked in groups and teams from time to time. Sometimes it is hard to differentiate between a team and a group, though groups are not always required to behave as teams. For example a group may be formed from representatives of a number of different organisations to ensure their separate interests are taken into account. Whereas a team may be said to have common objectives, groups may not. Consequently teams tend to develop individual and mutual accountability rather than individual accountability as in the case of groups. This means that they typically depend on other team members to achieve goals and therefore support each other and behave generally in complementary rather than
competitive ways. As a result, they are more likely than groups to use consensus approaches for decision making, share information and work collaboratively.

Team Formation
A team becomes an entity with time and can be characterised by its own unique behaviour. Of course in reality it is made up of a number of individuals who are each contributing to the team’s behaviour. Individuals may behave differently in a team when compared to their behaviour in non team situations. An individual who performs well on their own may not perform so well in a team and conversely, one who finds some tasks difficult on their own may find that working with others is more productive. Since projects need people to excel individually and as a team, it is highly important to create an appropriate environment. This environment needs to take into account many factors such as the needs of external stakeholders, the prevailing culture, the tasks and the needs of the individuals in the team.

Team Development
Figure 18 is based on the work of Tuckman (Tuckman B and Jensen N, 1977, ‘Stages of Small Group Development Revisited’, Group and Organisational Studies, vol 2, pp 419-427) who suggested that groups go through five stages during development as discussed below. In the beginning the group acts as individuals with different values, goals and expectations. Eventually the group becomes a team with shared values and expectations as explained below.

Forming – the group is established. Individuals are anxious about their personal identity, role, the impression they make, the attitudes and backgrounds of others.

Storming – conflicts emerge between individuals as they sort out their roles and differences are revealed. The phase is characterised by hostility and disruption.

Norming – the group develops ways of working together, closer relationships and camaraderie. The organisation, roles and working rules (norms) are
established. The framework enables group members to relate to each other and deal with performance issues.

**Performing** – the group matures and becomes productive. Some groups may get bogged down in earlier stages and never achieve maximum effectiveness.

**Adjourning** - eventually the group disbands or reforms. In projects this may be triggered by a change. Some may be planned, for example the completion of a phase and will require the cycle to be repeated.

---

**Figure 18 Tuckman’s Group Development Theory**

**Team Building Strategies**

A number of strategies are effective in building project teams as shown in figure 19. The business case provides the initial direction for the project. A kick off meeting is typically held to ensure the project team are briefed on the purpose for the project, its objectives and the benefits anticipated.

During the Storming stage, workshops enable individuals to explore their potential roles and contributions. Although conflicts are likely in this stage, they can be
managed effectively through workshops where a leader can maintain focus and support team development.

The Norming stage is effectively addressed through the development of the project management plan. A leader that engages the project team and seeks their contribution to the development of the project management plan is more likely to gain buy in and motivation to achieve the project objectives.

Similarly, there are a number of project management techniques that support the Performing stage. For example, monitoring and controlling processes such as earned value management, change management, issues management, quality reviews and audits and progress reporting.

Finally, a structured approach to the Adjourning stage can be supported by lessons learnt reviews, interviews and appraisals.

In addition to such techniques, figure 19 also shows how an effective leader is likely to adapt their style to suit the team’s development. Initially, when the team forms, a directive style is likely to be effective. During workshops and the development of the project management plan, the leader could use a democratic style in order to
achieve the buy in needed. Once everyone is aware of their roles, the work and objectives, etc., the leader can allow the empowered team to carry out the tasks, whilst focusing on exceptions, problems, overall control and forward planning.

**Communication Management**

The purpose of communications in projects is to ensure that information is provided by and received from stakeholders to enable effective decisions throughout the project. In any project there will be routine communications such as progress reporting and special communications when problems occur such as issue reporting. There may be formal communications such as project status reports and informal such as discussions to resolve problems. To be effective, all communications need to be provided in a timely manner and to the appropriate level of quality.

**Communication Planning**

To ensure effective communication, the project manager and team produce a communication plan at the beginning of the Definition Phase to define the communication requirements, methods, communication products and channels, and roles and responsibilities. An essential pre-requisite is a stakeholder analysis to identify information needs as shown in figure 20.

---

**Communication**: the giving, receiving, processing and interpretation of information. Information can be conveyed verbally, non-verbally, actively, passively, formally, informally, consciously or unconsciously.

**Communication Plan**: A document that identifies what information is to be communicated to whom, why, when, where, how, through which medium and the desired impact.

---

**Stakeholders & needs**

- information requirements
- communication mechanisms (methods)
- frequency
- information collection (sources)
- information collation (processing)
- roles & responsibilities in communications
- ‘unexpected information’ management

---

Figure 20  Communication Planning
Chapter 3 The Project Definition Phase

The Definition Phase of a project begins after the approval of the business case and involves the development of the project strategy into a baseline plan for the Implementation Phase, typically called the project management plan (PMP) as shown in figure 21. Definition often includes further optimisation of the solution defined in the business case and detailed planning.

The project team will be established during Definition who will carry out the studies and planning activities needed to develop the PMP. At the end of Definition, the project manager will submit the plan to the sponsor for approval to proceed to the Implementation Phase.

Definition (phase)
The second phase of the project life cycle. During this phase the preferred solution is further evaluated and optimized. Often an iterative process, definition can affect requirements and the project’s scope, time, cost and quality objectives.

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Figure 21 Developing the PMP
Project Management Plan

The PMP provides a baseline for the overall strategy throughout the Implementation, Handover and Closeout phases. It provides the overall direction and details the objectives, methods, organisation and controls to be used.

The PMP is owned by the project manager, developed during the Definition Phase by the project team and authorised by the sponsor. After authorisation, the PMP becomes the baseline for direction, performance measurement and evaluation. During implementation stages it is used to support assessment of project changes and performance, and at the end of each stage is used to review overall progress (gate reviews). After implementation stage reviews, the PMP is typically updated to include any performance improvements needed and to provide further guidance. During Closeout, the PMP provides a baseline for evaluating overall performance, learning lessons and recommending improvements. The PMP is usually placed under configuration control to prevent ad hoc, unauthorised changes and to maintain a clear baseline.

Project Management Plan:
A plan that brings together all the plans for a project. The purpose of the PMP is to document the outcome of the planning process and to provide a reference document for managing the project. The project management plan is owned by the project manager.

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Key Areas & Considerations

Why? (from the business case)

What?
Deliverables & Acceptance Criteria
Success Criteria
Key Performance Indicators
Scope of Work

When?
Timescales
Milestones
Phasing

Where?
Location

Who?
Roles & Responsibilities
Resource Plan

How much?
Budget
Cost Management
Process

How?
Project Strategy
Work Breakdown Structure
Handover Plan
Methods, Tools/Techniques
Control & Reporting
Specific plans

Figure 22 Typical contents of a PMP
Contents of the PMP

The main components of a typical PMP are shown in figure 22. The contents should be appropriate to the size, complexity and control needed for the project. For example, for a small project the PMP may be brief and refer mainly to the organisation’s existing processes. For larger more complex projects, the PMP may need to provide much greater guidance.

