Unit 7 – Planning

Unit 7 - Learning Objectives

To understand the importance of good planning
To gain an understanding of the Project Execution Plan (PEP) including:

- Its content
- The Project Control Plan (PCP)
- Its purpose through the life of the project
- The roles involved in creating and updating it

Planning overview

The APM defines planning as 'the process of identifying the means, resources and actions necessary to accomplish an objective.' Everything in a project needs to be planned and therefore the plan is more than a time schedule. It includes planning what needs to be delivered, how it will be delivered, who will be needed to deliver and how much budget will be required.

Planning is performed throughout the lifecycle in increasing levels of detail. It is the means of driving out uncertainty and having an agreed 'roadmap' for the journey. The principal plan in a project is the Project Execution Plan described below.

The Project Execution Plan

The purpose of the project execution plan (PEP) is to document the how, when, where and who of the project.

- **How** the work will be done.
- **When** it will take place.
- **Where** the work will be carried out.
- **Who** will do the work?

There will also be a statement that details **why** the project is being done, this statement will be summarised from the business case.

It will also include details of **what** the project is going to deliver and also **how much** it is going to cost.

- The PEP is produced during the definition phase of the project and it is the primary factor in the organisation giving the project the green light.
- The PEP will include all of the plans that are necessary to do the work that will achieve the projects specific objectives for change.
- At the end of the definition phase the project will be formally approved and the PEP will become the projects baseline. Through this the project can be monitored and any changes that are made can be controlled. It is therefore obvious that the PEP is a live document, neither static nor fixed.
- The PEP provides clarity of information, at any point a member of the project team can look at the PEP and understand the project and also know what work they need to do.
- It is the project manager who owns the PEP and it is also the project manager who is responsible for its authorship (although it is common for the project manager to enlist his team in this endeavour).
- The PEP can be viewed as a contract between the project manager and his/her team and the project sponsor and it provides a clear response to the business case. It ensures that everyone involved in the project is clear on how they are going to achieve the project's success criteria.

Policies/plans included in the PEP:

- Scope management: What is the scope for this project? What are the deliverables? What is included and what is excluded?
- Communications Plan: What is to be communicated? To whom? At what frequency? In which format? Are there any sensitivities? Are there any barriers to effective communication?
- Quality planning: What are the quality expectations/parameters for the project? What are the legislative standards the project is working to? Is the quality assurance requirement satisfactory? What quality control measures will take place?
- Budget/Cost Management: How much will the project cost? How much will each activity cost? What are the constraints and assumptions about the cost of each activity? How will cost variances be handled?
- Scheduling? What is required in terms of personnel, materials, equipment? What are the delivery milestones? Does the availability of resources affect the scope of the project?
- Risk management: what are the risks to the project? What are their potential impact, probability and exposure? How can the risks be mitigated?
- Project context: How does the project environment affect the completion of the project? (PESTLE)
- Stakeholder Management: Identify all stakeholders. What is their interest? What is their power of influence? Are they for or against the project? What do they want?
- Change management: How will changes be requested and authorised? What are the procedures for implementing change? How will changes be measured for potential impact on the time, cost, and quality objectives? How do the changes impact on the risk factors?

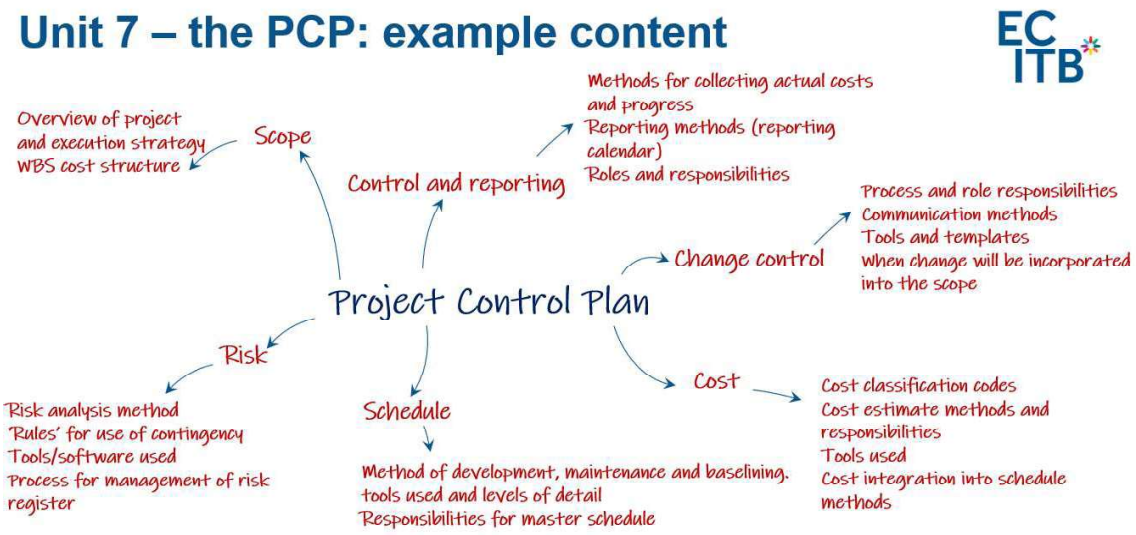
Project Controls Plan (PCP)

The Project Controls Plan is a well-defined Project Controls execution strategy that describes specific processes, procedures, systems, & tools used by the Project Control team throughout the project lifecycle. Therefore, the Project Controls Plan is a well-defined documented Project Controls approach that the Project Controls team needs to follow in a project.

“Project Controls Plan is a narrative or qualitative representation of the project control process, while the estimate, budget, schedule, etc. represent the quantitative aspects.” – AACE® International RP No.60R-10; Developing the Project Controls Plan

It describes specific processes, procedures, systems and tools used by the project control team throughout the project lifecycle.

The following diagram shows the areas that should be addressed in the PCP. In some projects the PCP may be part of the PEP.



Benefits are:

- Ensures appropriate controls are in place, understood and agreed
- Avoids ambiguity and confusion
- Ensures role responsibilities are clearly allocated and owned
- Gives stakeholders confidence

The project controller supported by other roles (such SME's and project manager) is responsible for creating and updating the PCP. It should be thought of as a dynamic document that is not only used but refined over the life of the project.

Learning Objectives

You should now have an understanding of the Project Execution Plan (PEP) including:

- Its content
- The Project Control Plan (PCP)
- Its purpose through the life of the project
- The roles involved in creating and updating it

Unit 8 – Scope management

Unit 7 - Learning Objectives

To gain an understanding of effective project scope management in terms of:

- What scope is
- Why it is important to manage the project scope efficiently
- What a WBS is
- What a PBS is
- What a CBS is
- What a responsibility assignment matrix is
- How the different breakdown structures interact
- How data-centric coding can support project controlling

Scope management

The scope of a project is the totality of the outputs, outcomes and benefits and the work required to produce them (APM BoK).

Scope management is the process whereby outputs, outcomes and benefits are identified, defined and controlled (APM BoK).

- **Outputs:** The products produced by a project. An electron microscope is an example.
- **Outcomes**: the changed circumstances or behaviour that results from the use of an output and leads to realisation of benefits. The electron microscope has given the organisation a new capability to identify new strains of bacteria.
- **Benefits:** By having the new capability, the organisation is able to develop new treatments for bacterial infections.

In essence the scope of a project is all of the products to be produced, all of the work undertaken and all of the benefits to be derived from the use of those products.

The process includes:

- High level scope definition recorded in the business case in support of the chosen option. In defining the scope, it is important to define the boundaries and interfaces with adjacent projects and other work. This will avoid duplication of effort, conflict and omissions.
- Gathered and categorised requirements (i.e. what the outputs must do to deliver the benefits). These are then baselined.
- Detailed scope definition. The project manager directs the requirements to the most suitable technical resource for this activity. The baseline scope is defined through breakdown structures including:
- Product (or service) breakdown structure – what will be delivered
- Work breakdown structure – activities to be completed
- Cost (or organisation) breakdown structure – the labour or non-labour resources needed to complete the work
- Controlling the scope through the use of change control and configuration management (including version control).

Factors when developing scope

These include:

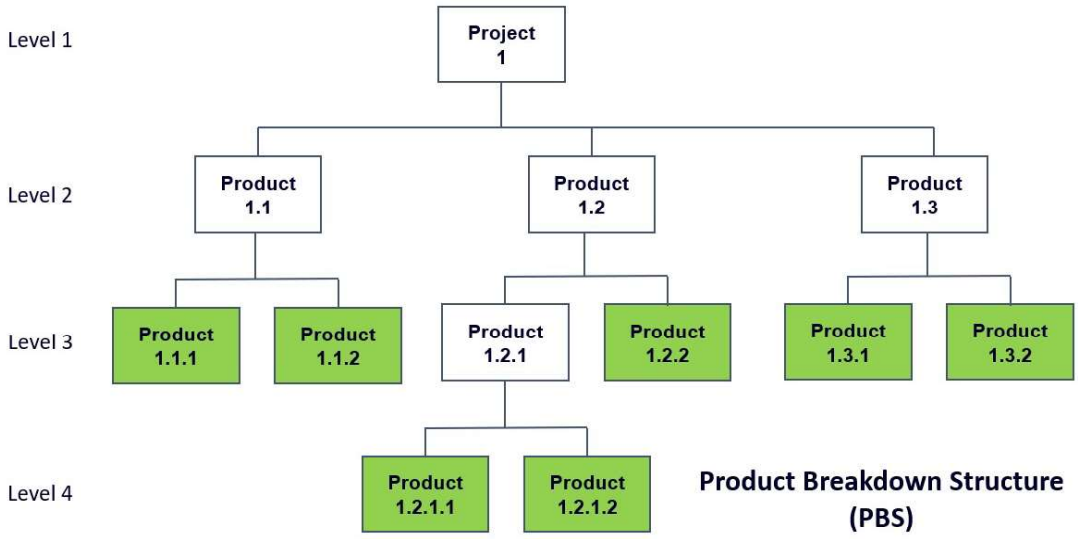
- What products are required (in scope) to deliver the capability needed for benefits realisation. Each item in scope will need to directly contribute to a benefit. Management of this linkage will ensure that all work done in the project has value. This will also allow a prioritisation of tasks to produce the minimum level of benefits desired by the organisation.
- Where the boundaries and the main constraints of the project are. This line will determine what is in and what is out of scope. It will prompt a review of the interfaces between what the project is delivering and what it is not delivering. An example is where a new software project is required to be installed with an existing hardware system.

- Assumptions. These should be documented so that they can be tested. For example, a project sponsor may assume that a project to develop a management system also includes certification of that system. If this is not the case, additional cost will be incurred. This clarity helps project managers avoid “scope creep,” which occurs when deliverables that were not part of the original scope statement are added to a project mid-stream.
- The resources available. Who will be available to deliver the scope? Where there are limited resources the scope may have to be reduced based on a priority basis.

Breakdown structures used to develop scope

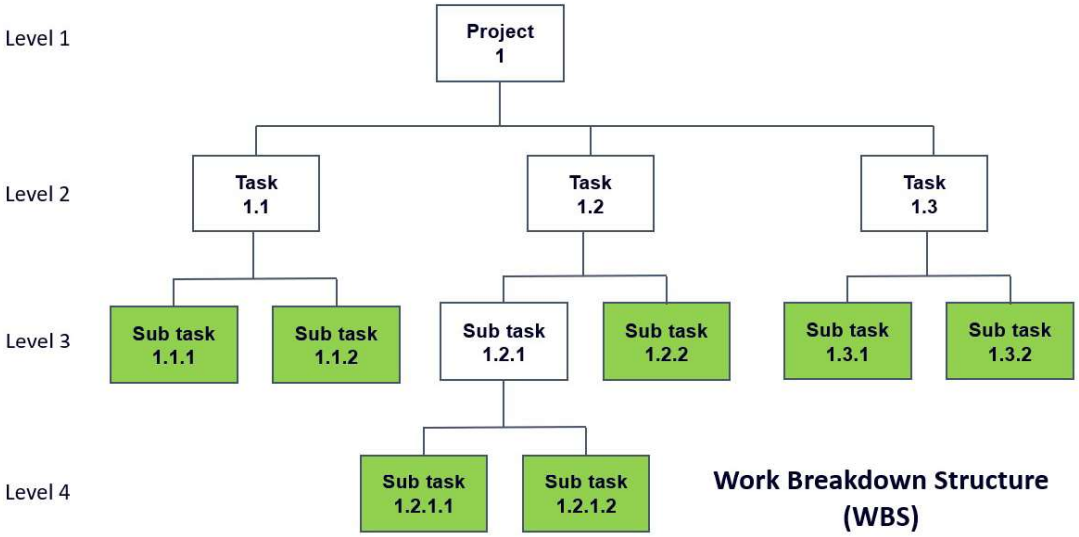
Product based planning focuses on all of the tangible products (management and specialist). The tool used is a **product breakdown structure (PBS).** This is a hierarchical breakdown of the project in terms of products/outputs which can be defined in terms of their quality and acceptance criteria. This reduces ambiguity regarding final acceptance.

The PBS uses nouns to describe the scope. This allows the team and stakeholders to visualise all of the products in categories. This makes it easier to identify missing items and manage stakeholder expectations and allows estimate of the components of the project to be obtained.

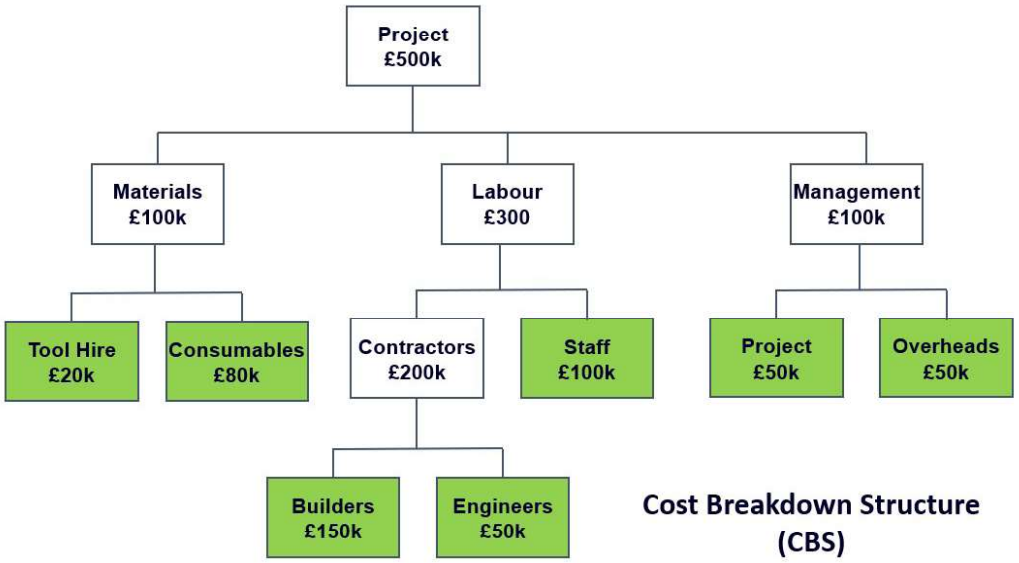


Work based planning focuses on the activities that need to be done. The tool used is a **work breakdown structure (WBS)**. This is a hierarchical breakdown of the project in terms of activities/work and provides a basis for estimation of effort and allocation of work packages.

The WBS is often used at the detailed planning stage and uses verbs to describe the scope. This allows estimating of the effort (man/hours) of the activities to be performed and facilitates the creation of work packages. It also creates ‘codes’ that can be used for reporting against estimates.



The cost breakdown structure (CBS) is a hierarchical structure used to organise the project costs according to category, often aligning them with the organisation's budgeting system. It facilitates tracking the budget performance of the project (APM BoK).



Responsibility assignment matrix

A responsibility assignment matrix is a chart or a diagram showing assigned responsibilities for elements of work. It is created by combining the work breakdown structure with the organisational breakdown structure (APM BoK).

The OBS shows the team roles available to the project. When it is combined with the work breakdown structure (WBS) it can be used to show who is available and allocated to complete elements of work, either at an activity or a work package level. This ensures that:

- there is clarity in task allocation which supports resource planning.
- resource owners (e.g. line managers) can provide support as they are aware of the allocated tasks.

When the OBS is combined with a product breakdown structure (PBS) is can be used to show who is allocated to produce the project outputs. This can either be at component level (e.g. single component) or a complete category of outputs (e.g. a complete assembly). This ensures that:

- there is clear ownership of product development.

  there is a clear point of contact for product-related information including progress status and technical information.

A RACI (or similar) 'code' can be added to the responsibility assignment matrix (also known as a RACI matrix) to describe how various roles participate in completing tasks or deliverables for a project. RACI is an acronym that describes four key responsibilities:

- **R – Responsible**. Those who are responsible for carrying out the task (or collection of tasks as part of a work package). There should only be one person responsible
- **A – Accountable.** Those accountable for getting the task completed. Accountability cannot be delegated.
- **C – Consulted.** Those consulted in the execution of the task e.g. consult a more senior project manager or specialist who has done something similar before. *Consulted* parties are typically the people who provide input based on either how it will impact their future project work or their domain of expertise on the deliverable itself. Consultation is usually a two-way communication process.
- **I – Informed.** Those that need to know of the decision or action e.g. site security when expecting a project delivery. These team members simply need to be kept in the loop on project progress, rather than roped into the details of every deliverable. This is usually more one-way communication.

This provides a useful visual of the allocation of responsibilities and provides clarity to all involved.