Project Quality

Quality Management focuses on the performance of the project and deliverables that are produced. Fitness for purpose means that the product must be suitable for the job it was intended for. However, often fitness for purpose is ambiguous especially when the products produced by the project are novel. In such cases, users define requirements that specify what the product should look like and how it should perform when used. These are agreed by the users and the project team and provide the baseline for effective quality management throughout the project.

Figure 23 Quality Management

Quality:
The fitness for purpose or the degree of conformance of the outputs of the process.

Quality Management:
The discipline that is applied to ensure that both the outputs of the project and the processes by which the outputs are delivered meet the required needs of the stakeholders.

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Quality Management Activities
Quality management is in effect the system that defines and controls all of the activities required to ensure quality. It covers four important areas as shown in figure 23 and described briefly below.

**Quality Planning** - defines the requirements, methods, stakeholder involvement and activities to be undertaken during the project.

**Quality Assurance** - addresses the tasks undertaken to provide confidence that the project quality requirements are being achieved.

**Quality Control** – verifies that the deliverables conform to the product specification through tests and inspections.

**Continuous improvement** – The previous three areas are concerned with ensuring the project delivers the benefits planned. The final area, continuous improvement concerns the development of good project management practice within the organisation.

Project Risk Management
Risk Definitions
A risk event may be defined simply as: anything that could happen that would affect the project objectives. A risk may affect the project objectives in any way: positively or negatively. Positive risks are termed ‘opportunities’ and negative risks ‘threats’.

In addition to risk events, it is important to understand the overall level of risk due to the combination of uncertainties and the accumulation of risk events in a project. In the case of investors, overall exposure will indicate the level and likelihood of
making a return. Furthermore, the level of exposure for the organisation is a combination of the possible effects from all of its projects and operations and consequently what needs to be controlled within manageable limits. This will determine the level of management reserve needed and the acceptable level of risk exposure for any project, where exposure is the degree to which a risk taker could be affected by an adverse outcome. The combined risk for a project is called project risk.

**Risk Management Process**

The APM defined process as shown in figure 24, is commonly used throughout projects and consists of five phases: Initiate; Identify; Assess; Plan Responses; Implement Responses, as described below. Risk Management is typically an interactive process, and for some risk events phases may need to be revisited or reworked. Risk Management is also an ongoing process – it will be repeated a number of times in the project life cycle.

**Initiate**

The purpose of the initiate phase is to ensure the project aims are understood and that the risk management process is focused appropriately. The main output is the Risk Management Plan which provides guidance to stakeholders. The initiate phase
is undertaken at the beginning of the Definition phase of the project life cycle, and typically reviewed and updated at life cycle phase and stage boundaries.

**Identify**

During this phase risk events are identified as comprehensively as possible within practical and cost effective limitations. A number of tools and techniques are commonly used for this phase such as brainstorming, workshops, interviews and surveys. The output of this phase is a list of risk events that are clearly defined and documented in a risk register.

**Assess**

The overall aim in the assess phase is to increase understanding to a level that enables appropriate and effective decisions to be made. Generally, this is undertaken in three steps:

- Evaluate causes of risk event and establish the probability of the risk occurring.
- Evaluate the consequences of the risk event on the project objectives and establish the level of impact on each objective.
- Prioritise the risk events in terms of significance.

**Plan Responses**

This phase considers two aspects: dealing with the risk and evaluating the effect of the response actions on project baseline plans. The main aim will be to avoid or minimise threats and exploit or maximise opportunities. Specific responses to risks may fall into a number of general categories. For example, it may be possible to prevent or reduce a threat, or enhance an opportunity through proactive means.

Alternatively, it may be possible to avoid a threat or develop a fallback plan to deal with a risk event if it were to occur. After response options have been assessed, project plans are analysed to identify the changes needed and impacts on project plans.

<table>
<thead>
<tr>
<th>Response options:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contingency</td>
</tr>
<tr>
<td>Avoid or accept</td>
</tr>
<tr>
<td>Reduce</td>
</tr>
<tr>
<td>Enhance</td>
</tr>
<tr>
<td>Exploit</td>
</tr>
<tr>
<td>Share or transfer</td>
</tr>
</tbody>
</table>
objectives if the response is implemented. Factors typically considered include effect on benefits, cost, timescales, product specifications, resources and stakeholders. In addition, responses to risks may themselves introduce new risks commonly known as secondary risks.

Finally, the response plan is reviewed and authorised for implementation. During the review, a major consideration will be the trade-off between the benefit arising from the risk response against the effect on the project. For example in an extreme case, it may be possible to reduce a risk significantly but the cost of the reduction may be prohibitively expensive. It is therefore possible for response plans to be rejected and/or re-assessed, or authorised.

Implement Responses
This phase covers the activities needed to implement, monitor and control risk responses. Baseline plans are updated and relevant stakeholders assigned ownership and authority to implement responses. Performance is monitored to ensure the plan is implemented effectively and to measure the effects of the response on the risk event. Further actions to manage the risk event may be decided if the risk response plan is ineffective.

Manage Process
The project manager is responsible for ensuring the risk management process is effective and may require reviews and audits to be conducted to evaluate effectiveness. Specific measures that may be useful in monitoring performance could be the overall risk exposure level, the level of crises and unforeseen events that occur. The process should be reviewed frequently and typically at the ends of stages to examine effectiveness, lessons learnt and to incorporate improvements.

Risk Register
The risk register is used to record, track and communicate risks and their status to project stakeholders. It is typically compiled
from summary information recorded in detail in risk inputs forms. A simple example is shown in figure 25.

![Risk Register]

**Risk Register**
- **Project Title:** Apollo Carriage
- **Project Manager:** A. Sands
- **Date:** 21 September 02

<table>
<thead>
<tr>
<th>Ref</th>
<th>Description</th>
<th>Owner</th>
<th>Prob</th>
<th>Impact</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Machine fault causing delays</td>
<td>L Smith</td>
<td>L</td>
<td>L</td>
<td>Increased maintenance</td>
</tr>
<tr>
<td>2</td>
<td>Power cuts stops production</td>
<td>L Brown</td>
<td>M</td>
<td>M</td>
<td>Back up supply</td>
</tr>
<tr>
<td>3</td>
<td>Suppliers increase prices</td>
<td>M Green</td>
<td>H</td>
<td>L</td>
<td>Investigate second source</td>
</tr>
</tbody>
</table>

**Figure 25 Simple Risk Register**

**Scope Management**

**Scope**
The scope comprises the project deliverables and the work associated with their production. Additional information is likely to be needed to produce a full scope definition including technical solutions, specific constraints such as the type and level of skills available, and management requirements such as reporting. The overall project scope is supported by detailed information on each task and typically described in a Scope Statement to support future decisions and develop a common understanding throughout the project. A high level Scope Statement is typically included in the business case. During Definition it is further developed and incorporated into the PMP.

---

**Scope:**  
The sum of work content of a project.

**Scope Statement:**  
A documented description of the project that identifies the project boundaries, its output, approach, content.

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A number of breakdown structures may be created during project planning and used to support the scoping activity as described below.

**Breakdown Structures**

The scope definition is typically supported by product and work breakdown structures. The Product Breakdown Structure shows a hierarchy of the project deliverables. The Work Breakdown Structure shows a hierarchy of the work to be carried out.

**Product Breakdown Structure**

A simple Product Breakdown Structure (PBS) is shown in figure 26 and shows part of the breakdown structure for a car. The hierarchy shows the relationships between families of parts that make up the total deliverable. This overall view of the deliverable, principal components and their relationships is useful during scope and planning. The lowest levels may represent component parts. The PBS also supports configuration management.

**Product Breakdown Structure (PBS):**

A hierarchy of deliverables that are required to be produced on the project.

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![Figure 26 Product Breakdown Structure](image)

**Configuration Items**

(Parts, Components, Docs, etc)

**Products at all levels**

---

**Level 1 Deliverables**

- car

**Level 2 Deliverables**

- chassis
- body

- suspension
- steering

- springs
- shocks

---

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Work Breakdown Structure

The Work Breakdown Structure (WBS) defines the work required to produce the deliverables. The Work Breakdown Structure is used to decompose the work into manageable packages which are called Work Packages as shown in figure 27. Each Work Package has specific deliverables and acceptance criteria to be met.

Work Breakdown Structure (WBS):
A way in which a project may be divided into discrete groups for programming, cost planning and control purposes.

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Combined PBS/WBS
In some cases a combined Product and Work Breakdown Structure may be used. This has some advantage over the WBS by showing the relationships between products at higher levels and work at lower levels. An example is shown in figure 28. Also shown in figure 28 is the numbering system which is mapped onto the hierarchy and maintains the relationships through its format. From this structure it is easy to understand which Work Package belongs to which area of work as well as its associated deliverables.

Figure 27 Work Breakdown Structure
Organisation Breakdown Structure

This structure is usually developed alongside the work breakdown and is shown in figure 29. This enables project stakeholders to communicate with the appropriate authorities for decisions, direction, reporting, escalation of issues and risks.
The Responsibility Assignment Matrix

The combination of a WBS and OBS can be used to show the relationships between the personnel working on each work package and the organisation. This is called a Responsibility Assignment Matrix and is shown in figure 30. The organisation may be the project organisation or in the case of a matrix structure, may be the company’s organisational structure. This provides a further benefit in linking the project team to their ‘home’ departments and allowing communications to take place between work package managers and the functional organisation. For example, to obtain additional support, expertise, etc.

**Responsibility Assignment Matrix (RAM):**
A diagram or chart showing assigned responsibilities for elements of work. It is created by combining the work breakdown structure with the organisational breakdown structure.

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**Figure 30 Responsibility Assignment Matrix**
**Cost Breakdown Structure**

Another structure used to support cost management and particularly earned value analysis is the Cost Breakdown Structure as shown in figure 31.

![Figure 31 Cost Breakdown Structure](image)

This structure combines the work breakdown structure and the organisation’s costing system to enable charges to be made against each work package. This enables actual costs to be compared to original estimates and budgets to improve estimating accuracy and support control actions.

**Schedule Planning**

Scheduling determines when activities and events are to take place. It requires all activities to be identified, their logical dependencies to be established and their durations to be estimated. This produces an overall schedule which can be used to plan resource allocation and determine overall costs. The schedule is produced through a number of steps as follows:

- **Produce logic network**
Project Management

- Allocate activity durations
- Conduct forward pass to determine project duration
- Conduct backward pass to determine float and critical path

The Logic Network

Figure 32, shows a simple network with six activities A to F. All activities to be performed are identified using the product and/or work breakdown structures. Those involved determine their logical sequence by deciding which activities must be completed before other activities can begin. Activities preceding the activity are called predecessors and those after the activity are called successors. A common way to develop the network is to place ‘post-it’ notes representing activities on a wall and arrange them in a logical sequence before transferring this information into planning software tools.

For example, the activities in figure 32 could represent a work package in a project to develop a new washing machine. The activities in this work package are to make a simple motor assembly that can drive a prototype washing machine, as listed in the table below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Design Assembly</td>
</tr>
<tr>
<td>B</td>
<td>Purchase Power Supply</td>
</tr>
<tr>
<td>C</td>
<td>Purchase Motor</td>
</tr>
<tr>
<td>D</td>
<td>Buy Chassis materials</td>
</tr>
<tr>
<td>E</td>
<td>Make Chassis</td>
</tr>
<tr>
<td>F</td>
<td>Assemble</td>
</tr>
</tbody>
</table>

Activity durations

The next step is to estimate the duration of each activity in the network (in days in this case). This has been added to the network as shown in figure 33.
Critical Path Analysis

A quick look at the information shows that the project is likely to take 28 days since A, C and F activities represent the longest path through the network. This is relatively easy for a case of six activities but would be very difficult in a project of hundreds or even thousands of activities. Fortunately the Critical Path Analysis (CPA) method enables the overall duration and other useful information to be easily calculated in all cases as described below.

Figure 34 shows the information used and produced during CPA. Each activity has the same information set. The activity name is conventionally shown in the middle cell and the duration in the top centre cell. Definitions of early and late dates are as follows:

**Early Start** (top left) – the earliest possible date an activity can start given the logical constraints

**Early Finish** (top right) – the earliest possible date an activity can finish given the logical constraints and its duration.
Late Start (bottom left) – the latest date an activity needs to start if it is not going to affect the overall project duration

Late Finish (bottom right) – the latest date an activity needs to finish if it is not going to affect the overall project duration.

The meaning and purpose of Total Float which is placed in the bottom centre cell is explained later.

The Forward Pass
The forward pass is a process which involves calculating the Early Start and Finish dates for each activity. Firstly to calculate this manually we will use days as the unit of time. Secondly we will use a stop watch concept based on days of elapsed time. At the beginning the stop clock will show 0 days since no time has been used. As we use time (i.e. elapsed time) it will be added to the stop clock reading.

In our network example the process begins by calculating the Early Finish of the first activity A, assuming the Early Start date is 0 days. The general formula is:

\[
\text{Early Finish} = \text{Early Start} + \text{Duration}
\]

Thus for activity A, Early Finish = 0 + 3
= 3

This value is entered in the top right cell for activity A.