	Project Manager	Designer	Buyer	Ops Manager
Survey site	I	R		AC
Identify risks	RA	C		I
Place contract	AC	C	R	I
HSE assessment	R	I		A

The following diagram shows a more detailed RACI matrix with work package codes (from WBS):

	Work Packages					
	1.2.1.1.	1.4.2.1.	2.2.3.2	2.3.1.1.	3.1.2.3.	3.2.1.1.
Sponsor	A	I	I	A	I	C
PM	R	A	A/R	R	A	A
Contractor		R	I	I	C	R
Architect		C	I		R	
Client	I	C	C		C	I
T.U.	I	I	C	C		I

Coding of scope

A robust WBS hierarchically and faithfully reflects all project tasks and work packages so that projects are easier to manage. In order to achieve the project objectives, the ISO 21500 standard suggests that the WBS must state all project deliverables and break them down into smaller packages.

All WBS elements must include identification codes aligned with the configuration management plan. This way, the PM team can control the progress and assign responsible people to each of them.

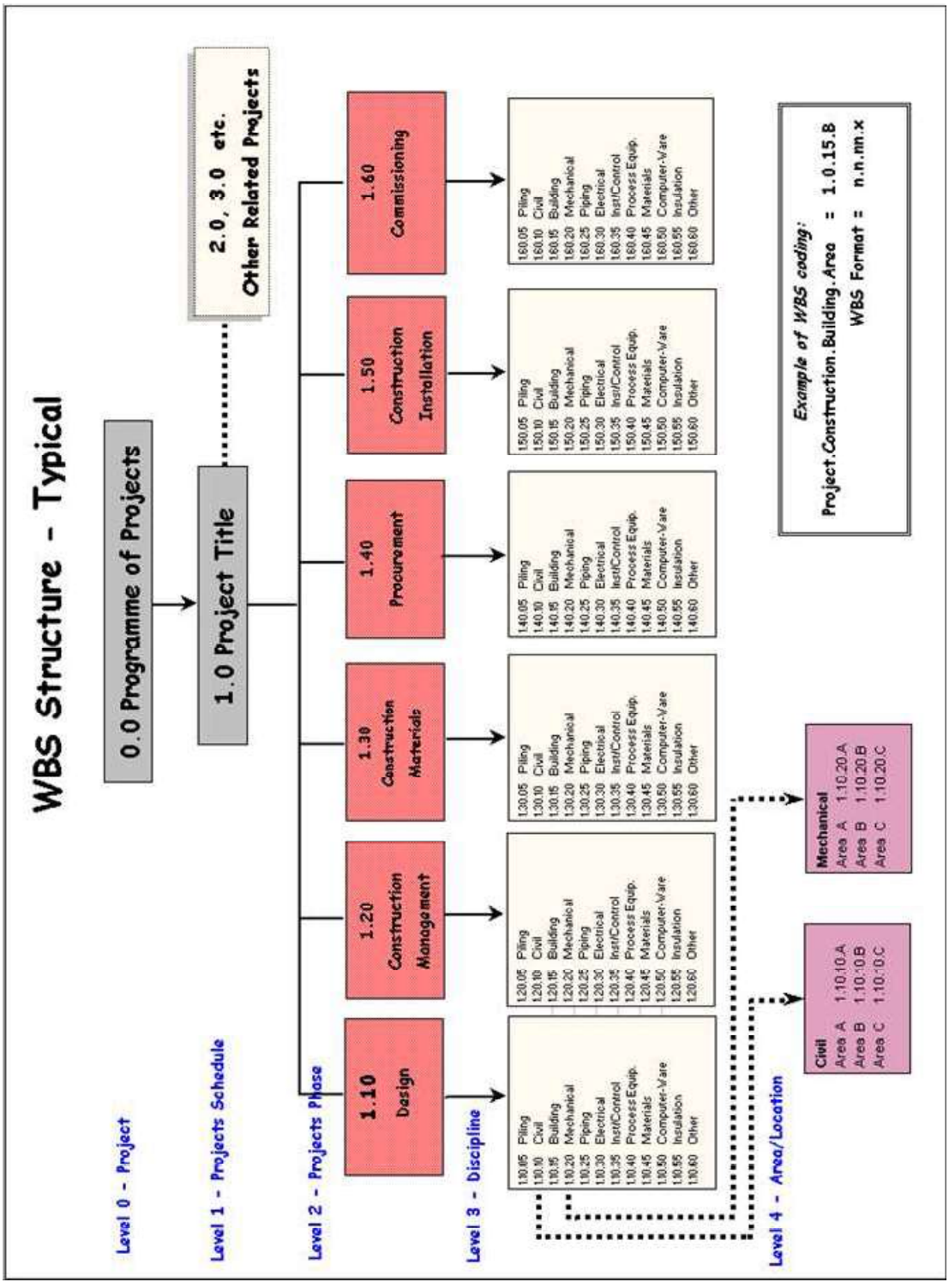
In order to classify the information contained within the WBS it needs a coding system. The WBS can then be used for archiving and retrieving project information, tracking and reporting purposes. Choosing a classification system is the first step when preparing the WBS and needs careful though and design. Factors that should be considered include:

- The level of detail required for estimating and tracking
- Integration with other control systems and organisational preferences/policies
- Alignment with the CBS

The CBS enables costs to be collected, analysed, and reported for any cost-generating item. These costs are also consolidated in a similar manner to the WBS. The codes of both systems may even be similar. However, the lower level of the CBS is generally known as the cost account (CA). The CA is the counterpart of the Work Package in the WBS. The CA is a natural and logical management centre in which the costs of the work to be performed are integrated.

In conclusion, the codes provide a mechanism against which resources (hours of effort and money) can be allocated and baselined against which actual usage can be compared and tracked.

The following WBS shows an example of coding:



Learning Objectives

You should now have an understanding of effective project scope management in terms of:

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Unit 9 – Estimating and whole life costs

Unit 9 - Learning Objectives

To gain an understanding of the following:

- Comparative estimating
- Bottom up estimating
- Parametric estimating
- PERT (3 point) estimating
- Estimating classifications
- Whole life costing

Estimating overview

The Importance and practical difficulties of estimating

Throughout the project life cycle the accuracy of an estimate will change. Estimates are, after all, only quantified approximations of project costs, durations and resources. Estimates however are vital to any project, without them you cannot put together a schedule, find out what your resource needs are or even draw up a budget.

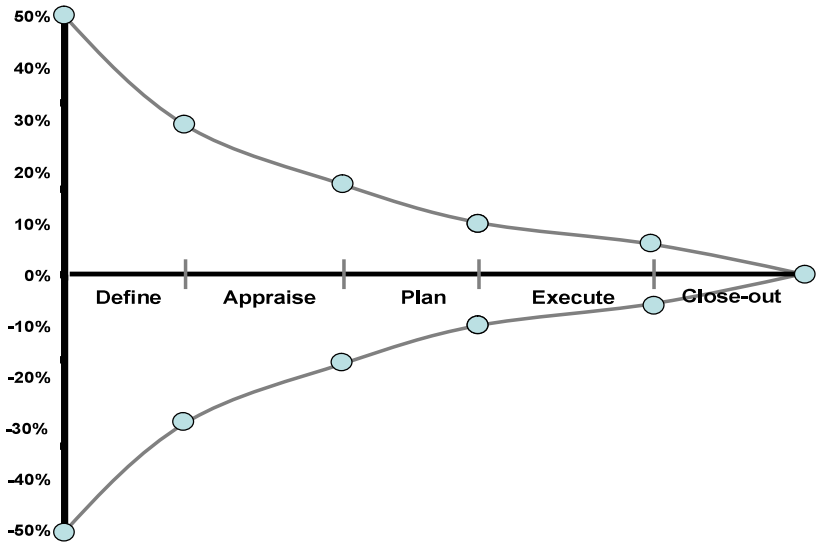
An important factor to keep in mind is that an estimate can never be 100% accurate (unless you are extremely lucky); therefore it is best not to mention accuracy and estimate in the same breath. When referring to estimating we will use the term range, this is breadth of tolerance around the expected result.

The start of a project is the hardest time to estimate, due to the level of uncertainty over key factors like, what is to be done, when, by whom etc. At this stage an estimate's range is likely to be wide, compared to the latter stages of a project when the detail is more clearly known.

It is quite common to update estimates throughout the projects life cycle. However, probably the most important estimate is the one that features in the project management plan (PMP). The reason for this is that it is the estimate upon which the project will be authorised.

The Estimating Funnel

The concept that estimates improve as the project life cycle progresses is commonly called the estimating funnel.



The above diagram illustrates how this process works as we progress through the project our estimate becomes more accurate.

Estimating techniques

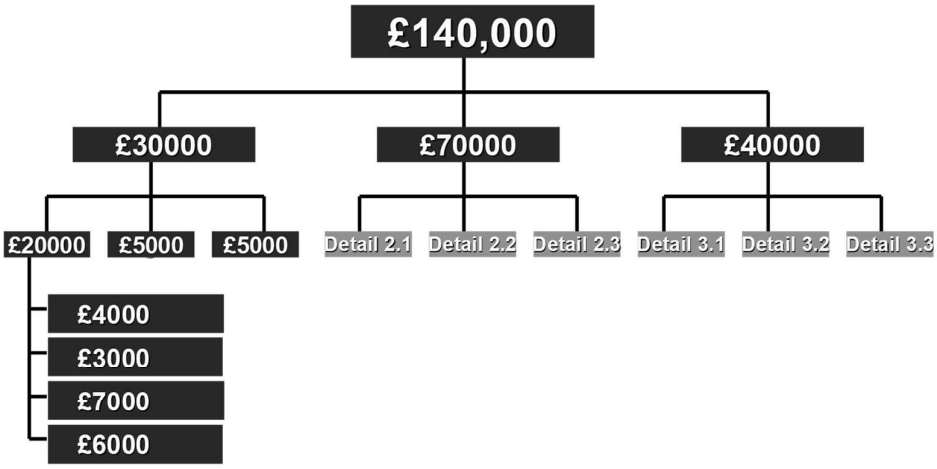
There are three main techniques for estimating (as stated by the APM), which are listed below. Each of these techniques is a useful tool when determining duration resources and costs.

Bottom-Up Estimating (Analytical)

Bottom-Up estimating requires the identification of each discrete activity required to complete the project. For each activity the resources (labour, materials, equipment or financial) and the elapsed time required to complete the activity are estimated. During this process it is important to allow for normal staffing overheads (leave, training, sickness).

Once you have identified any known constraints (limited skills, staffing, fixed dates before which certain activities cannot begin, equipment availability etc.), the Network Analysis process allows you to build up activity totals into a detailed estimate for the project.

The Bottom-Up approach is usually used when the fine detail of the programme and/or its component projects (Work Packages in the case or projects) are well defined. Because this approach is based on more information and is completed in more detail, the estimate can be more precise than a top-down.



The above diagram demonstrates how you can roll up the costs from the lowest level to gain your overall cost.

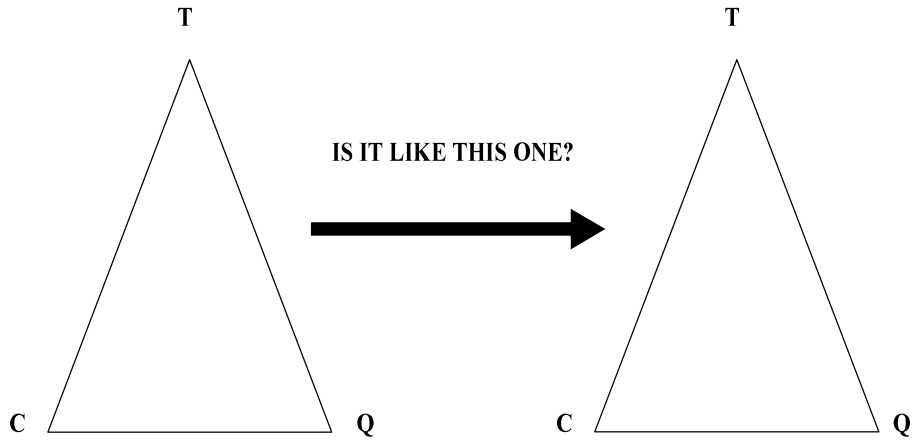
Comparative Estimating (Analogous)

Comparative estimating involves comparing current or completed tasks or projects for which you have some measures of the time and resources required. This method is based on actual past experience rather than opinion but will only be useful if the analogy is valid.

The previous task or project will be different in some respects - do these differences mean that the task or Project is not really comparable without having to make assumptions and thus reintroducing a large measure of opinion?

The Comparative method provides a firm basis for estimating if information is available, this information would then need to be scaled up or down to meet the needs of the project which is being estimated.

The following diagram highlights the fact that you are using comparisons with previous projects to base estimates upon.



Parametric Estimating (Statistical Modelling)

Parametric estimating uses defined parameters by which a project can be measured, such as the time or cost involved to build a specific project deliverable. This process can be repeated for a number of different deliverables, multiplied by the number of each of the parameters required to fulfil the project requirements.

The Parametric approach requires a reasonable amount of robust data in order to make this an easily accessible estimating technique.

An example for estimating the cost of a housing development is seen below. Type A house could be cost using the formula A=4X+2Y+3S, and Type B would be B=2X+Y+S

	Bed (X)	Bath (Y)	Reception (S)
Type A	4	2	3
Type B	2	1	1

The following technique uses one of the previous methods as its basis; it then provides outcomes based on their probability (high, medium and low)

Three Point Estimating

The previously mentioned forms of estimating do not necessarily account for things like human error, inconsistent data or straightforward errors in the estimating. However Three Point Estimating accepts a number of variations within the project values to produce a most likely outcome i.e. 90% probability, a mid-range value i.e. 50% probability and a least likely e.g. 10% probability.

Some organisations will ask their project teams or sub-contractors to provide a P10, P50, P90 estimate (where P stands for probability), although these numbers can vary dependant on the organisations requirements and level of risk they are prepared to accept.

These numbers are simply a probability of the outcome of a budget or schedule as an example.

The following equation is related to three-point estimating which is linked to PERT (Project Evaluation and Review Technique).

$$\frac{\text{(Optimistic Estimate + (4 times Most Likely Estimate) + Pessimistic Estimate)}}{\text{Divided by 6}}$$

You should be aware that as a general principal, the accuracy of a cost estimate should be consistent within a range appropriate to the progress stage of the project.

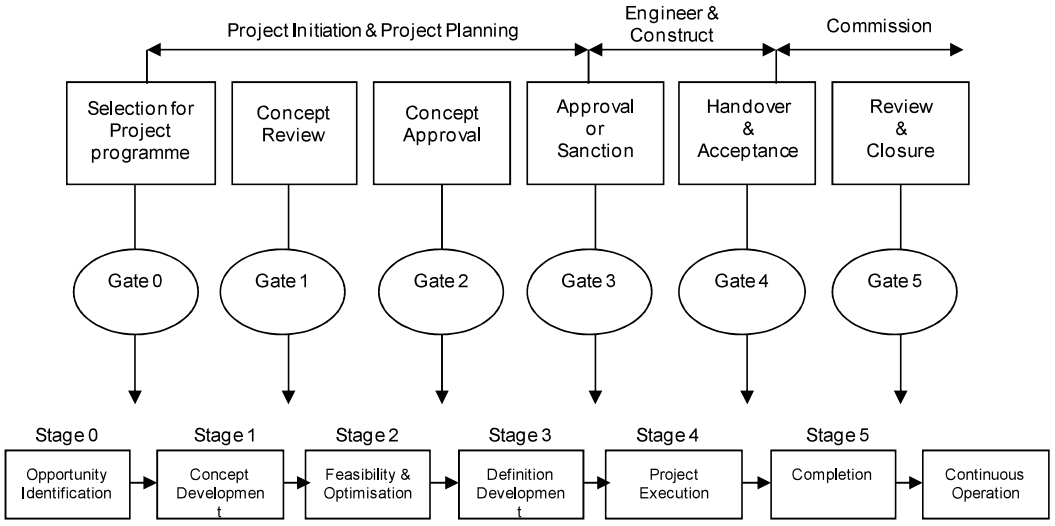
The Verification of the estimate accuracy is documented as part of the Risk Assessment process which is incorporated within the Project Risk Analysis and Management Strategy.

General Approach to Estimate Accuracy

In order of accuracy, the Unclassified (or Analogous) estimate, which is often referred to as a Rough Order of Magnitude (ROM) estimate, generally forms the first stage where no specific quantification is undertaken.

These estimates are a form of expert judgement which are based upon a minimum amount of information and can be the basis on which key strategic and entrepreneurial decisions and Asset Reference (Life) Plans are made.

At the other end of the estimating accuracy scale there is the fully Detailed Estimate, sometimes called the Definitive or Contractor's Estimate, which would be prepared during the Execution Phase of a project.



The classification of estimate accuracy types is appropriate to the progress stage of the project. Using the model shown below, at the Gate1/Gate2 (Conceptual Stages) the accuracy level is typically within the +/-30% range. However at the Gate3 (Sanction Stage) the target accuracy range will have been refined to +/-15%.

Thereafter, Post Sanction, further refinement takes place with the aim of establishing an estimate with an accuracy range of +/- 10% as quickly as possible.

The need to produce a more accurate estimate at this stage is threefold.

- It gives the Client/Project Sponsor a more accurate tool to re- appraise the Capital Costs and thereby to re-evaluate the project
- It provides a Baseline Cost (Control Estimate) against which cost performance can be measured
- It enables more reliable Planning and Scheduling to be performed

Within some organisations there is a requirement to produce a further refinement in the estimate, bringing the result to a +/- 5% accuracy. This is known either as an Execution Stage or Definitive/Contractor's Estimate and can be very time consuming to prepare.

These estimates are produced concurrently with the design aspects and come to fruition at about 70% completion of detailed design drawings and specifications, when substantive information is also available on vendor supply. The overall objective is to establish a definitive estimate.

Once established, these estimates can be used for the purpose of being the key cost control document against which all subsequent expenditure is monitored.

On the basis that they are also very expensive to produce, they tend to be called for only if project costs are forecast to significantly deviate from their budgets. This is generally too late to alter the course of events and simply demonstrates the nature and degree of error in the original estimates and brings in the bad news earlier.

Classification and Accuracy of Estimates

The accuracy of a cost estimate should be within the appropriate range consistent with the progress stage of the project. The accuracy should be verified by a documented Risk Assessment process.

The recommended nomenclature for estimate classification used by the Institute of Chemical Engineers and the Association of Cost Engineers is referenced in the following information by ** and utilises the Project Process Model (Gate Procedure)

Gate 0

Unclassified typically based on Asset Life Plan, no specific quantification undertaken.

ROM (Rough Order of Magnitude) based on past experience, no specific quantification undertaken. Order of Magnitude Estimate - also known as 'ballpark' or 'blue sky'.

An Order of Magnitude Estimate would be conducted with a minimum amount of information being available as a basis for key strategic and entrepreneurial decisions on site selection and even commercial feasibility of a project.

Empirical (Experiential) and Structural (Exponential) methods would compensate for information not available.

For Example:

An approximate estimate of a fixed investment cost can be made for an identical process to a previous plant, but at a different scale, on the basis that the total plant cost is related to capacity raised to a power, (to account for differences in scale of production) to which appropriate escalation factors to update from previous installations considered to be broadly similar in nature to the scheme under consideration would be added.

If there is not an adequate precedent then an outline flow sheet or schematic drawing is necessary to identify the main process steps and flow quantities. Step counting methods can then be used to estimate capital costs.

Step counting is based on a model which relates basic process parameters to total erected cost taking into account the number of main plant items or the number of functional units involved.

The probable accuracy of estimates of these types is typically in the range of 30% - 50%. The cost to produce an estimate of this accuracy is in the order of +/- 0.1% of the total project expenditure.

Note: Estimates which are prepared after Gate 0 are often classified as 'D' through 'A', where Class 'A' is the highest in the accuracy range and Class 'D' the lowest.

Gate 1

Class D- +/- 20% to+/-30% but is typically +/- 25% at the Conceptual Stage Gate 1.

Also known as a **Study Estimate

A Class 'D' Estimate is the preferred minimum order of accuracy when compiling estimates for use in the preparation of annual budgets for a capital programme. However, at this stage in the budget process, the project design may not be sufficiently developed,

and therefore a ROM or Unclassified Estimate may result. The cost to produce an estimate of this accuracy is in the order of 0.1% to 0.2% of the total project expenditure.

Gate 2

Class C- +/-10% to +/-25% but is typically +/-20% at the Pre-Sanction Stage Gate 2.

Also known as a **Preliminary Estimate

A Class 'C' Estimate is the preferred minimum order of accuracy when compiling individual project estimates for Pre Sanction approval. At this stage approximately 10% of the anticipated Project funding within the based annual budget would be applied for. This funding would then be used to develop the design and work scope sufficiently to allow a Class 'B' Estimate to be prepared. The cost to produce an estimate of this accuracy is in the order of 0.4% to 0.8% of total project expenditure.

Gate 3

Class B - +/-5% to+/-15% but is typically +/-10% at Sanction Gate 3.

Also known as a **Definitive Estimate

A Class 'B' Estimate is the minimum order of accuracy for individual projects requiring full Sanction approval. The cost of producing an estimate of this accuracy is in the order of 1.0% to 3.0% of the total project expenditure.

Post Gate 3

Class A - +/-2% to +/-5% but is typically +/-5% and is prepared during the Execution Stage.

Also known as a **Detailed or Contractor's estimate

The cost of producing an estimate of this accuracy is in the order of 5.0% to 10.0% of the total project expenditure.

Information Required for Preparing Estimates - Class 'D' to Class 'A'

Whole-life costs

The whole-life costs of a facility (often referred to as through-life costs) are the costs of acquiring it (including consultancy, design and construction costs, and equipment), the costs of operating it and the costs of maintaining it over its whole life through to its disposal – that is, the total ownership costs.

These costs include internal resources and departmental overheads, where relevant; they also include risk allowances as required; flexibility (predicted alterations for known change in business requirements, for example), refurbishment costs and the costs relating to sustainability and health and safety aspects.

Cost management

Cost management is the process of planning, estimating, coordination, control and reporting of all cost-related aspects from project initiation to operation and maintenance and ultimately disposal. It involves identifying all the costs associated with the investment, making informed choices about the options that will deliver best value for money and managing those costs throughout the life of the project, including disposal.

Techniques such as value management help to improve value and reduce costs. Open book accounting, when shared across the whole project team, helps everyone to see the actual costs of the project.

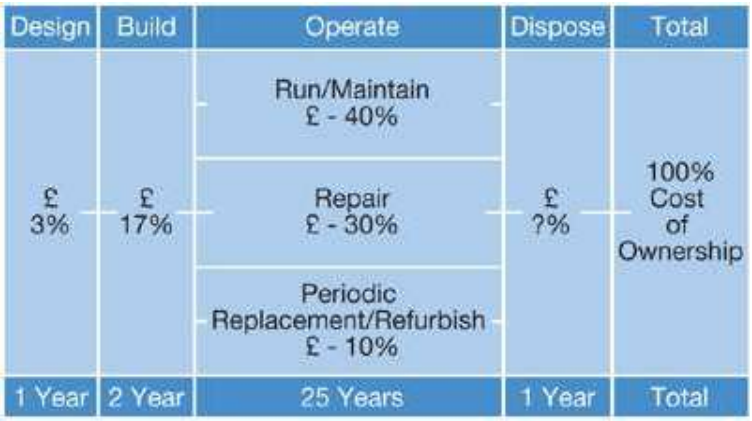
Future costs include all operating costs, such as rent, rates, cleaning, inspection, maintenance, repair, replacements / renewals, energy and utilities use, dismantling, disposal, security and management over the life of the built asset. Loss of revenue may also need to be taken into account - for example to reflect the non-availability of the revenue-generating building during maintenance work for example.

The real costs of an asset

Long-term costs over the life of the asset are more reliable indicators of value for money than the initial construction costs. This is because:

- money spent on a good design can be saved many times over in the construction and maintenance costs. An integrated approach to design, construction, operation and maintenance with input from constructors and their suppliers can improve health and safety, sustainability, design quality; increase buildability; drive out waste; reduce maintenance requirements and subsequently reduce whole-life costs.
- investment in a well-built project can, in turn, achieve significant savings in running costs.

This means that the client should be prepared to consider higher costs at the design and construction stages in the interests of achieving significant savings over the life of the facility. It is essential to consider long-term maintenance very early in the design stage; most of the cost of running, maintaining and repairing a facility is fixed through design decisions made



Capturing whole life cost

It is estimated that up to 80% of a building's whole-life cost can be attributed to running, maintenance and refurbishment costs. Consequently, there are spikes in expenditure at 10 years and every five years after that.

The initial choice of materials and the way that they are protected obviously plays an important role within the maintenance and refurbishment costs of a building over its lifetime. They therefore have a very large influence on the whole-life cost profile of the project.

The basic steps in Whole Life Costing

1. Identify capital and operational costs and incomes

2. Identify when they are likely to occur

3. Use "discounted cash flow" analysis to bring the costs back to a common basis – items should normally be entered into the analysis at the current cost and a "real" (excluding inflation) discount rate applied. Normally this will be done on a commercial spreadsheet package, which includes equations for discounted cash flow.

4. Undertake sensitivity analysis of the variables such as the discount rate, the study period, the predicted design lives of components, assumptions about running costs, etc.

Values for the costs should be as accurate as possible. Greater effort may be required for the most significant cost variables. Values can be derived from:

- a direct estimation from known costs and components
- historical data from typical applications
- models based on expected performance, averages etc.
- best guesses of future trends in technology, market and application.

For each cost, there should be an associated time profile of when the cost occurs (or recurs) for Whole Life Costing to be carried out. Time profiles of the costs may only consist of one occurrence but any cost spread over time or one which is repeated will generate a series of cost and time pairs. Costs may be fixed or variable over time. These values are most readily converted into calculations using a computer spreadsheet or purpose-built software.

The costs should be expressed in current terms as many financial or tax transactions are based on actual values at the time rather than the value in future (e.g. the current cost of a boiler should be used, not a projected future cost).

What other variables are important?

Aside from setting the performance criteria, it is essential to determine the following inputs to the calculation:

- the discount rate (if set too high it will make future costs appear insignificant)
- the period of study (often this is the contract period for PFI contracts or the period of foreseeable ownership)
- the format(s) in which whole life costs will be recorded and compared

(HM Treasury requirement for public sector organisations is 3.5% real discount rate, but different rates will be appropriate for different organisations.)

Learning Objectives

You should now have an understanding of the following:

- Comparative estimating
- Bottom up estimating
- Parametric estimating
- PERT (3 point) estimating
- Estimating classifications
- Whole life costing

Unit 10 – Scheduling and resourcing

Unit 10 - Learning Objectives

To gain an understanding of the following subjects:

- Project scheduling
- What a network diagram is
- What a Gantt chart is
- Use of a baseline
- What a cumulative s-curve is
- Project Resource Management
- What a resource histogram is

Creating and maintaining a schedule

A schedule is a timetable showing the forecast start and finish dates for activities or events within a project (APM BoK).

Scheduling is the process used to determine the overall project duration. This includes identification of activities and their logical dependencies, and estimating activity durations, taking into account requirements and availability of resources (APM BoK).

Schedule Presentation

Schedules may be presented in several ways and most software packages are capable of producing many different formats. The learners should be made aware that users often have preferences about how they like their information to be presented to them.

The most common way is to provide a bar chart (see below) which lists the relevant activities against a timescale. Another is to provide a simple activity listing which lists the activity descriptions, their durations, and their scheduled start and finish dates, and an indication of their criticality or what float is available.

The message is that users should be consulted about their preference and they should be

Milestone Schedules

These are used to record the key events throughout the duration of a project. Milestones (or “Events”) are often used as points of progress measurement, or as payment points – that is, a certain percentage payment may be related to the completion or passing of a milestone.

The way a milestone is defined is very important and you should be aware of the need to ensure that the project has full control over the content of a milestone.

For example, “Delivery of Compressor to Site” is a poorly defined milestone since the delivery is under the control of the supplier, and not the project team. A better definition would be “Final Factory Inspection and Release for Delivery” since the Project Team will carry out the inspection to ensure that the machine has been manufactured to the correct specification, and they will decide whether it can be released from the factory.

A typical Milestone Schedule is shown below.

MILESTONE SCHEDULE – *Example*

PROJECT – *Title*

W.B.S. Activity Code	ACTIVITY DESCRIPTION	Planned Date to Complete	Actual Date Completed	Responsible Authority	COMMENTS
1	Project Approval	Day 1		Project Management Team	
1.20.10	Mobilise Civil Contractor	Day 65		Construction Manager	
1.50	Commence Construction	Day 65		Construction Manager	
1.10	Design Completion	Day 75		Design Manager	
1.50.10	Building Access For Equipment	Day 130		Construction Manager	
1.40	Procurement Complete	Day 135		Equipment Manager	
1.50	Construction Complete	Day 185		Construction Manager	
1.60	Commissioning Complete	Day 205		Commissioning Manager	
1.60	Handover / Sign Off	Day 265		Project Manager	

Enter the Following

Actual Planning Dates: Day XX

Responsible Authority Resource

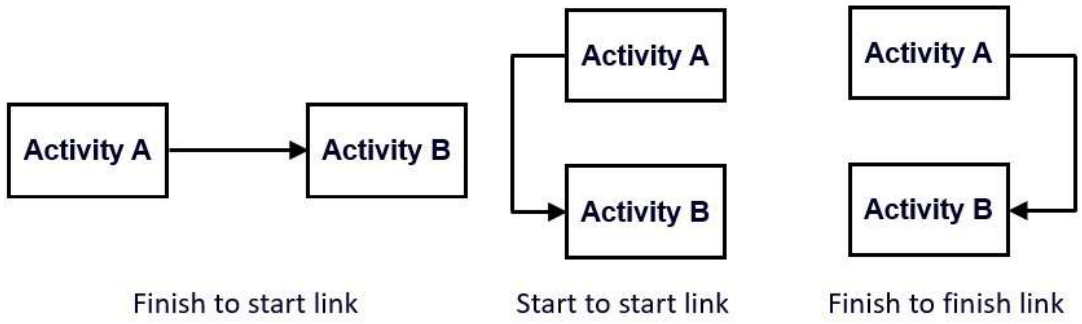
Client's Name

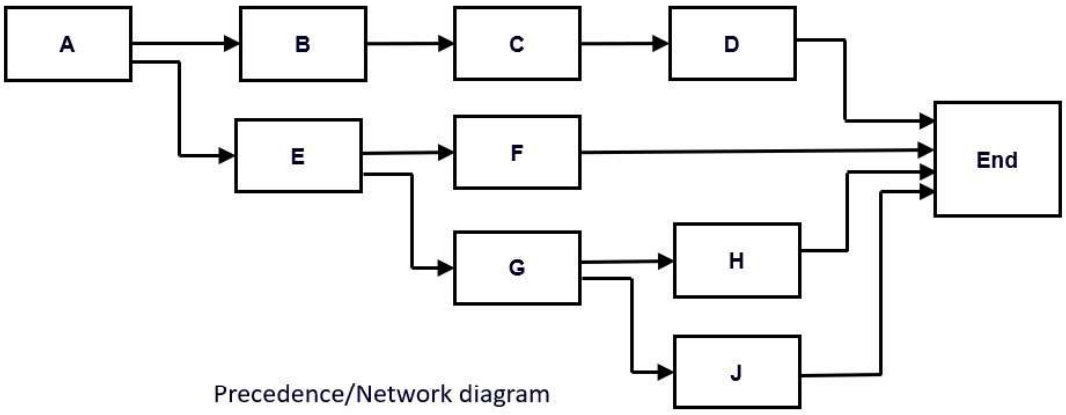
Project Tools - Progress Management *Apr-05*

The scheduling process:

Step 1: Create precedence/network diagram

The process starts by taking the activities from the agreed scope (e.g. WBS) and establishes the logic between the activities. This will enable a precedence/network diagram to be created. The following diagram shows the types of links that are generally considered to be best practice:

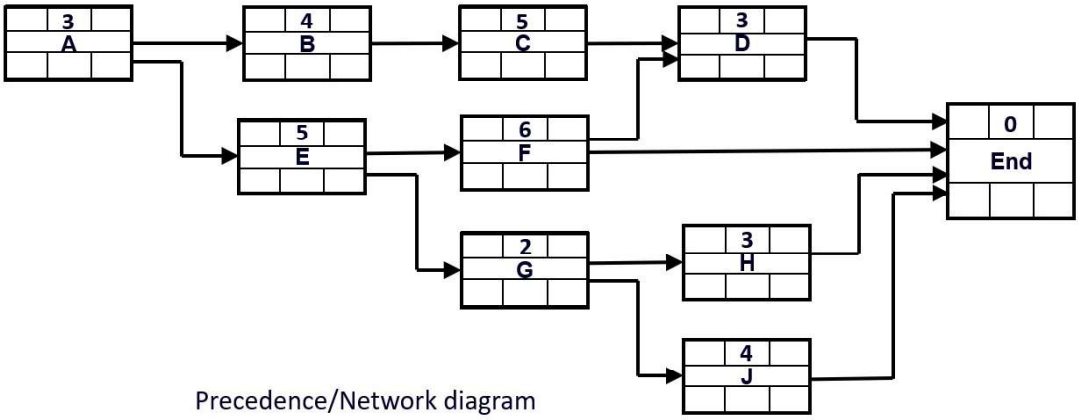




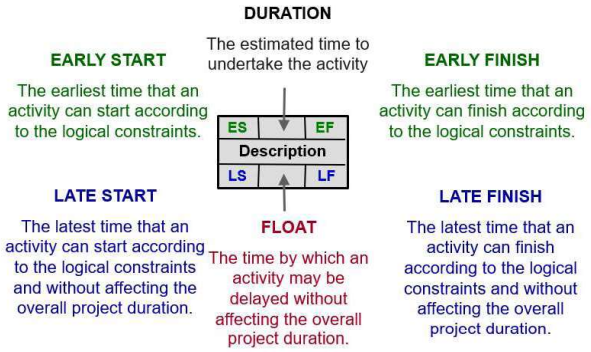
Precedence/Network diagram

Step 2: Estimate activity durations

Once the network diagram has been created, estimates of duration (based on the effort required) can be made for each activity. It is useful to use 3-point estimating for each activity i.e. best and worst cases and the most likely point in that range. It is important that the relevant experts are involved in the estimating process as well as a variety of views to both improve the accuracy of estimates and stakeholder confidence.