As soon as activity A has been completed, activities B, C and D can start. The Early Start for each is the same as the Early Finish for A (i.e. 3, which is also the current elapsed time shown on the stop watch). Thus:

Activity B, Early Finish = 3 + 5
= 8

Activity C, Early Finish = 3 + 15
= 18

Activity D, Early Finish = 3 + 7
= 10
Activity E depends on D and therefore its Early Start is the same as the Early Start for D and thus:

\[ \text{Activity E, Early Finish} = 10 + 3 \]
\[ = 13 \]

The Early Start for activity F is a little more difficult since activity F has three predecessors – B, C and E. Activity F cannot start until all three of its predecessors have been completed. The elapsed time when all three are complete will therefore be 18 since the worst case is activity C. (Note the other predecessors activities B and E finish earlier.) Thus:

\[ \text{Activity F, Early Finish} = 18 + 10 \]
\[ = 28 \]

Thus the forward pass process has enabled the overall duration to be calculated, as shown by the Early Finish of activity F, the last activity in the network, as shown in Figure 35.

**Backward Pass**
From the forward pass, it can be seen that some paths through the network are shorter than others. These have spare time which means they could start later without affecting the overall duration. This spare time is called Total Float and is the time by which an activity may be delayed or extended without affecting the total project duration. It
is useful to identify activities with Total Float since work could be delayed to address resource peak demands and overloads without affecting the project duration.

The calculation that enables the Total Float to be calculated and the critical path to be identified is called the Backward Pass.

For the purposes of this calculation, it is assumed that the Early Finish date for the project is the same as the Late Finish date, i.e. 28 days (as shown for activity F the last activity in the network). Working backwards, if the Late Finish date for F is 28 and its duration is 10, then activity F must begin no later than 18 (i.e. the Late Start date). Thus the general formula:

\[
\text{Late Start} = \text{Late Finish} - \text{Duration}
\]

Thus:

\[
\text{Activity F, Late Start} = 28 - 10 = 18
\]

The Late Finish for activities B, C and E (the predecessors to activity F) is the same as the Late Start for activity F and therefore 18.

The Late Start dates for these activities can be calculated using the general formula as shown in figure 36.
The Late Finish for activity A depends on the late starts of activities B (13), C (3) and D (8). Of these three values the earliest value must be taken, thus 3 (as for activity C). The backward pass is completed by calculating the Late Start for A, thus:

\[
\text{Activity A, Late Start} = 3 - 3 = 0
\]

**Total Float**

Once the backward pass has been done, the activities with Total Float values can be identified. Figure 37 shows how activities A, B and C would appear on a Gantt chart (explained in more detail later). Each activity would be plotted from its Early Start (ES) date to its Early Finish (EF). This represents the duration of the activity on the chart and is typically shown as a rectangular box with its width corresponding to the time. The Late Finish (LF) position is plotted next, which for activity A is in the same position as the Early Finish date. Thus there is no gap between the EF and LF positions. However, for activity B, the ES, EF and LF positions show a gap between the Early and Late Finish dates and this represents the Total Float for activity B. A thin line is typically used to represent Total Float on the chart as shown in figure 37. The value is entered into bottom centre cell in the activity box for B.

The correct way to calculate Total Float is:

\[
\text{Total Float for an activity} = ((\text{Late Finish} - \text{Early Start}) - \text{Duration})
\]
Thus for activity B:

\[
\text{Total Float} = (18 - 3) - 5 = 10
\]

A quicker way to calculate Total Float is:

Late Finish - Early Finish

Thus for B:

\[
\text{Total Float} = 18 - 8 = 10
\]

However this only applies in the case a simple network with ‘Finish to Start’ dependencies. If other types of dependencies are used, for example Start to Start, the first formula should be used.

The complete Total Float calculations for all activities are shown in figure 38.

**The Critical Path**

The critical path can be identified once total float calculations have been completed, since the path with the longest duration will have the lowest total float (i.e.

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**Critical Path:**
A sequence of activities through a project network from start to finish, the sum of whose durations determined the overall project duration.

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![Critical Path Diagram]

**Figure 38 Total Float & Critical Path**
zero in our case. The critical path is also identified in figure 38 with bold lines around the activity boxes.

**Free Float**

An activity with no Total Float is critical and if delayed will delay the project by the same amount. It is therefore important for a project team to know critical activities and ensure they do not slip. Activities with some Total Float could be delayed without affecting the overall duration but this does not mean they will not affect other activities. To find out which activities are free of such constraints the Free Float value is calculated as shown in figure 39.

Free float may be defined as the amount an activity can slip without affecting the timescales of any other activity. To identify free float for an activity it must be compared with all of its immediate successors. In figures 38 and 39, it can be seen that A has an Early Finish date 3 and that B has an Early Start date also 3. Therefore there is no gap. However, activity B has an Early Finish date 8 and its successor activity F has an Early Start date of 18, a gap of 10. Activity B therefore
has 10 days of free float and can be rescheduled within this window without affecting its successor activities. Another activity in figures 38 and 39 with free float is E, which has 5 days.

Free float is useful since rescheduling activities with free float is less risky than those with total float but no free float.

**Gantt Chart**

The project network and critical path analysis provide useful information to the project team. In effect they represent a time model of the project which enables the team to prioritise the work in terms of criticality. It also enables the team to examine the logical dependencies, consider the constraints and risks, develop ‘work arounds’ to solve problems and evaluate ‘what if’ scenarios to optimise the project timescales. However, it is not necessarily the best form for communicating schedule information to all stakeholders. Another useful method for communicating project schedule information to project stakeholders is a Gantt chart (figure 40) which can be produced from the critical path analysis information.

**Producing the Gantt Chart**

To develop a Gantt chart, activities are shown against a common timescale (project calendar) from their Early Start date to their Early Finish date. Float is projected to
the Late Finish date as described previously. Critical activities are typically highlighted in some way and total float shown in a way that distinguishes it from planned work. Each activity therefore has a window within which it must be completed if the planned project duration is to be achieved, as shown in figure 40.

**Milestones**

Milestones can be used to highlight important events in the project schedule (NB. in scheduling an event is a point in time and has no duration). A milestone may for example, show: a stage boundary; the handover of a key deliverable; the completion of a set of activities. Milestones are useful for communicating schedule information to the project sponsor and users.