Precedence/Network diagram
with estimated durations added



Step 3: calculate overall duration, critical path and floats

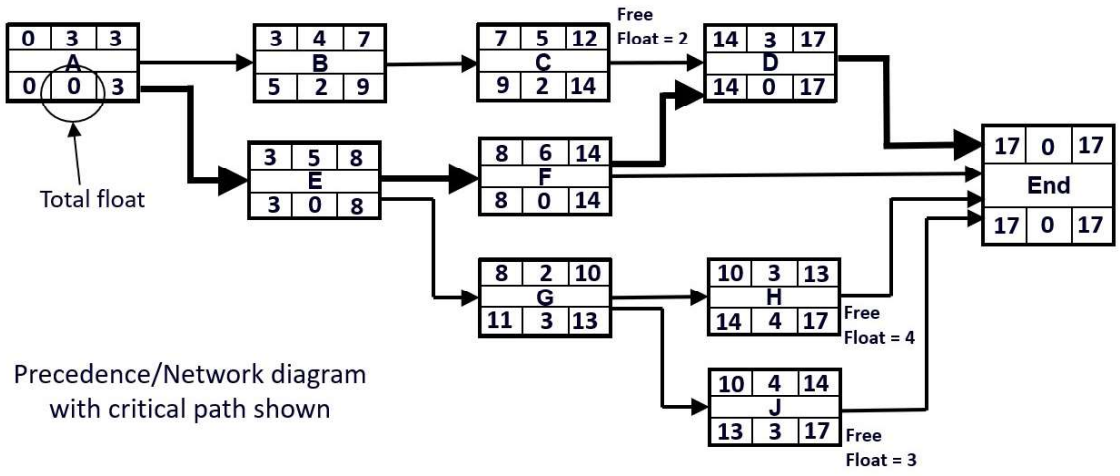
The overall duration of the schedule, total and free float and critical path can now be determined. This is normally performed through the use of dedicated planning software although is important for project professionals to understand how this is done so they can verify that plans are robust and built of defensible logic.

Critical path is a sequence of activities through a precedence network from start to finish, the sum of whose durations determines the overall duration (APM BoK).

Total float is the time by which an activity may be delayed or extended without affecting the overall duration or violating a target finish date (APM BoK).

Free float is the spare time at the end of an activity that can be used without delaying its successor activity (APM BoK).

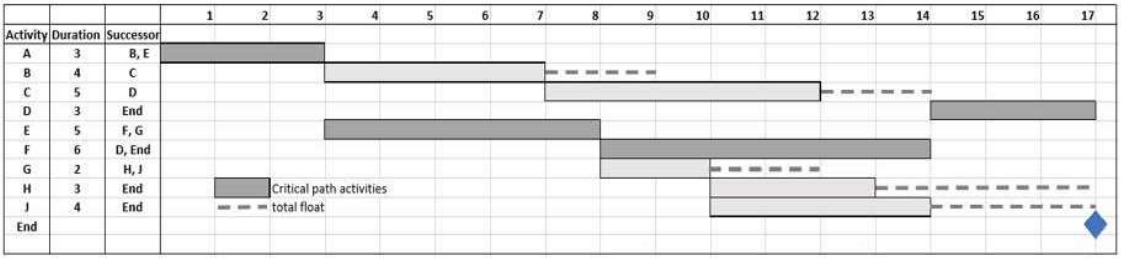
The critical path can now be determined by looking for the continual path which determines the end date. This is the path with zero total float as shown:



For presentation purposes, this diagram can be mapped onto a calendar of time and shown as a Gantt chart.

A Gantt chart is a graphical representation of activity against time (APM BoK).

It is one of the most common ways of presenting a schedule. An example for the previous network is shown below:



A Gantt chart (using the critical path method) is used to:

- Show the project activities, their start and finish times and the logical relationship between them. It shows the critical path and float (total and free) and can be used to develop a resource profile/histogram. It therefore becomes a powerful way of communicating the project timeline to the stakeholders.
- Document actual project progress against the schedule. The original schedule is baselined and the progress (i.e. percentage complete) is added on a regular basis. This will show the difference between the original schedule and the latest schedule status. This can be repeated as every update to show a progress 'narrative'. This will allow a forecast of remaining work to be produced and action to be taken.

Step 4: optimise and baseline

Once a schedule has been created considering the resources available, it needs to be reviewed by the relevant stakeholders, including those who have to complete the activities to ensure that it is realistic and deliverable. There may need to be several iterations before an optimal schedule is produced. Once agreement has been gained, the schedule must be baselined (e.g. v1-0) against which progress and change will be measured.

Step 5: maintain the schedule

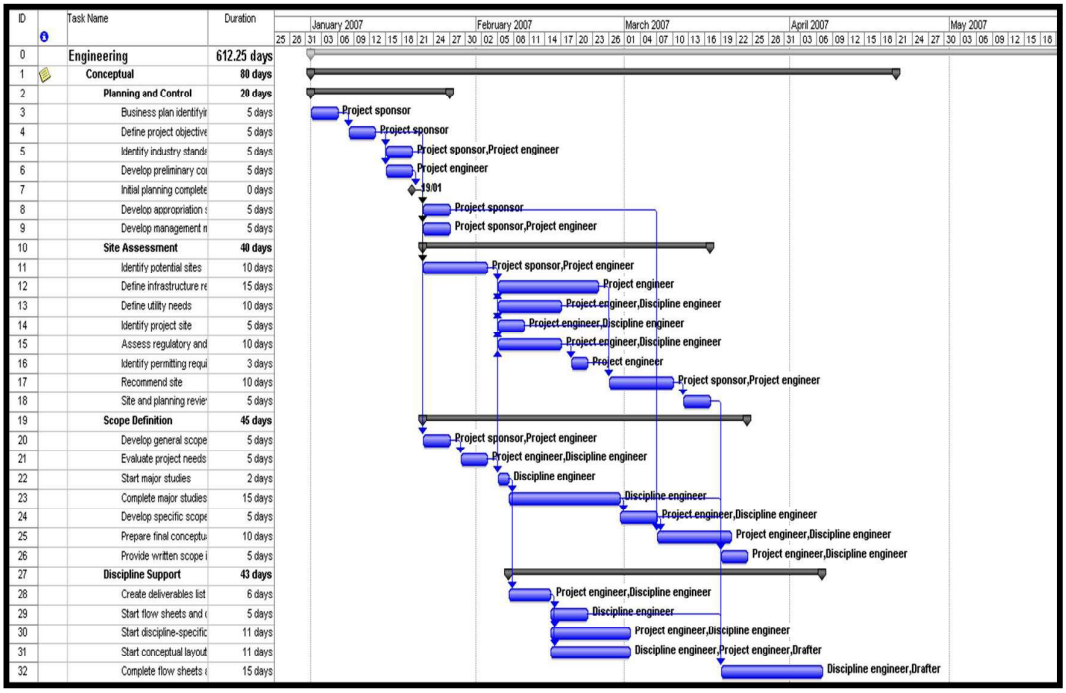
The schedule is a dynamic document that shows not only what was planned to be done, but also what has been done and a forecast of what has yet to be done.

Mechanisms must be in place to gather progress in an agreed and timely way so that the schedule can be updated. Finished tasks should be shown as 100% complete, incomplete tasks (or portions of tasks) should be moved to a date when it is envisaged, they will start.

The effect of delays on subsequent activities, the critical path, free and total float and the end date are essential to forward planning and recovery.

Major changes to the schedule may require re-baselining following agreement with the sponsor.

The following example shows a schedule produced using planning software.



Resource management

Resources are all the labour and non-labour items required to undertake the scope of work to the required quality (APM BoK).

Resources can be categorised into consumable and non-consumable and include:

- People
- Machinery
- Technology
- Property
- Materials
- Facilities
- Cost (covered in later part of this chapter)

Categorising resources makes it easier to understand what a resource is, where it can be obtained from and an input to scheduling and prioritising them.

Resource allocation is the process by which labour and non-labour resources are attributed to activities (APM BoK).

Projects, plans and schedules are almost always constrained by limited resources and therefore, a key part of project management is resource acquisition, allocation and management.

The policies and procedures to be used for acquiring goods and services will be set out in the resource management plan. Mobilising the project involves getting all the resources in place that are needed for the project to begin.

Considerations when allocating and categorising resources in a linear lifecycle.

The characteristics of the different categories of resource should be understood when sourcing and allocating them to project activities.

The considerations for doing this include:

- Time factor in obtaining resources. In order for them to be available when needed, lead times need to be understood and built into schedules and plans. For example, human resources may need to be recruited, inducted and trained in the skills needed, material will need to be procured from suppliers and money obtained from fund holders. All of this will take time and needs to be factored into the project plans. and how they are allocated to meet the requirements of the project following a linear life cycle.
- The amount of resources needed. Using the schedule of work and estimates of effort, resource profiles for each type of resource can be produced to show the levels of resources needed at any point in time. Resources can then be obtained through liaison with line managers and suppliers via contracts. Where resources do not match the planned profile, available float can be used, scope adjusted, or timescales extended.
- Cost of resource. Managing the budget and controlling the cost depends on efficient and effective use of resource. Ensuring that the right quality of resource is important. For example, buying material that is of higher quality or employing people who are overqualified will increase costs. Also, key to this is ensuring the resources are not available before the work is scheduled (e.g. expensive hired plant sitting around when not required) or not returned when no longer needed (e.g. contractors on site after the work is complete).
- Ensuring the right category of people are allocated to the right job. This can be achieved through the use of a RACI chart (responsibility assignment matrix). This helps visualise the activity to person relationship and provides clarity of roles and responsibilities.

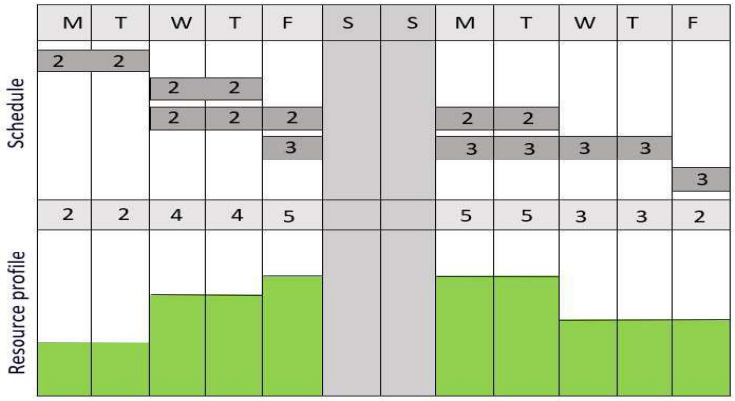
Resource scheduling

Resource scheduling involves the following steps:

- *Allocation* – this involves estimating the amount of effort for each task and the resources required to undertake it. A responsibility matrix can be used.
- *Application* – this involves applying the resources to the schedule and summarising them using a resource histogram to show the amount required for any time period and by resource type or role if necessary.
- *Scheduling* – this involves reviewing resource profiles (histograms) and resolving resource conflicts by either resource smoothing or resource levelling depending whether there is a constraint on time or resource availability.

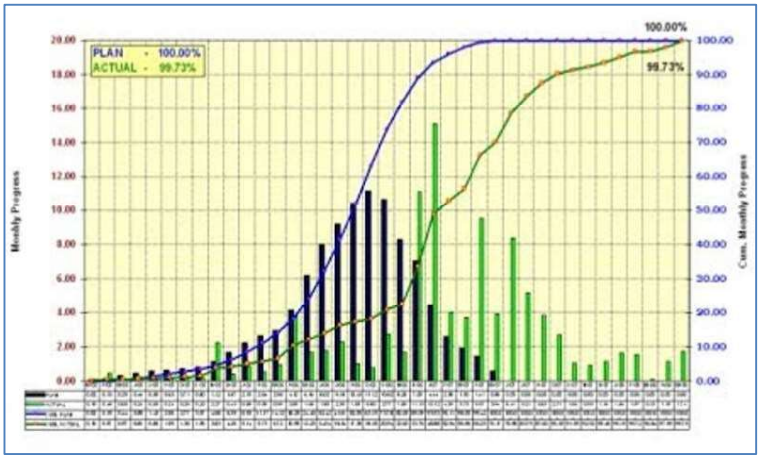
Examples of a resource histogram:

			Day										
Task	**RES**	**WBS**	1	2	3	4	5	6	7	8	9	10	11
Activity A	2 x A	1.1.1											
Activity B	1x A	1.1.2											
Activity C	2 x B	1.1.3											
Activity D	2 x B	1.2.1											
Activity E	3 x B	1.2.2.											
Activity F	1 x A	1.3.1											
Activity G	1 x A	1.3.2											
Activity H	1 x A	1.3.3											
Total Resource A per Day			2	1	1	1	1	0	0	1	1	1	1
Total Resource B per Day			0	2	3	3	0	2	2	1	1	1	1
Resource Histogram for Resource A		2											
		1											
Resource Histogram for Resource B													
		3											
		2											
		1											



When the resource usage as shown in the histogram, is drawn cumulatively, the result is a curve (S-curve) that shows the planned deployment of the resources over time. This can be used as a basis for monitoring actual resources usage against those planned (see earned value management).

Example of an S-curve:



Resource smoothing and resource levelling

There are two basic options available to optimise schedules:

- Resource levelling (resource limited scheduling)
- Resource smoothing (time limited scheduling)

Resource levelling is an approach used during resource optimisation that delays activities such that resource usage is kept below specified limits. Also known as Resource limited scheduling (APM BoK).

The question that this method seeks to answer is: 'given the amount of resource we have available, when will the project finish?'

Resource smoothing is an approach used as part of resource optimisation that involves utilising float or increasing or decreasing the resources required for specific activities, such that any peaks and troughs of resource usage are smoothed out avoiding extension of the duration where possible. Also known as Time limited resource scheduling (APM BoK).

The question that this method seeks to answer is: 'given the fixed deadline we have to meet, how much resource do we need?'

Summary of smoothing and levelling

Smoothing	Levelling
Used when time is more important than cost and where scope and quality are not negotiable. This involves adding resources such as more people, the same people working longer hours or more equipment to meet fixed deadlines.	Used when there are fixed resources available to determine when the work will be finished. This is where cost is more important than time. Where the planned resource profile (using the resource histogram) exceeds the actual resources available, planned completion dates will need to be delayed and the overall duration increased.
Aims to achieve a smooth usage of resources, avoiding peaks and troughs of resource demand. To achieve this, it may be possible to re-order tasks where the logic of interdependencies is not fixed. Examples of this include using available float, splitting tasks and performing tasks in parallel. This may overload resources.	Ensures that resources are used within their capacity (e.g. amount available) and does not overload them in trying to meet unachievable deadlines or increase risk in a project by splitting tasks or trying to complete them in parallel. It ensures that the correct resources are allocated to tasks that are relevant to their knowledge area.
Delays some work to 'smooth' the resource profile. This removes some flexibility from the schedule and its ability to deal with unavoidable delays. The advantage is usually a more efficient and cost effect use of resources.	Retains the flexibility of the schedule and its ability to deal with unavoidable delays. The advantage is that staff have 'breathing space' between tasks before starting the next one. This will improve the probability of achieving the right levels of quality safely. Staff will have time to deal with problems.
It should be noted that there is a finite limit to the resources that can be applied to some tasks due to things such as physical space (e.g. plumbers in a kitchen). If the resource is finite and the hours available limited, then the only option may be to extend duration.	

Learning Objectives

You should now have an understanding of the following:

- Project scheduling
- What a network diagram is
- What a Gantt chart is
- Use of a baseline
- What a cumulative s-curve is
- Project Resource Management
- What a resource histogram is

Unit 11 – Risk and issues

Unit 11 - Learning Objectives

To gain an understanding of how to:

- Identify and quantify risks
- Structure a risk using the meta language
- Perform an assumptions analysis
- Present risk and contingency data
- Recognise potential consequences and opportunities of risks
- Understand viable responses to risks
- Monitor risks
- Allocate of contingency
- Manage issues

Risk management

Risk is the potential of a situation or event to impact on the achievement of specific objectives (APM BoK).

Risk management is a process that allows individual risk events and overall risk to be understood and managed proactively, optimising success by minimising threats and maximising opportunities.

A helpful way to describe a risk event is by using a structure known as the risk meta-language which consists of a single statement made up of the following three clauses:

- Cause or existing condition e.g. 'because of...'
- Risk event e.g. 'this may happen...'
- Impact/effect e.g. 'leading to...'

An example is:

'Due to existing public opposition to the project, a public enquiry may be held, leading to extensive delays and additional costs.'

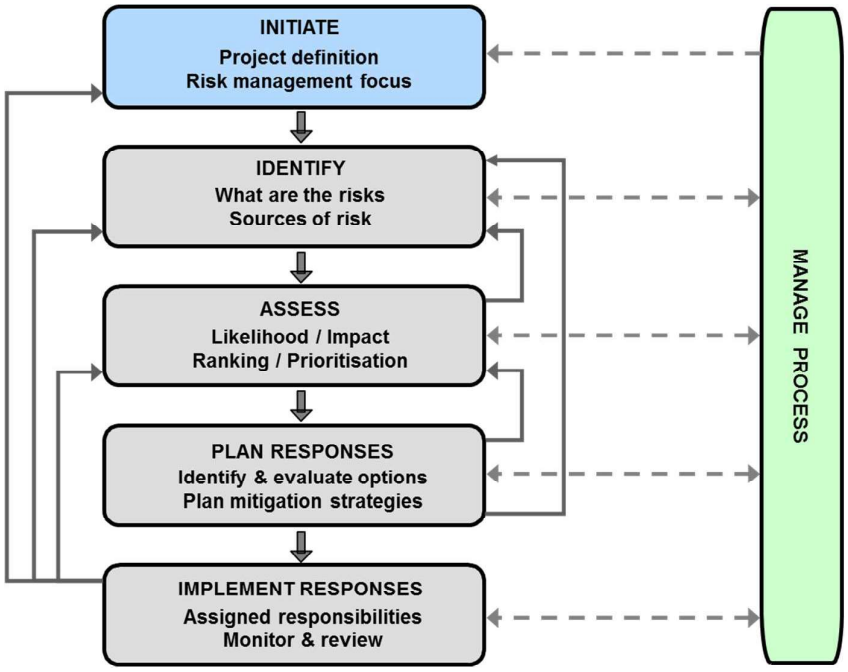
It is quite common to only think of risks as having potentially negative effects, but the term 'risk' should consist of both threats and opportunities.