A milestone is inserted in the network and Gantt chart as shown in figures 41 and 42. Note that a milestone does not affect the critical path analysis and that a milestone may or may not be on a critical path as shown in figure 41 (milestone 1 and 2).
Resource Planning

Resource planning involves a number of further steps in the development of the baseline plan to ensure the people, materials, support and facilities needed to accomplish each activity are identified and scheduled. This information enables the procurement of resources at the right time, quantity and quality for each activity. The main steps are:

- allocation of resources to activities
- aggregation
- scheduling
- optimisation

**Resource:**
All those items required to undertake a project and include people, finance and materials.

**Resource Planning:**
A process that evaluates what resources are needed to complete a project and determines the quantity needed.
It is important to consider the utilisation efficiency, practical limitations, possible overloads, bottlenecks and conflicts that may exist both within the project and also its context when planning resources.

**Allocation**

The resource requirements for each activity are identified according to the nature of work. Initially it may be assumed that resources are available on demand. However, there may be other constraints that need to be taken into account for example: the level of resources; types (e.g. materials, labour, etc.); quality requirements; risks and uncertainties. Valid questions in the case of labour resources for a particular activity would be:

- **what skills are needed?**
- **what is the minimum number of people needed for this activity?**
- **what is the maximum practical number of people that can carry out the activity?**

In many cases the nature of the work and characteristics of the resource type, will affect allocation. For example: to paint the inside of a telephone box may take one person two days. It would be a little cramped if the job had to be completed by two people over one day. Both cases use the same amount of resource but one is less practical. Conversely, to move a heavy machine may require no less than two people for safety reasons. Standing working practices may also need to be taken into account, for example:

- **how long is a working day?**
- **are there any public holidays?**
- **are there any allowances for working conditions?**

Each activity must therefore be considered on the basis of the work to be undertaken, known limitations and constraints. Labour resources are allocated to each activity in calendar units as shown in figure 43 (people per day in this case). Other resources may be allocated in appropriate units.
Aggregation

Aggregation is the relatively simple step of adding the resources in each period as in figure 43 and creating a resource histogram as shown in figure 44. An assumption used in this case is that all the labour types are the same, in which case the histogram shows peaks and troughs in the distribution of resources against time. In real situations it is unlikely that labour types will be the same and aggregations will be needed for each type to understand the relevant resource peaks and troughs.

Scheduling

The histogram represents the resource demand for the project. However, there may be reasons why this demand cannot be met. For example, perhaps the company undertaking this project is very small and only has four people that can work on the project at any one time. In this case there is a conflict between the demand and availability that must be addressed.
There are several ways to overcome resource limitations. For example:

- **re-schedule the activities in the project to take advantage of any float**
- **reduce the scope of work**
- **work overtime**
- **take longer if necessary**
- **work more efficiently** – perhaps by using a different method
- **use contract labour**
- **subcontracting**

Each case may present other trade-offs or constraints. For example, working overtime may increase costs. Reducing scope may be unacceptable.
Resource Smoothing or Time Limited Scheduling
Adjusting activities and resources to ensure resources are used efficiently within fixed time constraints is called resource smoothing or time limited scheduling.

This seeks to smooth out peaks and troughs by rescheduling activities within the existing float and adjusting resources to obtain a smoother profile (see figure 45).

Resource Levelling or Resource Limited Scheduling
Adjusting activities and resource levels to accommodate resource overloads is called resource levelling or resource limited scheduling. Levelling may lead to an increased project duration (see figure 46) which has to be traded against the other success criteria.

Resource Levelling:
Resource leveling forces the amount of work scheduled not to exceed the limits of resource available. This results in either activity durations being extended or entire activities being delayed to periods when resources are available. This often results in a longer project duration. It is also known as resource limited scheduling.

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Optimisation

Resource planning is an iterative process and may require the project logic network to be revisited as well as adjustments made to resources. It may also need to consider additional activities or allowances to cover risks and uncertainties. Overall through the combination of the project network, Gantt chart and resource analysis, a model can be developed that enables different options to be considered prior to the plans being ‘baselined’.

Estimating

Estimates in projects are quantified assessments of resources and time required to complete part or all of a project. They are used to support investment appraisal and support project Go/No Go decisions. They are also used to define baseline budgets and to support performance assessments and predictions throughout the project.

Estimating Accuracy

Estimating accuracy will vary through the project lifecycle depending on the level of uncertainty, quality and availability of information (see figure 47). Information during the Concept stage is likely to include only high level designs and strategies. Consequently accuracy is likely to be ‘rough order of magnitude’ due to the uncertainties and lack of hard information. As more data becomes available during
feasibility, estimating accuracy should be sufficient for the approval of the business case. Accuracy will continue to improve during Definition and at the beginning of Implementation as detailed designs, scope of work and detailed plans are produced. This is necessary to control cost, time and performance during Implementation since unreliable estimates will cause management problems and reduce team morale. Estimating accuracy should improve throughout implementation sub stages as more details and results of work are defined and recorded. At the end of each sub stage, information and lessons learnt will help to improve estimating accuracy.

Factors that affect estimating accuracy may be grouped as follows:

- **skills & competences**: different skills will affect cost, timescale and quality
- **poor definition**: objectives unclear, methods unknown
- **changes**: baseline estimates need to include approved changes; poor change control will affect outturn against estimates
- **new or complex technology**: brings risks and uncertainties; lack of data
- **lack of information**: leads to assumptions; increased risk

**Estimating Methods**

Three methods commonly used are:

- **Bottom-up**
- **Comparative**
- **Parametric**

**Bottom Up (Analytical or Grass Roots)**

Estimates are based on a detailed analysis of the work at the lowest levels of the WBS (see figure 48). Estimates of resources required, time, materials and cost may be made. These estimates may be difficult to do during the early stages of a project since they need fully detailed information. Once details are available, analytical estimates can be used to validate previous estimates and are likely to be more reliable than other methods.
Comparative (Analogous)
This method can be used when relevant and valid historical information exists (see figure 49). For example, if the time taken to build a boat is known from historical information, the time to build a larger and similar boat can be estimated. Estimates can therefore be generated by scaling values. Estimating reliability may be affected by a number of factors for example, a change in the methods used to build the large boat.

Parametric Estimating
These are generated by statistical models. They are based on correlations between technical, scope and other parameters of projects based on analysis of historical performance. Correlations between cost and parameters (sometimes called ‘cost drivers’) such as physical aspects, weight, size, power, complexity and performance characteristics (e.g. speed, accuracy of the deliverables) may be identified to enable estimates to be produced from product requirements and other constraints. The reliability of
these models depends on their ability to replicate the real world and they may involve complex calculations using statistical data. They will also need to be calibrated by comparing results with real world data before they can be used reliably. Once this has been done, estimates can be produced very quickly.

A simple case of estimating the cost of a new vehicle will help to explain parametric estimating.

A company has been manufacturing different kinds of vehicles for some time and has collected cost data against three parameters that seem to drive the overall cost of the vehicle: size, weight and power. They have deduced that size contributes 25% of the

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**Parametric Estimating:**
An estimating technique that uses a statistical relationship between historical data and other variables (for example square metreage in construction, lines of code in software) to calculate an estimate.