An example of an opportunity is:

'Due to public support for the project, additional funding may be available, leading to a higher quality solution.'

The risk management process

The process described in this section is based on the APM's Project Risk Analysis and Management (PRAM) guide.



Initiate

This first stage of the process sets the scene and establishes a baseline upon which to proceed. The first aspect of initiation is to be clear about the objectives, scope, success criteria and benefits of the project. This is vital as risk is something that may have an effect on those objectives, scope, success criteria and benefits.

Once these have been established the second aspect of initiate is to decide and document how risk management is going to be applied to the project. This will be determined by many factors including organisational governance requirements, risk management organisational maturity, the importance of the project, its size or value, complexity, stability/novelty, etc.

The process must be agreed along with the metrics for measuring risk (e.g. high impact = >3 months, low impact = <£10 000). One of the outputs of the initiate stage will be the **risk management plan**, which in addition to the above will document the risk roles and responsibilities, any tools and techniques used to manage risk and risk reporting requirements. The risk management plan (created by the project manager and approved by the sponsor) will normally be part of the project management plan (PMP).

Note: the risk management plan does NOT contain any risk events or how they will be managed. They are recorded in the risk register.

Identify

The purpose of this stage is to capture the risks that will be subsequently managed. It is therefore important that the right stakeholders must be involved, and the most effective methods/techniques employed.

Identified risks should be entered into a project risk register/log. This document should be kept up to date throughout the project and will show the latest status of risk events.

The techniques for identifying risks include:

- **Brainstorming**. A diverse group of people connected with the project are gathered together in a meeting to collectively suggest or 'brainstorm' a wide range of risks from their individual point of view and experience. The brainstorm will normally be structured using a series of risk areas and led by an experienced facilitator. The aim is to get a wide range of risks and not to analyse them in any depth as this will be done later. This is a very creative forum for collecting risks.
- **Interviews**. A more targeted way of identifying risks is to hold structured interviews with relevant stakeholders. They range from an informal discussion to a structured time-bound interview with a set of pre-agreed questions. The interview has the advantage of being personal and can identify risks which individuals may be reluctant to suggest in a more open forum.
- **Checklists.** These use a set series of statements or questions that an individual or a group can work their way through. For example: 'Does the project have any novel technology? If yes, what are the risks?'
- **Lessons learned.** This is a rich source of identifying risks. The past has a habit of repeating itself and seeing what risks were identified in previous projects and what issues occurred can help in populating a new risk register. The cause of the lesson and not just the effect should be considered so that risks can be fully understood and not just copied.
- **Questionnaires.** These are similar to interviews but are remote and can be sent out to a wide range of stakeholders. The questions need to be carefully crafted and must be unambiguous and the responses collected and analysed so that the concerns of the responders and the associated risks can be understood.

- **SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis.** The strengths and weaknesses of the organisation and/or the project team are potential internal sources of risk e.g. good infrastructure, lack of skills. The opportunities and threats represent external risk to the project e.g. higher demand for a product, economy crash. The use of SWOT can add structure to a brainstorm. PESTLE can also be used.

Assess

This is where the identified risk events are assessed and understood for their probability and impact. The combination of probability and impact produces the severity of risk (i.e. probability x impact = severity). This represents the inherent risk (i.e. before mitigation). This will be a key consideration when prioritising risks and deciding on responses.

Another aspect of assessing a risk is consideration of its 'window', i.e. when or within what period the risk could occur (e.g. imminent, within stage, within project, beyond project). This will allow responses to be scheduled.

Once the individual risk events have been assessed, the overall project risk can be calculated to understand the project and organisational exposure.

Risk severity should be reassessd after applying a response strategy

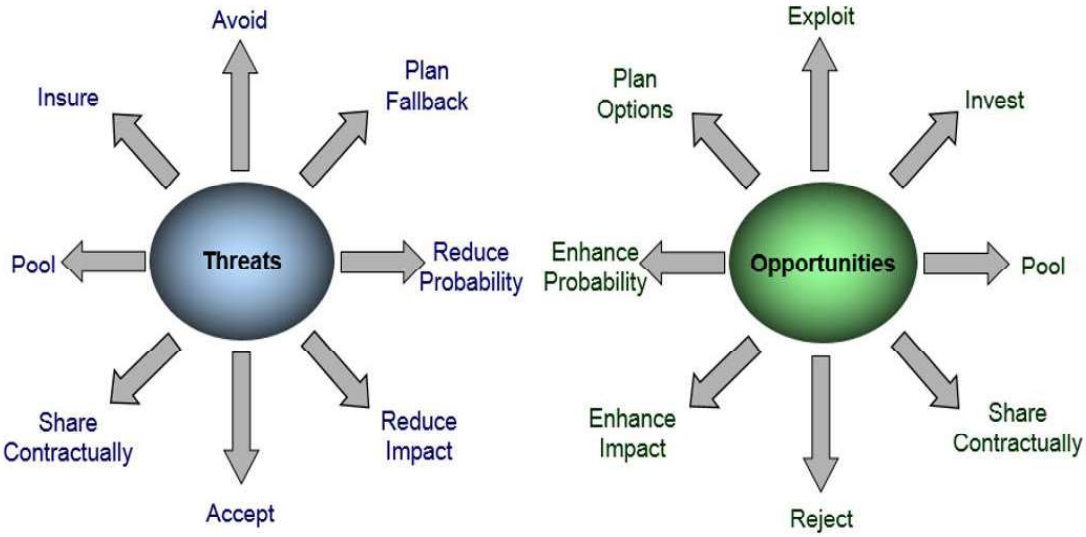
A probability/impact matrix (showing both threats and opportunities) is often used as shown in the example below. This allows the risk levels to be visualised both before and after mitigation

Probability	Threats Risk Score = Probability x Impact					Opportunities High (RED) / Med (YEL) / Low (GRN)				
0.90 Very Likely	0.05	0.09	0.18	0.38	0.72	High	High	High	Med	Low
0.70 Likely	0.04	0.07	0.14	0.28	0.56	High	High	Med	Med	Low
0.50 Possible	0.03	0.05	0.10	0.12	0.40	High	High	Med	Low	Low
0.30 Unlikely	0.02	0.03	0.06	0.12	0.24	High	Med	Med	Low	Low
0.10 Very Unlikely	0.01	0.01	0.02	0.04	0.08	Med	Low	Low	Low	Low
	0.05	0.10	0.20	0.40	0.80	Very High	High	Med.	Low	Very Low
	Example Impact Definitions – May Be Tailored to Each Project Objective Impact on an Objective (e.g. Cost, Schedule, Scope, Quality)									

The risk register should be updated to show probability and impact of each risk.

Plan responses

The diagram below shows possible responses for both categories of risk:



There are two main types of response to threats and opportunities – a proactive and a reactive approach.

Proactive approaches include:

Threats:

- **Avoid** - Change objectives or practices so that the risk cannot occur.
- **Insure/transfer –** Pass the responsibility for bearing the impact to another party (insurance is one example of this). Important to appreciate that making somebody (such as a contractor) the risk owner does not automatically transfer the risk to them.
- **Pool** – This is where an organisation self-insures itself against risk and absorbs the impact by having a risk pool with other projects.
- **Reduce impact and/or probability –** Action is planned in advance to reduce either the probability and/or the impact. This is probably the most common form of risk response.
- **Accept –** The risk is accepted, and no mitigation is planned. It is important that the risk is monitored and reported on and not ignored as risk severity can change.

Opportunities:

- **Share contractually –** This is where the impact of the risk is shared by two or more parties e.g. a client and a contractor. This should incentivise both parties to work collaboratively to manage the risk.
- **Enhance probability or impact –** Action to make the opportunity more likely to occur or the impact greater.

- **Reject –** This is where an opportunity has been identified (e.g. early delivery through incentivising contractors) but has been rejected (e.g. because the support team will not be in place to accommodate the earlier delivery).
- **Exploit –** An example of this is where a fixed price contract has been placed and the contractor identifies areas where they can do things more efficiently than planned. This will increase their profit levels.

Reactive approach:

- **Contingency plan –** This is the provision of additional time or money to deal with the risks should they happen

All responses should be assessed as to their effectiveness and cost. It is important to consider the level of risk remaining, following the application of mitigation.

These are called the **residual risks**. As a result of mitigation, additional risks may be created, and these are called **secondary risks**. The risk register should be updated to show planned responses.

Implement responses

Plans need to be resourced, implemented, monitored, and adjusted as required and reported on. Consideration must be made regarding the amount of resources required for the responses and every risk should now be allocated an owner who is responsible for ensuring the agreed actions are implemented. Monitoring and reporting requirements should have been agreed and documented in the risk management plan.

It is important as part of continuous improvement that the process effectiveness is monitored by the project manager with action taken as required. It is important that new risks are captured, and existing ones are reviewed for changes throughout the life cycle and that the risk register is updated.

Closure of risk

Once the possibility of a risk occurring has passed or the risk has occurred and been dealt with, it can be 'closed' by updating its status in the risk register and no longer monitored and reported on. Closed risks form an important input to the lessons learned process.

Contingency

For residual risks that may occur contingency plans should be developed in case they do. Contingency plans should be appropriate and commensurate to the impact of the original risk. In many cases it is more cost effective to allocate a certain amount of resources to mitigate a risk rather than start by developing a contingency plan which, if necessary to implement, is likely to be more expensive.

The number of scenarios likely to require a full contingency plan depends upon the project. Contingency planning should not be confused with the normal re-planning necessary to react to minor changes in the developing project plan.

Costing Risk

Risks cost money and we need to be able to plan for this and set realistic budgets. We introduce a little bit of accounting jargon in this section but it contains some useful ideas that could save your career.

It is often the case that time delays are viewed less seriously than obvious cost increases. It is of course possible to put a cost figure on a time delay simply by calculating the cost of staff working on the project for the extra time. The argument that 'We have the staff anyway' retains little credibility these days. If the time delay was unacceptable you may also need to think about the cost of overtime or extra staff to get the project back on track.

Let's look at an example of how this might affect project cost.

There is a project budget of £10k and the project is due to last 10 weeks.

Just to keep things simple we'll say that the only cost of this project to the organisation is staff time amounting to £1k per week.

Suppose there is a 50/50 chance of a risk occurring that will delay your project by two weeks.

What will this project cost?

The answer is that it will cost either £10k or £12k and if you aren't ready to spend £12k then you aren't ready to do the project.

Expected Monetary Value

An accountant may give a slightly different answer to the previous question by looking at the 'Actuarial' cost of the project using the Expected Monetary Value (EMV) of the risk. EMV is a mathematical formula that can help make comparisons between a range of uncertain outcomes.

EMV = p x o

Where p = probability and o = outcome

For example a risk has a 75% chance of occurring and may cost £1k.

The EMV of the risk is:

0.75 x £1,000 so EMV = £750

Using the concept of EMV for comparative purposes suppose someone was to offer you two envelopes. Envelope A contains £1,000 and envelope B has a 50/50 chance of containing £2,500. Which would you choose? Looking at the EMV of each:

A is 100% certain so has a probability of 1 therefore

A = 1 x £1,000 EMV = £1,000

B has only a 50% chance of occurring therefore

B = 0.5 x £2,500 EMV = £1,250

In theory you should take envelope B as the EMV is higher. In practice your decision will depend on how badly you need the £1,000 and whether you are prepared to take a gamble.

Going back to our earlier example of the 10 week project, an accountant might say the expected cost of the project was:

Project budget + EMV of risk

Hence the project would cost £10k plus:

EMV = 0.5 x £2,000 = £1,000

A total of £11k.

This is fine in theory but in practice, if the risk occurred and a budget of £11k is held, there is still not enough to meet the cost of the risk.

Calculating Contingency

The concepts of EMV and Actuarial cost really come into their own when starting to plan for the risks that fall into the accept category. A detailed response plan for each of the individual risks may not be prepared but a contingency sum should be set aside to deal with those risks that do occur.

Suppose there are 10 accepted risks, each is 50% likely to occur and each will cost £2k if it does occur:

The EMV of each risk = Σ 0.5 x £2,000 = £1k so the total for 10 risks = £10k

The project needs a contingency of £10k to cover these risks.

Of course EMV doesn't equal reality. What it is saying is that half of the time £2k per risk will be needed and the other half won't occur. Looked at another way the £10k contingency will only be enough to cover costs half of the time. You can be 50% confident that the project can cover its risks.

Contingency for high impact risks

Let's look at another example. Suppose there is a risk that is only 5% likely to occur but if it does it will cost £250k:

EMV = Σ 0.05 x £250,000 = £12,500

It is pointless having £12.5k in the contingency budget if this risk actually occurs. A risk with this level of impact would have to be viewed individually and the necessary contingency would need to exist at the institutional, rather than project, level.

At the risk of stating the obvious, averages only work with a range of numbers. EMV is useful for looking at groups of similar risks. EMV doesn't make sense if you are looking at a single risk with high impact or probability.

Contingency for high probability risks

Let's say there are 5 risks each with an 80% probability of occurring and they will each cost £4k:

EMV = Σ 5 x 0.8 x £4,000 = £16k

Rather than ask for the £16k EMV, the full £20k is needed should all of the risks occur. With a probability of 80% it is much more likely than not that the risks will occur - so plan for them. What this is really providing an opportunity to make savings against a realistic budget. If only 3 of the risks occur £8k of contingency budget will have been saved.

In summary Actuarial cost based on the EMV of groups of similar risks can give a guide as to how much contingency a project requires. Not all of the risks will occur but the contingency should cover those that do. Special arrangements will need to be made where a single risk could have a very high impact. Unless the probability of such a risk is very low it may undermine the business case for the project.

This technique can also be useful in helping you plan your budget. Contingency is not a 'slush fund' or 'padding' to cover for poor project management: it should be justifiable and reviewable. The contingency is there for specific risks and should only be released if a risk occurs. The project Steering Board or its equivalent should authorise the release of contingency funds.

Issue management

In project management, an issue occurs when the tolerances of delegated work have been or will be exceeded. They are different to problems that are dealt with on a day-to-day basis by the project manager and team. Issues require support from the sponsor to agree a resolution (APM BoK).

Issues may develop when a risk event occurs and issues happening may be the result of a new, as yet unidentified risk. A high number of issues may be indicative of poor risk management.

While risk management is a proactive activity, issue management is largely reactive.

The process for managing issues is:

- log and assess new issues
- escalate issues
- assign actions and apply change control
- track issues

Log and assess new issues

Issues are logged in an issue register. Once this is done, rapid analysis is performed to understand the nature of the issue along with its causes and potential impact. Delays at this stage may increase the impact of the issue (e.g. an oil spillage or security breach). If the issue is as a result of a risk that has materialised, the risk register should be updated to show the status of the risk.

Issues are prioritised taking into account:

- Scope
- Quality
- Time
- Cost
- Benefits

Escalate issues

They are escalated by the project manager to the sponsor who may in turn, escalate them to the governance board for resolution if the impact of the issue exceeds the project tolerances set by them. This is a key aspect of project governance and ensures that issues that exceed delegated tolerances are escalated to the owner of those tolerances.

The issue register should be updated to show the date of escalation.

Assign actions and apply change control

Actions are assigned to the person or group who is best placed to address them. They in turn, will identify and implement a resolution in a timely manner. Issues that result in changes to any part of the baseline plan (e.g. scope and quality) where delegated tolerances are breached, should be managed via the change control process.

Track issues

Management of issues should be tracked from identification through to resolution. This includes reporting on the status and progress of the issue as well as updating plans and re-baselining where necessary. This ensures that the actions are both being taken and are effective.

Activities to overcome barriers to issue management

Barriers can include:

- Lack of time to process issues.
- Holding on to issues too long.
- Corporate ‘blindness’ to the underlying cause of issues.
- A culture of blame or ‘bravado’ where the team try and solve problems above their delegated limits.

Activities that can alleviate these include:

- Having an agreed issue management process that is promoted and understood.
- Engagement of a project management office (PMO) to help facilitate the process.
- Having clear and agreed delegated tolerances for each role in the team.

Learning Objectives

You should now have an understanding of the following:

- Identify and quantify risks
- Structure a risk using the meta language
- Perform an assumptions analysis
- Present risk and contingency data
- Recognise potential consequences and opportunities of risks
- Understand viable responses to risks
- Monitor risks
- Allocate of contingency
- Manage issues

Unit 12 – Quality management

Unit 12 - Learning Objectives

To gain an understanding of:

- Project quality management
- The difference between quality planning, quality assurance the quality control and continuous improvement.
- The benefits of project quality management.