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![Graph showing parametric estimating](image)

**Figure 50 Parametric Estimating**
cost, weight 35% and power the remaining 40%. They have also found how each parameter affects the cost as shown in figure 50. For example, the cost increase for parameter A is a constant rate, whereas it is an increasing rate for parameters B and C.

Once these relationships have been defined, a cost estimate can be derived for each parameter based on the value selected for each parameter. For example, for a ‘low’ weight a cost of X, for a ‘medium’ size a cost of Y, and for ‘high’ power a cost of Z. These values are then weighted according to the contribution each parameter makes to the overall cost. Thus:

\[
\text{Total cost} = (X \times 35\%) + (Y \times 25\%) + (Z \times 40\%)
\]

This is of course a very simplified model and in reality the development of a reliable parametric model will require good statistical samples and understanding of the interrelationships between each parameter and correlations between costs and each parameter. Such models are typically calibrated against bottom up estimates and actual results. Once the model has been calibrated and proven, this method can produce reliable estimates quickly. However parametric methods are limited in use when there are frequent changes in methods or technology.

**Procurement**

Procurement is the process of acquiring new services or products. It covers the financial appraisal of the options available, development of the procurement or acquisition strategy, preparation of contract documentation, selection and acquisition of suppliers, pricing, purchasing, and administration of contracts.

**Procurement Plan**

The Procurement Plan is produced during the Definition stage of the project and is part of the Project Management Plan. It provides the strategy for procuring all project items and guides project stakeholders on the acquisition of resources.
needed to undertake the project. The following aspects need to be taken into account when defining the procurement strategy:

- solutions available
- project success criteria
- benefits
- deliverables

The strategy will define the overall objectives and approaches to be taken for defining requirements, obtaining bids, tenders and proposals from suppliers, evaluation of bids, selection of suppliers, placing of contracts and management of suppliers. An overview is shown in figure 51. In general, it should include:

**Contract Strategy**

A contract is a legally binding agreement in which the supplier enters into obligations to supply services or products and the buyer agrees to pay for them. A contract document formally records the agreements made and includes the agreed terms and conditions for the transactions. Each contract will need to be fitted to the requirements and risks involved.

**Procurement Selection**

Selection of products and suppliers may occur throughout the project. It may be necessary to obtain advance information from suppliers to support feasibility studies and the business case. Later more formal and detailed submissions may be required. In most cases the selection process is affected by ethical and practical considerations and should be defined appropriately in the procurement management plan during definition.
Selection Criteria
The main criteria for evaluating bids is linked directly to project success criteria and would take into account specific procurement requirements such as the organisation’s methods, preferences and standards. The criteria may also have to take into account regulatory requirements. Typical examples are given below:

- **Price** – linked to the overall project cost budgets
- **Quality** – requirements of project deliverables and compliance
- **Timescales** – linked to overall project timescales
- **Supplier delivery dates**
- **Contractual Terms** - including payment arrangements
- **Incentives and Guarantees**
- **Cost of in service support** - such as spares and maintenance
- **Risk Management capability**
- **Resource and mobilisation capability**
- **Quality Management capability**
- **Responsiveness to changes**
Chapter 4 The Project Implementation Phase

The implementation phase is where the work planned during definition is carried out to produce the deliverables. The main focus for the project management team is to maintain focus, co-ordinate and control the work and the many interdependencies that are necessary to achieve the project objectives. Implementation is often broken down into a number of stages, such as design, build and test, to provide structure and breakpoints. Gate reviews may also be conducted to provide more high level control and enable the wider participation of external stakeholders.

Project Control

The Control Process

After the project management plan and associated implementation plans have been developed and approved by the sponsor, they are ‘baselined’ and the implementation phase begins. For the project management team this will mean maintaining focus on the project objectives, co-ordinating day to day activities, controlling the work at all levels, communicating the project status and management actions to stakeholders, managing risks and escalating issues to higher authorities.

A simple control process known as the Deming cycle is shown in figure 52 and underpins the essential activities for the management team during implementation.

This section builds on this simple framework to explain the main activities that need to be performed during implementation.
Key Project Control Processes

The first step in control involves the comparison between actual performance and the baseline plan. This requires actual performance to be measured in some practical way to establish any deviations from the plan and to evaluate their likely impact. Once this has been done actions can be placed to correct adverse trends. Such actions may depend on the nature of the variance. For example, ‘no variance’ would indicate that work was progressing satisfactorily and would not require any special action other than continuous monitoring and recognition of the team’s progress. A variance that was caused by additional work that is clearly out of scope requires a retrospective change to be raised in order to bring the baseline plan in line with the work being done. In this case it would also be appropriate to check the management system to find out why work on an unauthorised change had taken place. Another variation may be due to poor performance in which case the root cause would need to be established and corrective action taken. If however, the variance was outside the control tolerances agreed by the project manager and sponsor and recorded in the PMP, it may need to be escalated to a higher authority.

Figure 52 Simple Control Process
If work is completed, say in the case of a work package, the project manager would need to check the outputs and ensure that handover of any deliverables form the work package is managed effectively. The project manager should also provide feedback to the work package team, consider lessons to learn and show recognition and appreciation for their efforts.

The typical range of control options depends on the cause of an adverse variance as shown in figure 53. In addition to the actions shown in figure 53, occasionally adverse situations may arise due to the original estimates not being realistic. This problem can seriously affect team motivation if allowed to continue for too long. In such cases it is advisable to reset the baseline plan, record the variances and revisit the causes of the problem at the next appropriate opportunity, and conduct a lessons learnt review.

Figure 53 Action Options
The project control cycle continues throughout the implementation phases until all the necessary work has been completed and the project is ready to move into the Handover Phase.

**Success Criteria and Key Performance Indices**

The success criteria and key performance indicators defined during definition and stated in the approved PMP enable project work to be controlled through ‘Management by Exception’ principles. Success criteria are assigned to each work package during project scoping. This enables each work package manager to monitor and control performance at that level. If performance exceeds tolerances agreed with the project manager, the work package manager can escalate the problem and request support from the project manager. Similarly, if the project exceeds overall tolerances agreed between the project manager and sponsor, problems become issues in this case and should be escalated by the project manager to the sponsor.

**Issue Management**

A concern that threatens the project objectives becomes an issue when it cannot be controlled by the project manager. In such situations, the project manager must escalate the issue to the project sponsor. The sponsor will then seek a resolution by engaging the stakeholders as appropriate and where

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**Issue Management:**

The process by which concerns that threaten the project objectives and cannot be resolved by the project manager can be identified and addressed to remove the threats they pose.

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appropriate, the project steering group. Issue management is one of the fundamental roles of the steering group and obviously the appropriate membership of the group will impact on their ability to resolve issues.

Common problems in issue management are:

- **incorrectly identifying problems as issues thus diverting management attention from other important tasks**
- **failing to escalate issues in a timely manner when the resolution owner has been unable to resolve the issue**

Reporting on the progress of an issue is performed by the project manager until successfully concluded. Issues are recorded in an issue log. Typical information recorded is shown in the example issue log in figure 55.

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Raised by:</th>
<th>Date of issue</th>
<th>Impacts</th>
<th>Possible resolution</th>
<th>Resolution owner</th>
<th>Final outcome</th>
<th>Closure date</th>
</tr>
</thead>
</table>

Figure 55 Issue Log

### Information Management and Reporting

Reliable information is required by project stakeholders to enable them to make effective decisions, anticipate and respond to future events such as risks and opportunities, and take into account uncertainties and current problems. Information management is required to ensure that appropriate information relevant to and generated in the course of a project, is made available to project stakeholders in a timely manner.

#### Information Management Plan

A project information management plan defines: how information will be managed during the life and after the project; the purpose and scope of information products; their ownership; formats; distribution; control; processing; storage and disposal.
The way in which information is managed should be established as early as possible in the project. Typically this would be part of the communications strategy in the project management plan and will typically address the following:

- **Information Management Objectives**
- **Roles and responsibilities**
- **The process**
- **Documentation and Information Product specifications**
- **Links to the communication plan and process**

**Information Management Process**

The process will define how information will be acquired, accessed, stored, communicated, disposed of and archived. The main components of a simple system are shown in figure 56.

**Information Sources**

Data generated and needed by a project can be significant and in many different forms. Sources need to be identified and appropriate methods used to capture and gather data. For example: during meetings; from reports; through surveys and from data gathering exercises.
Recording and Storage
Information needs to be recorded and stored. Consideration should be given to stakeholders needs for accessibility, security of the information, and methods.

Distribution
Information needs to be distributed and communicated to stakeholders in a timely manner. The information needs of stakeholders may vary during the project to reflect changes in the nature of work, stakeholders and project team.

Archiving
Some information will not be needed on a day to day basis but need to be availability to meet regulatory requirements or resolve future problems. For example, it may be necessary to review product design information in the event of a safety problem or failure during operation of a deliverable. In such cases, information is archived in secure facilities where access and maintenance of the information may be controlled.

Disposal
When information is no longer useful it needs to be disposed of correctly. This may be subject to regulatory requirements. Prior to disposal, information products should be assessed for their asset value. Some information may be useful to third parties and may contain sensitive data. Adequate disposal procedures are necessary to maintain confidentiality and security.

Key Information Products
There are many information products generated and used in a typical project. Some important examples are shown in figure 57. Documents used to define requirements include the Business Case and Product Specification. These are typically defined during the Concept Phase and updated in the course of the project.

Stakeholders involved in these documents are likely to include the sponsor, project manager, users and operators, external client and corporate management.
Planning documents include the project management plan, supporting plans such as quality, change and risk management plans, and implementation plans such as project networks. These are mainly used by the project team and other stakeholders such as resources managers, to define and control day to day activities.

Control documents include routine progress reports, exception reports, various logs such as quality, change, risk and configuration logs. These are used for both day to day activities and at major milestones to record and communicate status on progress to project stakeholders.

Project Reporting
Many reports are produced during the life of a typical project including routine progress reports, quality reports and exceptions reports. Some examples are described briefly below.

**Progress reports:** for example highlight reports between project manager and sponsor; checkpoint reports between work package managers and project manager. To present progress, forecasts, variances, performance, problems, issues, etc.

**Quality reports:** for example to record evidence of quality assessments, inspections and tests.

**Audit reports:** to provide information on the outcomes of audits.

**Project reviews:** to record results of project reviews, issues and recommendations.
Risk assessment: to provide results from risks assessments, status on risks and response actions

Financial: to report on the financial position of the project such as cash flow, forecasts and earned value data

Exception reporting: to reduce the burden on a project team the principle of exception reporting is preferred. This involves setting tolerances against parameters and only reporting 'by exception' when the tolerances are exceeded.

Change Management
Change management covers the identification, evaluation, authorisation and implementation of project changes. Initially, a change management plan is defined during Definition and typically as part of the development of the PMP. It is owned by the project manager, authorised by the sponsor and provides guidance for controlling changes arising in the course of the project, including external and internal changes. The plan defines the roles and responsibilities of stakeholders, the process to be used and associated documentation.

Change Process
A simple change control process is shown in figure 58 and described below.

Request and Registration
A change may come from any project stakeholder. Changes requested by external stakeholders are likely to be captured and communicated to the project team by the sponsor. Requests are usually formally made on a change request form and recorded in a change register (log). The register records key information such as requestor, date, description of change and priority.
**Evaluation**

Changes are initially assessed to consider if the change is worth progressing since further evaluation may be expensive and time consuming. Detailed evaluation will assess the change impact on project overall benefits, objectives and deliverables using the PMP as a baseline. The costs of processing the change itself should be taken into account as well as the costs and effects on the baseline plans. Other factors considered during assessment include identification of risks and uncertainties arising from the change and impact on stakeholders.

**Recommendation & Decision**

The output from this stage will be a recommendation supported by estimates of the impacts on benefits and project success criteria. The change is reviewed, accepted and or rejected. The ultimate authority for this decision may rest with the sponsor and may be delegated to the Change Control Board.

**Change Control Board:**
A formally constituted group of stakeholders responsible for approving or rejecting changes to the project baselines.

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*Figure 58 Simple Change Process*
**Updating Plans & Implementation**

Baseline plans are updated to record changes to management and implementation documents, and the approved change is implemented.

**Documentation**

The two main forms used are the Change Form (sometimes initially called the change request form) that documents the history of a change from origination to conclusion, and the Change Register or Log that records summary details of all project changes including those accepted and those rejected, in order to communicate the change status efficiently to stakeholders. These documents are shown in figure 59.

![Figure 59 Change Documents](image)
The Change Form is typically completed in four stages:

**Change Description** - completed by the originator, contains title information, description of the change, originator details, the date raised, and the change priority. The benefits and reason for the change are also included in this part.

**Impact Assessment** - completed by change assessors to establish the overall benefits arising from the change. The benefit analysis must take into account the positive and negative impacts on the benefits as stated in the business case, deliverables, cost, time and quality, and business as usual activities. Other important information includes any consequential risks arising from the change, implications for project stakeholders, and any effects on deliverable items as a result of undertaking the change.

**Recommended Action Plan** – the project team defines the detailed plan for implementing the change including additional funding, resource requirements, changes necessary to baseline plans and technical aspects.

**Authorisation** - records the approval including authorisation signatures and any conditions or additional comments on the change.

Summary information entered in the change form is read across to the change log to inform project stakeholders of progress.