Quality Management

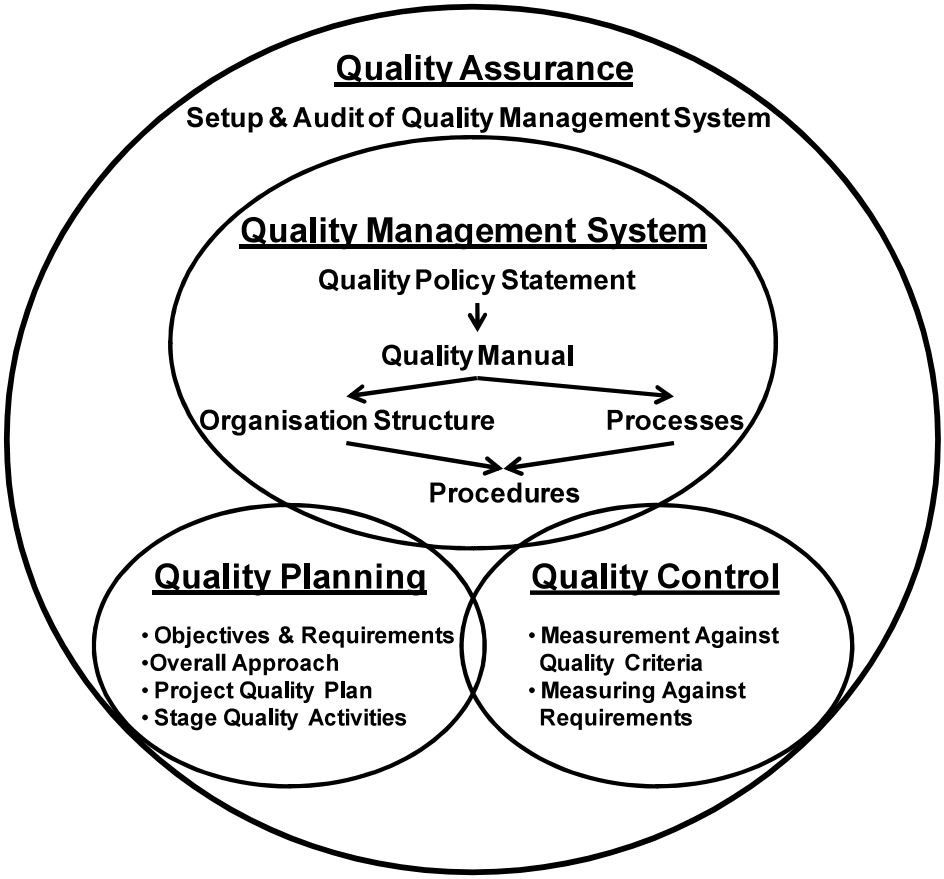
Quality management is the process of ensuring that the quality expected by the customer is achieved. How quality is going to be achieved needs to be planned and documented.

There are a number of elements involved which inter-relate as follows:

- A **Quality System** is normally utilised to implement quality management. This will have processes, procedures and an organisation structure. Both client and supplier may have quality systems, the project would have to decide which one to use, or perhaps a mixture of them both. Adopting a project management methodology typically is part of a corporate quality management system.
- **Quality Assurance** ensures the quality system is being operated and is effective in achieving an end product, which meets quality, customer and stakeholder requirements. The role of quality assurance should be separate from the project team, and in some cases it may be independent of the organisation to monitor the use of the quality system across the organisation.
- **Quality Planning** will establish the objectives and requirements for quality, detailing the necessary activities for the application of the quality system. In the Project Plan document, quality requirements and expectations are recorded before the project is undertaken, as well as the quality method to be undertaken. This will remove uncertainty and allow quality to be achieved in a visible and understood manner. The delivery of the projects products and services may be broken down into a number of manageable work packages. When this happens, the quality requirements of each should be detailed in a stage plan. Upon completion of each package/phase, the customer checks whether the product is fit for purpose, whether it matches the quality criteria and signs off accordingly.
- **Quality Control** ensures the products meet the quality criteria specified. Products are examined to determine if they meet requirements. These can be done in formal quality reviews.

Benefits of Quality Management

- Provides opportunities for continual improvement.
- Improves product quality and repeatability.
- Increases process efficiencies.
- Reduces failure costs.
- Increases employee satisfaction.
- Reduces staff turnover.
- Provides confirmation of detailed customer requirements.



Cost of Quality Management

The cost of quality refers to the total cost of all efforts related to quality. Project decisions can impact on operational costs, on quality as a result of product returns, warranty claims and recall campaigns. However the temporary nature of the project means that investments in product quality improvement, especially defect prevention and appraisal, can often be borne by the acquiring organisation rather than the project, since the project may not last long enough to reap the rewards.

Quality costs are also the total costs incurred in investment in preventing non-conformance to requirements, appraising the product or service for conformance to requirements and failing to meet requirements (rework). Failure costs are often categorised into internal and external. Failure costs are also called cost of poor quality.

Failure costs typically comprise:

- Costs of correcting defects, before and after delivery.
- Cost of overruns against time and budget.
- Unnecessarily high maintenance costs.
- Indirect costs associated with a frustrated work force.
- Indirect costs that users incur due to poor quality products (e.g. loss of business due to poor reputation).

CONTINUOUS IMPROVEMENT

There are 2 main processes employed to continuously improve.

Problem solving - is used whenever there is a known problem (therefore reactive), which we have to define and then provide a solution. Problem solving is focused on specific non-conformences or improvement projects. Problem solving is supported by a number of problem solving tools which are discussed at the end of this section.

Process Improvement - is used as the name suggests, to improve processes. There may not be a perceived problem but the process in itself may be inefficient, incur duplication of effort etc. For improving processes we use flow charting techniques.

Both processes take advantage of being systematic in that they:

- Are thorough.
- Provide evidence to show how the problem was solved or process improved.
- Help avoid the rush to jump-to-a-solution without knowing the real causes.
- Enable possible solutions to be tested.
- Help with complex or undefined problems.

Why improve processes and solve problems?

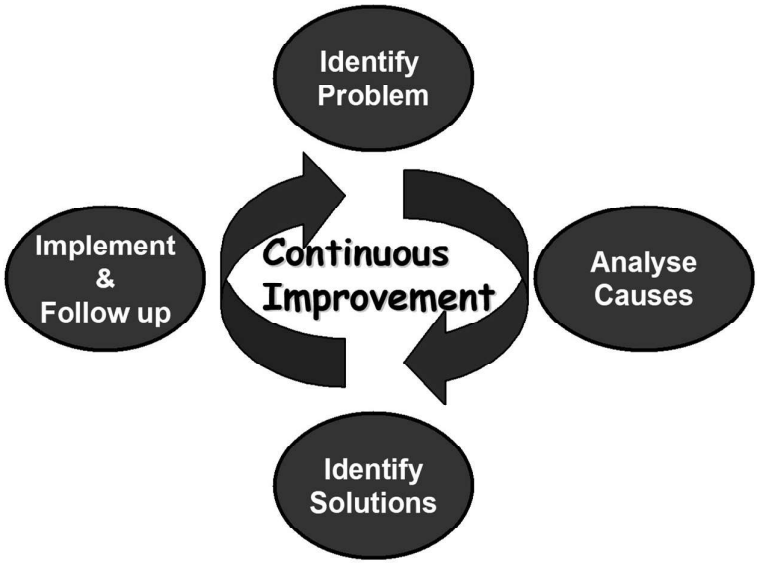
Using teamwork, successful techniques and good data we can improve the quality of our processes and services and therefore improve the quality of delivery to the customer.

Problem solving

The complexity of businesses using processes, people, equipment, resources and suppliers, means that there will always be problems to solve and processes to be improved. The four-stage process is a sequence of logical steps, which focus problem solving on the identification of the root causes of the problem.

The four stages are as follows:

4 Stages of Problem Solving



Improvement requires two skills:

Problem analysis – where a non-conformance is identified and an analysis conducted to identify the root cause.

Implementation of changes – where a plan must be put in place to ensure that the identified solutions are implemented successfully.

Check sheets

Description

A Check Sheet is an easy to use, structured form that makes it easy to record and analyse data. Tally marks are made to indicate how often something occurs. Check sheets provide a clear record of gathered data in a form that permits easy analysis.

Check Sheets:

- Identify and quantify possible causes, types and locations of problems.
- Standardise data collection for a process – ensuring that everyone collects comparable data in the same format.

Principles

- keep the form simple and easy to understand.
- Include only information you intend to use.
- Make sure people interpret the categories in the same way.
- Keep separate check sheets for different days, people etc.
- Try out the form before you use it.

Instructions for use

1. Decide what data is needed.
2. Decide how the results will be analysed and used.
3. Design a Check Sheet for recording data.
4. Validate by testing it on someone not involved in its design.
5. Gather the data.

Example

Expense Report Receipts Missing					
Type	Sales	HR	Mfg	Purchasing	Total
Taxi	10			4	14
Meals	12	2		8	22
Fuel	2	6	1	1	10
Total	14	8	1	13	46

Pareto

Description, In the late 1800s, economist and avid gardener Vilfredo Pareto established that 80% of the land in Italy was owned by 20% of the population. While gardening he later observed that 20% of the peapods in his garden yielded 80% of the peas harvested.

The Pareto Principle or the 80:20 Rule has proven its validity in a number of other areas.

In the business world, it has been found that the principle could be applied to many areas, such as:

- 80% of decisions come from 20% of meeting time.
- Roughly 80% of your managerial problems and headaches are caused by just 20% of your problems.
- 80% of your measurable results and progress will come from just 20% of the items on your daily To-Do list.
- 80% of a Manager's interruptions come from the same 20% of people
- Roughly 20% of the input errors typically cause the lion's share of defects.
- Roughly 80% of customer complaints are about the same 20% of your projects, products or services.

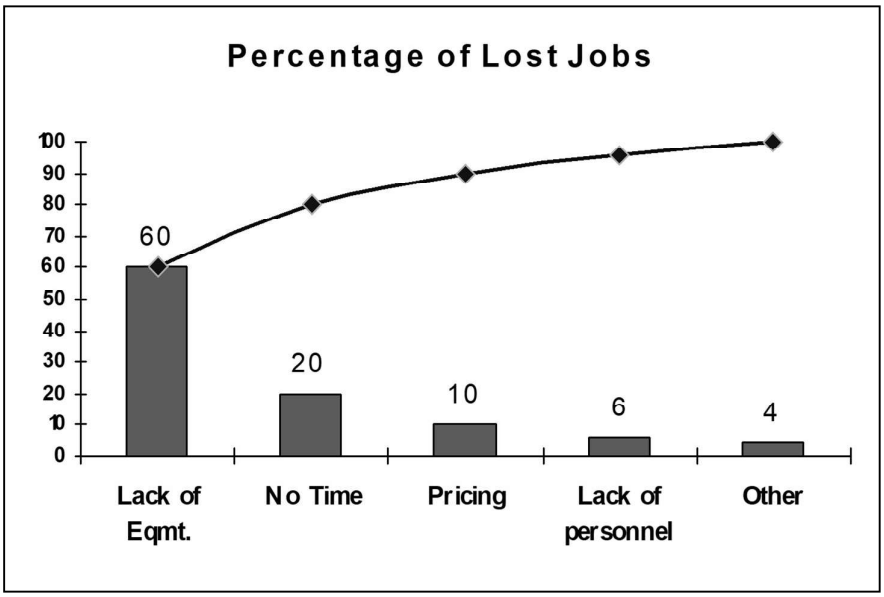
A **Pareto Chart** communicates the results of an analysis used to narrow down the sources of trouble, by ranking or prioritising data in order of importance. The Pareto principle states that “for nearly any event or consequence, of all the contributing factors, only a small number will account for the bulk of the effect”. Pareto analysis shows at a glance which problems, options or possible causes are top priority.

For problem solving, the analysis can be used during step 1- define the situation, to help narrow the scope of a problem. During step 3- identify root causes, it can also be used to rank problems and look closer at non-conformance data.

Principles

Instructions for use

1. Classify the group data based on shared characteristics such as non-conformance, downtime, customer complaints.
2. Organise the data in order of magnitude on the vertical axis.
3. Arrange the groups along the horizontal axis. Begin at the extreme left with the one costing the most or occurring most frequently. Proceed in descending order.
4. Draw the bars to the values on the vertical axis.
5. Draw a cumulative curve or line graph across the top of the bars. This represents the cumulative total for each item and plots the curve of the Pareto Chart. End the curve at 100 percent in the upper right hand corner.
6. Interpret the results. Compare the height of the bars to evaluate the relative importance of the problems.



The above diagram is an example of a Pareto analysis chart.

Control Charts

The **Control Chart** also known as a **Shewhart** chart (after its inventor Walter A Shewhart) or a **Process Behaviour Chart** is a graph used to study how a process changes over time. Data are plotted in time order, with a central line for the average, an upper line for the upper control limit and a lower line for the lower control limit. These lines are determined by historical data, by comparing current data to these lines you can draw conclusions about whether the process variance is consistent (in control) or unpredictable (out of control), affected by special causes or variations.

Control charts used for variable data are employed in pairs.

The top chart monitors the average, or the centring of the distribution of data from the process.

The bottom chart monitors the range, or the width of the distribution.

E.g. If you were at a shooting range, the average is where the shots are clustered on the target; the range is how tightly they are grouped.

The control charts used for attribute data are used singly.

When should we use a control chart?

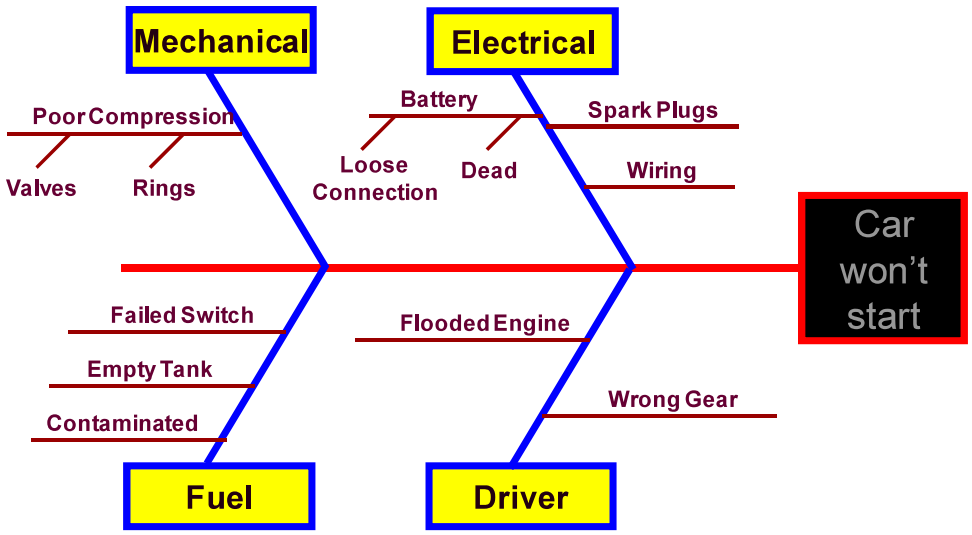
- When controlling ongoing processes, by finding and correcting problems as they occur.
- When predicting the expected range of outcomes from a process.
- When determining whether a process is stable (in statistical control).
- When analysing patterns of process variation from special causes (non-routine events) or common causes (built into the process).
- When determining whether your quality improvement project should aim to prevent specific problems or to make fundamental changes to the process.

Basic procedures for using a control chart

- Choose the appropriate control chart for your data.
- Determine the appropriate time period for collecting and plotting data.
- Collect data, construct your chart and analyse the data.
- Look for “out-of-control signals” on the control chart. When one is identified, mark it on the chart and investigate the cause. Document how you investigated, the learning outcome, the cause and how it was corrected.

Cause and Effect (Fishbone/Ishikawa)

The Cause and Effect diagram is a powerful technique used to graphically depict and organise possible causes or risks of a situation. This technique combines analytical and creative thought with team effort and provides a way to break down problems into smaller pieces, which are easier to manage and understand.



Learning Objectives

You should now have an understanding of the following:

- Project quality management
- The difference between quality planning, quality assurance the quality control and continuous improvement.
- The benefits of project quality management.

Unit 13 – Procurement and contracts

Unit 13 - Learning Objectives

To gain an understanding of the following:

- Procurement.
- Supply chain management
- C contracts and how they inform project controlling activities
- Contractual relationships
- Contract administration

Introduction to Procurement

"Procurement is the process by which the resources (goods and services) required by a project are acquired. It includes development of the procurement strategy, preparation of contracts, selection and acquisition of suppliers, and management of the contracts."
(APM BoK)

Basic Procurement Process

"A procurement strategy should be prepared as part of the project management plan (PMP). The procurement strategy will set out how to acquire and manage the internal or external resources (goods and services) needed for the project." (APM BoK)

A basic procurement strategy would commonly contain the following:

The make or buy decision

The Make option	The Buy option
Possibly less costly	Possibly Less costly
Easier integration of operations	Utilise expertise of suppliers
Utilises existing capacity that may be idle	Possibly only small volume required (more cost effective to sub-contract)
Direct control is maintained	Limitation of in-house capacity or capability
Avoids unreliable suppliers	Augment existing labour force
Stabilisation of workforce	Multiple sources of supply to maintain
Possibly less costly	Indirect control

Use of a single integrated supplier or multiple discrete suppliers

Using a single integrated supplier, in for example a construction setting would mean that you would employ a builder who would carry out the building and take responsibility for, plumbing, electrical work and decorating.

The other option is to go for multiple discrete suppliers; using the construction example again you retain responsibility for contracting the electricians, plumbers and decorators.

Both methods have their advantages and disadvantages. With a single integrated supplier you are effectively delegating responsibility for the construction to one supplier, which makes communication simpler and reduces your workload. On the negative side you are heavily dependent on that one supplier; anything that goes wrong with the supplier can have a much greater impact. In terms of communication you are distanced from the project and it depends on the level of trust you have for the supplier as to whether or not you can rely on the progress information they are giving you.

With the multiple discrete suppliers you are able to select the people you want for each aspect of the task, you can monitor each aspect of the task directly, rather than having to go through just one supplier. On the minus side it is a far more time consuming way of doing things, it is also dependant on your level of expertise in the area. It might be more efficient to utilise the expertise of others and allow someone else to select the contractors required.

Required supplier relationships

Key to effective supplier relationships is collaboration and the realisation that there are significant benefits to be gained from collaborating closely with suppliers, treating them as a potential source of competitive advantage, rather than a necessary cost.

There is a move away from the more traditional reactive approach to supplier relationships towards a strategic long term focus, with less attention on price and a greater emphasis on delivery capability and value.

Conditions and form of contract

We will discuss the various types of contract later in the module, but for the purposes of the procurement plan it is worth considering the form you wish it to take.

You may decide to use one comprehensive contract or a sequence of contracts, you might use parallel contracts or you might decide that you will use sub-contracts.