**Configuration Management**

The purpose of Configuration Management is to ensure integrity of the products in terms of their description (specifications), their physical form and their functionality. It therefore covers the configuration control of the individual components of a product to ensure that each component performs its function within the product.
**Configuration Items**

There are two main groups of products generated in the course of a project: deliverables (i.e. as used during operation), management products (used to control the project but not delivered to users). Both need to be controlled to ensure that changes and deviations with baselines are recorded and traceable. Products or components controlled by a configuration management system are called Configuration Items and can only be changed through a formal change process.

**Configuration Management Planning**

A Configuration Management Plan is developed as part of the PMP to provide guidance on the configuration policy, objectives and processes.

![Figure 60 Configuration Management Activities](image)

**Activities**

Configuration management is undertaken alongside the change control process and involves four main activities: Identification, Control, Status Accounting and Auditing as shown in figure 60.
The items to be controlled are identified by the project team and approved by the project manager. Other stakeholders may also be involved in identification including operators and users. Configuration Management begins as the first products are identified and produced and continues throughout the life of the product (i.e. through Implementation, Handover and Operation stages of project). It may therefore involve the handover of configuration information to business as usual operatives.
Chapter 5 The Project Handover & Closeout Phase

The Handover milestone is a significant point in the project life cycle since it typically transfers the product from the project environment into an operational environment. At this point the ownership of project deliverables is often legally transferred from the project manager to the sponsor and user. The Handover decision will depend on the product achieving the acceptance criteria.

Project Closeout is the process of closing the project in a controlled manner typically through a combination of formal and informal approaches. Closeout will normally occur when all of the products have been delivered, project activities have been completed, and essential follow on activities have been planned and handed over to appropriate authorities such as product support operations.

In certain circumstances such as changes in viability or requirements, projects may be closed before planned completion. In these cases, a controlled closeout approach will enable the organisation to minimise disruption to other projects and business as usual.

In all cases, Project Closeout provides an opportunity to reflect specifically on the performance of project management, learn lessons and make improvements to project management methods.

This section describes the objectives, processes, stakeholders and documentation involved in project handover and closeout.
Project Handover

Purpose

The purpose of handover is to ensure:

- **deliverables meet the defined acceptance criteria**
- **ownership is successfully transferred from the project manager to the project sponsor**
- **the product is physically delivered to its operational environment**
- **any product support activities needed during operation are planned and implemented**

Handover Plan

The main activities shown in figure 51 are typically undertaken to ensure the project deliverables are formally handed over to the sponsor and users. They are defined in

![Handover activities diagram]

Figure 51 Handover activities
a handover plan to provide guidance to key stakeholders on the process and their involvement. The plan defines the objectives, stakeholders and methods for acceptance and delivery to ensure handover is successfully achieved.

Key stakeholders likely to be involved include:

- **project manager** – achievement of acceptance and delivering products
- **project sponsor** – formal acceptance of product and handover to operators/users
- **project team** – conducting acceptance testing and handover activities
- **quality assurance** – monitoring and auditing product acceptance and certifying results
- **users** – (including those people involved in the business as usual activities) witness acceptance testing, taking delivery and starting up product operation.

The handover plan will include tasks to be undertaken by the project implementation team to complete acceptance and delivery of the products, and tasks that need to be carried out by the sponsor and stakeholders (most likely operators and users), to receive, start up and operate the deliverables safely in their final operation mode. Handover may be an instantaneous, gradual or phased process.

A snagging list is generated during handover to list any minor shortcomings identified during acceptance. Typically, rectification actions will be agreed between the sponsor, project manager and operators as appropriate. In some cases rectification will need to be done before handover, and in some cases may be more practical after handover. Timescales for implementing these actions will be agreed between the project manager and sponsor.

**Project Closeout**

Project closeout involves completion of all product and project handover activities in a controlled manner. Product handover activities are included in the previous
discussion covering product handover and actions specific to project closeout are shown in figure 52 and described below.

- **identification and disposal** of non deliverable materials and documents. For example, product design data may need to be archived to enable retrieval at a later date.

- **demobilisation** including arrangements for disbanding the project team and supporting infrastructure; conducting performance appraisals; completion of technical and quality audits.

- **contract and purchase order** closure and arrangements for any continuing contractual obligations such as technical support during operation.

- **project accounts** are finalised

![Figure 52 Project Closeout activities](image)

**Closeout Report**

A closeout report is produced by the project manager to record the final outcome of the project against the success criteria, any issues outstanding and actions arising from closeout. Before project closeout, the project manager should conduct a Post-
Project Review (see below), record lessons learnt and recommend improvements. Finally, when all closeout tasks have been completed, the sponsor will formally sign off the project to release the project manager.

**Post Project Review**

**Purpose**

The Post Project Review (or Appraisal, or Evaluation) is a structured audit and review of the project history and the final conclusion. Its output is a report that provides learning points for the future including recommendations for process improvement and training. The main inputs and outputs are shown in figure 53.

**Objectives of the PPR**

The main objectives are to:

- identify strengths and weaknesses in the performance of the project
- establish the key lessons learnt
- to make recommendations for improvements (methods and competences)

**Scope of Review**

The Post Project Review addresses:

- **History of the project** – what major problems occurred during the project and how well they were dealt with?

- **Performance** - how well did the organisation and team perform? Areas such as decision making, team leadership and development, team working, single point accountability.

- **Effectiveness of the project strategy** - how well the project was implemented? What went wrong and what went well?
Estimating accuracy - accuracy of the original estimate and factors that caused estimates to change. Were sufficient provisions made to cover uncertainties, changes and risks?

Effectiveness of specific processes - such as change control, risk management, control and co-ordination. How well did these processes control specific aspects of the project?

Review Preparation
The project manager is responsible for organising the meeting and ensuring that any preliminary audits and reviews are carried out. Stakeholder attendance is typically decided by the Sponsor and Project Manager. The review meeting should aim to get views from as many stakeholders as possible, both within the project team and from outside. It is not always practical for all stakeholders to attend the review. In such cases, their contributions may be obtained prior to the meeting through for example, interviews, workshops or correspondence. These inputs may then be included in the meeting.
The Review Meeting
Ideally an independent facilitator should chair the meeting to prevent the review from being dominated by subjective and ‘blaming’ issues. Facilitators are often provided by functions within the organisation with responsibility for improvement and maintenance of standards, for instance Quality Assurance or Project Support Office. During the meeting it is necessary to document the review and record the results and actions that arise. This is typically undertaken by an individual from the Project Support Office.

Publishing the Findings
In many organisations the project manager is responsible for co-ordinating and issuing the report covering the lessons learnt and recommendations for improvement to relevant stakeholders. Distribution may include the project team, other project managers within the organisation, the internal organisation, external sponsors, and external suppliers.