In terms of the contracts conditions you will have to consider things like; dispute resolution, termination, and confidentiality and of course contract payment methods.

Types of pricing or methods of reimbursement

We will look at this subject in greater detail later on in the module. During the creation of the procurement plan we should be determining the terms of payment that are most likely to motivate suppliers/contractors to deliver the objectives of the project.

Supplier selection and sources

Determines the method you will employ in your selection process. The decision on whether to go for a competitive tender or non-competitive tender (sole source), also your company may have a list of preferred contractors that you must use.

If you decide to go for a competitive tender it is important to use an objective process when selecting a supplier or contractor, this will help you to avoid the influences of personal preferences. Inform suppliers of your needs, both technical and financial, this will allow you to draw up a short list based on the suppliers best able to meet the criteria you have stipulated.

Procurement Strategy – Implementation

The implementation of the procurement strategy may now be considered in some detail. It should be noted that the procurement processes described are typical of those in general use in the building, civil and engineering industries.

Supply Chain Management influences the progress measurement, cost management, and reporting and could also impact upon the development of the estimate and schedule if early solutions arrived at change at a later date.

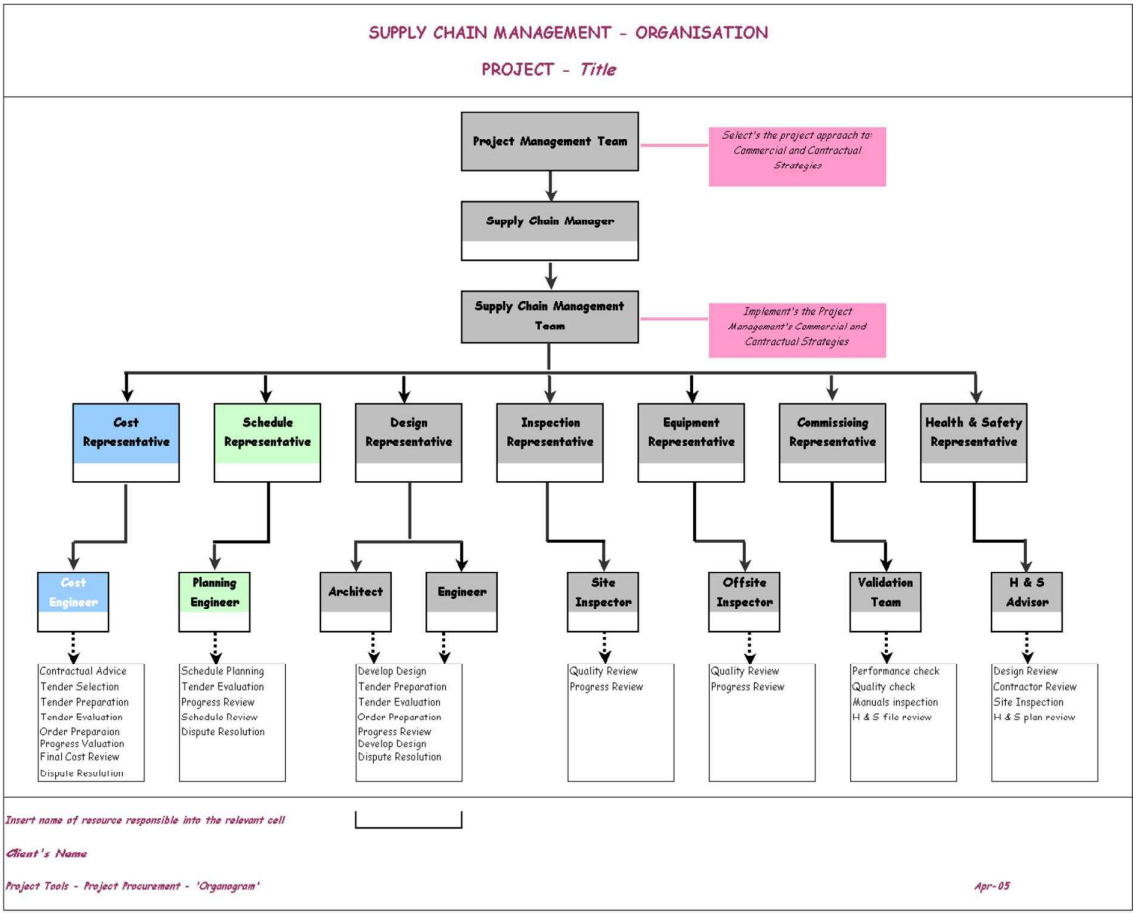
The implementation of a Procurement Strategy involves the following key activities:

- Producing Project Execution Procedures.
- Developing a procurement organisation.
- Developing the contract strategy, selecting appropriate conditions of contract.
- Contract procurement by the tendering process, including pre-qualification, preparing enquiry documentation, tendering and contractor selection, preparing the contract and order.
- Monitoring current status of activities, expediting progress and reporting
- Administering the contract
- Avoiding disputes, advising on dispute resolution

The Supply Chain Management comprises the following:

Inputs	Project Execution Procedures, organisation and procurement strategies
Decisions	Prequalification, selection of appropriate contract arrangements, and tendering information
Activities	Prepare enquiries, tender, bid evaluation, and contractual agreements. Post contract, expedite and monitor progress and resolve disputes
Outputs	Dispute resolution strategy, progress and report information.

Project procurement organigram example



Contract Selection

The selection of a suitable form of contract to satisfy the project's procurement strategy involves assessing a number of issues. The issues include evaluating the requirements of the client and the information that will be available at specific stages of contract development.

The Selection Checklist template (**see the diagram on the following page**) is a development of the assessment of information and requirements used to establish the procurement strategy. It should be considered separately for each package of work designated as a contract in the procurement strategy. The relevance of the checklist of all questions or statements for each issue requires consideration and a record of the answer should be agreed.

The template is split into the three following elements:

Contract selection - general project information

The issues considered in this section are of a general nature to the project including the main objectives, scope and timescale to complete the work.

Contract selection - design stage information

The issues considered in this section are for designing the scope of works including who will be responsible for the completed design of the works, when detailing will be required and where it will be done.

Contract selection - delivery stage information

The issues considered in this section are to enable complete delivery of the scope of works and includes the method of managing and supporting construction, and the time scale constraints.

Assessing the Selection Checklist

The contract selection checklist should be completed, and the answers or statements evaluated. The most appropriate forms of contract can be advised following consideration of the checklist evaluation. No quantitative calculation based upon the answers can dictate which the most appropriate form of contract is. Experience has shown that the most appropriate form of contract selected should reflect a pessimistic contractual scenario despite the optimism in the answers of the project team.

Standard forms of contract – Construction Industry

Standard forms of contract have been compiled by a series of consultative bodies representing clients and consultants, contractors, and suppliers to meet common requirements. The standardisation is based upon common experiences of these representative bodies and is an attempt to provide a basis for reaching an agreement whereby one party (the contractor) undertakes to perform the requirements of the other party (the client). The experiences of the representatives of these bodies are used to compile a set of standard conditions that are universally understood by the parties to the contract.

The standard conditions of contract – Construction, have been prepared by the following bodies to meet specific types of project work.

J.C.T. Joint Contracts Tribunal Limited (J.C.T.) – used primarily in the U K for both minor and major building works. Mechanical and electrical work is limited to domestic requirements.

General Conditions of Contract (G.C.E.) – used primarily in the U K for projects that has elements of both building and civil works and significant mechanical and electrical work.

Institution of Civil Engineers (I.C.E.) - used for U K projects and in countries where the project team are influenced by U.K. legal practices. The conditions are for primarily major civil engineering works with significant mechanical and electrical work.

The Engineering Construction Contract (E.C.C.) – suite of conditions introduced mid 1990 are a development being used for the same applications as I.C.E. The E.C.C. conditions introduce the method of evaluating change in the contract by ‘actual cost’.

Federation Internationale Des Ingenieurs Conseils (FIDIC) – used throughout the world for projects outside of the U.K. involving building, civil and engineering, process plant and turnkey works.

Institute of Chemical Engineers (IChemE) – used throughout the world where the project is influenced by U.K. legal practices, the conditions are for use on projects that involve process plant and turnkey works.

Federation of British Electro, Technical and Allied Manufacturer's Association – used in the U.K. for work on process plants aimed at mechanical engineering and electrical disciplines for both new construction and modification works.

Highways works – used in the U.K. for road construction and associated structures, bulk earthworks and landscaping projects.

Demolition works – used in the U.K. specifically for demolition works.

Client's bespoke – used throughout the world when working on projects for a specific client. Clients have prepared conditions of contract that are pertinent to their particular industry

The Tendering Process

The tendering process – flowchart (**see the diagram on page 19)** shows the sequence and stages required to implement the project contract strategy for contract production. Some stages may in practice be overlooked but the decisions and content will still be required.

Contract Strategy – agreeing the scope of work, appropriate conditions of contract and the basic contractual requirements that are determined as the initial proposal.

Tendering Stages

Pre-qualification – informing potential consultants, contractors or suppliers of the project, timescale and scope. The pre-qualification process includes preparing information to advise parties of the work required, the proposed contract provisions and the information that will be available. Interest in tendering for the work is recorded on receipt of compliant 'expressions of interest' within the stated time scale.

Tender list – selecting potential tenders from the information provided in 'expressions of interest'. The product of the assessment is a short list of potential tenders capable of undertaking the work from which the tender list should be made.

Tender enquiry – preparing the documentation from the information made available and influenced by the requirements of the proposed contract. The enquiry should be issued to the planned project timescale. Suitable time should be allowed for compilation and submission of the tender in the required form and time in accordance with project procedure or codes for selective tendering. The project team should agree before receipt of tenders as to how the selection criteria will be used.

Tender evaluation – comparing the submitted compliant tenders for arithmetic accuracy and ensuring 'like for like' technical and commercial proposals. If there are any

anomalies these must be resolved by discussions between the parties. The objective of any discussion is to complete the 'like for like' assessment and to create documentation that will be included in the contract.

Note: The technical evaluation will be conducted separately from the commercial evaluation. Those conducting the technical evaluation will not have access or information relating to the commercial section of the tender.

Tender recommendation – preparing a complete arithmetic reconciliation of the tender submission, and comparison of all tenders using a weighted selection criteria matrix. The information is used to make a recommendation as to the project's preferred contractor, consultant or supplier.

The Contract - compiling all the information prepared by the project team upon which the tender submissions from the appointed tenderer is based to create a formal contract agreement

The Order - preparing a formal Purchase Order document that will create the commitment within the cost control system. The component parts of the order should be identical to the contract as it will be the contract that will be used as the basis in dispute resolution.

Supply chain hints and Tips

- Structure the supply chain organisation to complement the project organisation.
- Select the most appropriate conditions of contract
- Select the most competitive and appropriate supplier of resources
- Monitor progress of all the work
- Avoid or resolve disputes quickly

Learning Objectives

You should now have an understanding of the following:

- Procurement.
- Supply chain management
- C contracts and how they inform project controlling activities
- Contractual relationships
- Contract administration

Unit 14 – Change control

Unit 14 - Learning Objectives

To gain an understanding of:

- What a change is
- How to apply a change control process
- What questions to ask when assessing a change request

Change control process

Change control is the process through which all requests to change the baseline of a project are identified, evaluated and approved, rejected or deferred (APM BoK).

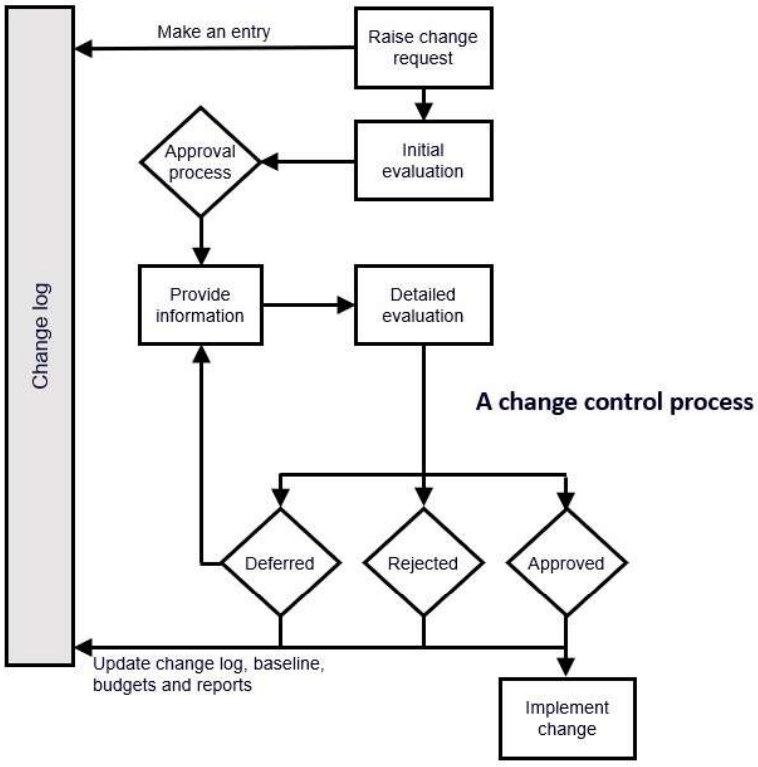
Change requests may arise as a result of:

- Issues arise or risk materialise
- New or change in stakeholder requirements
- New regulations
- Plans no longer valid

Managing requests for change is a major success factor in project management. Where there is ineffective change control there exists a high probability of scope creep, problems caused by the effects of poorly understood impact on other parts of the project, contractual conflict, increased costs and loss of stakeholder confidence.

Managing requests for change in a controlled way allows the sponsor to both understand the implications of change and make more informed decisions regarding responses.

The following process/steps are used to implement change control:



Raise and log a change request

Requests for change should be logged in the change log (or change register). In a controlled environment, change requests should be submitted in a structured and agreed method such as a request for change (RFC) form. This encourages the initiator of the change to inform the project manager of the reason for the change and any additional information that will help the project manager to assess it. Formal capture ensures that all change requests are documented, which both avoids them being overlooked and allows reporting on change status to senior management.

Initial evaluation

The change request is reviewed to consider if it is worthwhile evaluating in more detail or should be rejected at this early stage. Approval may be needed to complete detailed evaluation. This may be because of the cost and time required to complete the investigation (e.g. where specialist involvement is required to investigate the change) or the delegated limits that the project manager has been given.

An example is where a customer is considering a change to a product being developed by a supplier. The supplier realises that detailed evaluation of the change request will be expensive and time consuming and therefore asks if the customer is willing to pay for detailed evaluation.

Detailed evaluation

Subject matter experts may need to be used to complete this step and therefore may need planning before commencement. An example of this is structural analysis of a technical component. The proposed change should be evaluated in terms of impact including:

- Success criteria and baseline
- Benefits
- Scope
- Quality
- Time
- Cost
- Resources
- Risk
- Stakeholder engagement

This stage may also identify options for responding to the change request. Where this is the case, the impact on the plans and business case of those options should be assessed to allow an informed decision to be made.

Recommendation

The evaluated change request is now escalated with recommendation to the sponsor and/or wider governance board to approve, reject or defer the change. The sponsor is accountable for ensuring that a decision is made and communicated.

Some changes may be deferred so that progress and completion of a project is not interrupted. This may follow introduction of a change freeze (a decision point after which no more changes will be implemented). It may be more convenient to consider changes post transition during upgrades and outages.

The decision must be documented in the change log to provide an audit trail of decisions and to ensure that communication can take place.

Escalating the change request supports project governance by ensuring that the right level of authority is applied.

Update plans and implement

If the change is approved, plans and other technical documents must be updated to reflect the change. Configuration records must also be updated to reflect their current status such as version number. This ensures everyone understands what products are in use. Other configuration items may need to be changed as well.

The change must be communicated to affected stakeholders, implemented through appropriate planned actions and monitored through to completion.

Learning Objectives

You should now have an understanding of the following:

- What a change is
- How to apply a change control process
- What questions to ask when assessing a change request

Unit 15 – Information management

Unit 15 - Learning Objectives

To gain an understanding of the following:

- Sources of information
- Gathering data and assessing its integrity
- Organising, storing, and retrieving information
- Processing information and data
- Developing systems for security and confidentiality of information
- Understanding the importance of version control

Document Control

An appreciation and understanding of the specific nature of document control and communications and the importance of keeping records of project activities is essential to the success of the project.

Project documentation can be defined as that information either in paper or electronic form, which is essential to control all aspects of a project from initial conception through to completion and project closure.

The communication of information through the availability of up-to-date project documentation at the point of use, with clear identification, indication of its current status and changes since its inception, is essential for the efficient operation of a project.

Information management changes during the project life cycle in terms of understanding what is needed, who to disseminate information to, when to issue information and when to destroy it. However, pertinent information must adhere to the communication plan.

Further complexity arises when considering commercial confidentiality and statutory obligations such as information security and freedom of information. Information management in a project needs to integrate with the organisation's information management process.

Configuration management is a good method of controlling the integrity of plans and documents throughout the project life cycle. A configuration management process is described later in this module.

Information Management

The following description of information management is taken from the APM Body of Knowledge

Information management is the collection, storage, dissemination, archiving and appropriate destruction of project information. Information reporting takes information and presents it in an appropriate format which includes the formal communication of project information to stakeholders.

Information management describes the means by which an organisation efficiently plans, collects, creates, organises, uses, controls, disseminates and disposes of its information, both structured records and unstructured information.

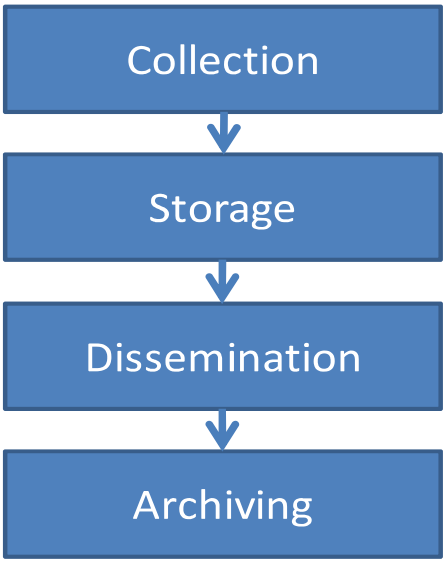
Through this it ensures that the value of that information is identified and exploited to the fullest extent, both in support of its internal operations and in adding value to its service delivery functions.

Projects generate, utilise and absorb significant quantities of information. It is important that there is an appropriate process in place to manage the information. In managing information, consideration also needs to be given to communication and formal reporting to stakeholders. Without the availability of appropriate, timely and accurate information,

projects would necessarily be chaotic and any decisions taken would be merely arbitrary, even capricious.

Information Management Process

The following diagram is an example of a simple information management process.



Collection

All appropriate project-related information must be collected e.g. end of phase reports, risk logs. The methods used to collect information must be determined to prevent information from being missed. The project manager has overall responsibility for information management but it is important that others contribute.

Information may be collected from many sources including

- Internal project workforce
- External project workforce e.g. contractors and sub-contractors
- Suppliers
- Client
- End users
- Other internal teams or departments e.g. finance, accounts, HR, procurement.

Project managers should make it clear to everyone involved in the project what information they will be expected to provide, in what format, when and how often. For the internal workforce this can be achieved through their individual key work objectives e.g. specifying that production of performance data is required as well as performing the allocated work packages or tasks. For external contractors this requirement e.g. for regular performance related data could form part of the contractual obligation.

Storage

All information relating to the project must be stored so that members of the project management and project team who need access to the information are able to gain that

access. It is highly likely that project information will be stored electronically. Some project information will be sensitive or confidential in nature some will not. This should not be left to chance. It is therefore important to decide:

- What information should be stored securely
- How should it be stored to limit access
- Who should be authorised to access it
- What information is suitable for general release e.g. to aid good communications

Finding the answers to these questions will create the secure environment needed for the project information. The responsibility for managing information during the project lies with the project manager however ultimately the organisation has overall accountability for the security of information.

In the event of any breach of security it is the organisation which would face the consequences. It is therefore important that others contribute to the decisions on the aforementioned questions and should include the sponsor, steering group, project team and in some instances the external client. Any procedures developed will have to comply with legal requirements such as the Data Protection Act.

Dissemination

The information that has been collected must be disseminated to the correct people. This can be done using a variety of mediums, use of email, formal written reports, face-to-face meetings, newsletters etc. Reporting procedures should be part of the communication plan and should specify what format the reports should take as well as the frequency. The following three formats should be considered

Report everything – on the plus side reports of this type are detailed and thorough but are cumbersome and time consuming for the project manager to compile each week/month. The volume of information may also be overwhelming for the reader and important matters could be overlooked because of the scale of the reports.

Exception reporting – at the opposite end of the scale and means that reports are only provided when things are not going to plan (or are outside of agreed tolerances), for example, if things are too far ahead of or too far behind schedule, if you have over-spent or under-spent or if the quality of the deliverables is better or worse than planned. Reporting by exception as a method is useful in reducing the burden of reporting, but it is important to note that it requires a level of trust between the project manager and the stakeholders. There must be a clear understanding when using this method that no news is good news and that anything to the contrary will be reported and not simply ignored.

R.A.G. (Red Amber Green) – this method lies somewhere between the other two and is a compromise but effective method. All information required for project reports is agreed and set out in a table format including any performance indicators cost, time, quality etc. In the same way as in exception reporting tolerances will be agreed for each area. The project manager is then able to provide an abbreviated project report in the following way

- Green – performance is on plan
- Amber – performance is not on plan but within tolerance
- Red – performance is outside of tolerance

Any red areas will be supported by a narrative which should address the causes and proposed recovery plan. Some organisations may expect a brief narrative for amber areas particularly if monthly reports indicate the situation is worsening rather than improving.

This is a format often preferred by stakeholders as everything is available but attention is focussed on the areas of most concern.

Archiving (and Appropriate Destruction)

Project Archiving is an essential part of the Project Close-out process. Although a project's 'Lessons Learned' may have been disseminated, a future project manager or other members of staff may wish to reference information from previous projects.

This information may include, but not be limited to:

- Cost Variances.
- Schedule Variances.
- Durations to help build Norms information.
- Contractor or sub-contractor performance.
- Individual performance records.
- Contract information to support dispute resolution.
- Detail of risks, referenced from the Corporate Risk Register.
- Project Plans.
- Risk Plans.

Who is involved in information management?

Three main roles are involved:

- The owner of the information, who is responsible for a specific item of information and accountable for its accuracy, availability and security.
- The custodian of the information, who is responsible for maintaining the underpinning IT and service delivery facilities.
- The user (both internal and external), whose access and use of the information are specified by the owner and enforced by the custodian, where appropriate.

Management is responsible for the governance of information as a corporate asset.

These requirements apply to all the information assets of the organisation.

Outcomes from effective management of information

Information is a key resource of the organisation along with people, finances and material assets; information is a business issue.

Through effective management of the organisation's information resources and information systems corporate managers can:

- Add value to the services delivered to customers.
- Reduce risks to the business.
- Reduce the costs of business processes and service delivery.
- Stimulate innovation in internal business processes and external service delivery.

Knowledge management

Knowledge management is another important aspect of information management. It is about making information usable, so that some form of action can be taken on the basis of that knowledge. It is often the product of project and post-project reviews incorporating lessons learned from each. Reference to this material by project managers assists with future project management, develops the individual and increases the organisations project maturity.

Knowledge management comprises:

- Intellectual capital (knowledge assets held by the organisation, including the expert knowledge of individuals).
- Computer-supported collaborative work (ways of facilitating exchanges of knowledge amongst working groups).
- Employee empowerment (ways of enabling individuals to benefit from the organisation's collective knowledge).

Configuration Management

Configuration management comprises the technical and administrative activities concerned with the creation, maintenance and controlled change of the configuration throughout the project life cycle.

A configuration is the functional and physical characteristics of the final deliverable as defined in technical documents and achieved in the execution of project plans. These plans should contain all items that can be identified as being relevant to the project and that should only be modified after relevant authorisation.

management can therefore be regarded as asset control and is essential whether one or more versions of a deliverable will be created. At its simplest, configuration management must involve version control (APM BoK).

Configuration management process

Planning

Configuration management planning is the foundation for the configuration management process. Effective planning coordinates configuration management activities, in a specific context over the product life cycle. The output of configuration management planning is the configuration management plan.

The configuration management plan for a specific product should:

- Be documented and approved.
- Be controlled.
- Identify the configuration management procedures to be used.
- Make reference to relevant procedures of the organisation wherever possible.
- Describe the responsibilities and authorities for carrying out configuration management throughout the project life cycle.

The configuration management plan may be a stand-alone document, part of another document or composed of several documents.

In some situations the organisation will require a supplier to provide a configuration management plan. The organisation may wish to retain such plans, either as stand-alone documents or to incorporate them into its own configuration management plan.

Identification

The selection of configuration items and their inter-relationships should describe the product structure. Configuration items should be identified using established selection criteria. Configuration items should be selected, whose functional and physical characteristics can be managed separately to achieve the overall, end use performance of the item.

Selection criteria should consider:

- Statutory and regulatory requirements.
- Criticality in terms of risks and safety.
- New or modified technology, design or development.
- Interfaces with other configuration items.
- Procurement conditions.
- Support and service.

The number of configuration items selected should optimise the ability to control the product. The selection of configuration items must be initiated as early as possible in the product life cycle. The configuration items should be reviewed as the product evolves.

Control

After the initial release of product configuration information, all changes should be controlled. The potential impact of a change, customer requirements and the configuration baseline will affect the degree of control needed to process a proposed change or concession.

The process for controlling the change should be documented, and should include the following:

- A description of, justification for, and record of, the change.
- A categorisation of the change, in terms of complexity, resources and scheduling.
- An evaluation of the consequences of the change.
- Details of how the change should be authorised.
- Details of how the change should be implemented and verified.

Status Accounting

The configuration status accounting activity results in records and reports that relate to a product and its product configuration information. The organisation should perform configuration status accounting activities throughout the life cycle of the project, in order to support and enable an efficient configuration management process.

During the configuration identification and change control activities, configuration status accounting records will be created. These records allow for visibility, traceability and for the efficient management of the evolving configuration.

They typically include details of the project configuration information (identification number, title, effective dates, revision status, change history and its inclusion in any baseline), the product's configuration (part numbers, product design or build status), the status of release of new product configuration information and the processing of changes.

The evolving product configuration information should be recorded in a manner that identifies the cross-references and interrelationships necessary to provide the required reports.

To protect the integrity of the product configuration information and to provide a basis for the control of change, it is recommended that configuration items and related information be held in an environment that:

- Is commensurate with the conditions required (e.g. for computer hardware, software, data, documents, drawings).
- That provides protection from corruption or unauthorised change.
- That provides means for disaster recovery.
- That permits retrieval.

Audit

Configuration audits should be performed in accordance with documented procedures, to determine whether a product conforms to its requirements and product configuration information.

Normally there are two types of configuration audits:

- A functional configuration audit is a formal examination to verify that a configuration item has achieved the functional and performance characteristics specified in its product configuration information.
- A physical configuration audit is a formal examination to verify that a configuration item has achieved the physical characteristics specified in its product configuration information.

A configuration audit may be required before the formal acceptance of a configuration item. It is not intended to replace other forms of verification, review, test or inspection, but will be affected by the results of these activities.

Closeout

The function of the configuration process in the project closeout is to ensure that the acceptance criteria of the deliverables have been met, that the deliverables are fit for purpose.

Similarities between configuration Management and version control.

Configuration management is the administrative work that has to be done to create unique identities for configuration items, and to control changes as they occur.

Version control is similar, in the respect that it is a methodology of recording change, usually to plans or documents.

E.g. If you were building a house, the architects plan for the house would be a configuration item. If the plan was changed, you would need to operate change control and have a system to update and record the change. For this you would use version control to record the update. The original plan for the house could be version 1; the updated plan could be version 1.1.

Some people do relate configuration management to version control, but it is probably more accurate to describe it as very detailed change control.

Learning Objectives

You should now have an understanding of the following:

- Sources of information
- Gathering data and assessing its integrity
- Organising, storing, and retrieving information
- Processing information and data
- Developing systems for security and confidentiality of information
- Understanding the importance of version control

Unit 16 – monitoring, control and reporting

Unit 15 - Learning Objectives

To gain an understanding of project monitoring and control including:

- What project monitoring and control is
- What effective reporting looks like
- What EVA (earned value management) is and its attendant terminology
- What cost control consists of

Monitoring and Control overview

Monitor and Control is the process of tracking, reviewing, and regulating the progress to meet the baselined objectives defined in the Project Execution Plan

Monitoring includes:

- Measuring progress in terms of achievements
- Measuring actual cost v planned cost
- Measuring time taken v baseline schedule
- Checking risk status and exposure
- Monitoring the number of changes and their impact on the project

Corrective actions can only occur once the project status is understood.

These processes track, review, and regulate the progress and performance of the project, identify any areas in which changes to the plan are required and initiate the corresponding changes.

The key benefit of this is that project performance is observed and measured regularly and consistently to identify variances from the project management plan. Monitoring and controlling also includes:

- Controlling changes and recommending preventive action in anticipation of possible problems (note change control is covered in another unit of this course)
- Monitoring the ongoing project activities against the project management plan and the project performance baseline
- Influencing the factors that could circumvent integrated change control so only approved changes are implemented.

This continuous monitoring provides the project team insight into the health of the project and identifies any areas requiring additional attention.. In multi-phase projects, monitoring and controlling coordinates project phases in order to implement corrective or preventive actions to bring the project into compliance with the project management plan. This review can result in recommended and approved updates to the project management plan.

For example, a missed activity finish date may require adjustments to the current staffing plan, reliance on overtime, or trade-offs between budget and schedule objectives.

Monitoring and controlling includes the following project management processes.

Monitor and control project work

Monitor and Control Project Work is the process of tracking, reviewing, and regulating the progress to meet the processes performance objectives defined in the Project Management Plan. Monitoring includes status reporting, progress measurement, and forecasting. Performance reports provide information on the project's performance with regard to scope, schedule, cost, resources, quality, and risk, which can be used as inputs to other processes.

Inputs and outputs:

Inputs	Outputs
1. Project Management Plan 2. Work performance data 3. Performance reports 4. Forecasts 5. Enterprise environmental factors 6. Organisational process assets	1. Change requests 2. Project management plan updates 3. Project document updates

Perform Integrated Change Control

Perform Integrated Change Control is the process of reviewing all change requests, approving changes, and managing changes to the deliverables, organisational process assets, project documents, and the project management plan.

Inputs and outputs:

Inputs	Outputs
1. Change requests 2. Organisational process assets	1. Change request status update 2. Project management plan updates 3. Project document updates

Verify Scope

Verify Scope is the process of formalising acceptance of the completed project deliverables.

Inputs and outputs:

Inputs	Outputs
1. Scope baseline 2. Stakeholder requirements documentation 3. Requirements traceability matrix 4. Validated deliverables	1. Accepted deliverables 2. Change requests

Control Scope

Control Scope is the process of monitoring the status of the project and product scope and managing changes.

Inputs and outputs:

Inputs	Outputs
1. Project management plan 2. Scope baseline 3. Work performance data 4. Stakeholders requirements documentation 5. Requirements traceability matrix	1. Work performance measurements 2. Change requests 3. Organisational process assets updates 4. Project management plan updates 5. Project document updates

Control Schedule

Control Schedule is the process of monitoring the status of the project to update project progress and managing changes to the schedule.

Inputs and outputs:

Inputs	Outputs
1. Project management plan 2. Project schedule 3. Work performance data 4. Organisational process assets	1. Work performance measurements 2. Organisational process assets updates 3. Change requests 4. Project management plan updates 5. Project document updates

Control Costs

Control Costs is the process of monitoring the status of the project to update the project budget and managing changes to the cost baseline.

Inputs and outputs:

Inputs	Outputs
1. Cost performance baseline 2. Project funding requirements 3. Work performance data 4. Organisational process assets	1. Work performance measurements 2. Forecasted completion 3. Organisational process asset updates 4. project management plan updates 5. Project document updates

Perform Quality Control

Perform Quality Control is the process of monitoring and recording results of executing the Quality Plan activities to assess performance and recommend necessary changes.

Inputs and outputs:

Inputs	Outputs
1. Quality management plan 2. Quality metrics 3. Quality checklists 4. Work performance measurement 5. Approved change requests 6. Deliverables 7. Organisational process assets	1. Quality control measurements 2. Validated deliverables 3. Organisational process asset updates 4. Change requests 5. Project management plan updates 6. Project document updates

Report Performance

Report Performance is the process of collecting and distributing performance information including status reports, progress measurements, and forecasts.

Inputs and outputs:

Inputs	Outputs
1. Project management plan 2. Work performance data 3. Work performance measurements 4. Organisational process assets	1. Performance reports 2. Organisational process assets updates 3. Change requests

Monitor and Control Risks

Monitor and Control Risks is the process of executing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating the risk process throughout the project.

Inputs and outputs:

Inputs	Outputs
1. Risk register 2. Risk management plan 3. Work performance data 4. Performance reports	1. Risk register updates 2. Organisational process assets updates 3. Change requests 4. Project management plan updates 5. Project document updates

Administer Procurements

Administer Procurements is the process of managing procurement relationships, monitoring contract performance, and making changes and corrections as needed. It includes the contract and relationship between the buyer and seller, reviewing and documenting how a seller is performing or has performed and, when appropriate, managing the contractual relationship with the external buyer of the project.

Inputs and outputs:

Inputs	Outputs
1. Procurement documents 2. Procurement management plan 3. Selected sellers 4. Performance reports 5. Approved change requests 6. Work performance data	1. Procurement data 2. Organisational process assets updates 3. Change requests 4. Project management plan updates

Project Reporting

Project managers walk a fine line when it comes to requesting (*and actually getting*) status reports from staff members. On one hand, status reporting procedures shouldn't be too cumbersome or intrusive. Project staff may come to resent the attention and the perceived lack of trust and confidence. However, no project manager can afford to be caught unaware by performance or scheduling problems. He or she must rely on the team to provide timely, effective and realistic feedback, the quality and quantity of that feedback cannot be left to chance.

While status reporting requirements may vary by project complexity, duration and scope, regular reporting routines should always be established. These routines should be set as soon as the project starts, be enforced consistently and should include the following:

Communication Guidelines:

The specification of meeting methods and protocols, including the usage of group meetings, one-on-one's, phone conferences, emails, memos, forms or project management software.

Content Guidelines:

The specification of the format and content of status reporting, including information to be included in reports and standardised agenda formats for meetings.

Scheduling Guidelines:

Determination of the expected frequency, timing and duration, of meetings, phone conferences and the submission of status reports. While flexibility must be considered, these guidelines can help staff members better allocate their time and will help the project manager schedule sufficient time for status reviews, analysis and feedback.

Feedback Guidelines:

Status reporting should be a two way street, with staff status reports being acknowledged and feedback provided when appropriate. In addition, a regular routine for management reporting should be established, to keep team members advised on the status of global project issues.

Consolidation Guidelines:

Depending on the size and organisation of the project team, status report consolidation may be necessary and appropriate. For example, individual status reports may have to be viewed as a whole if progress statistics are to have any real meaning.

Earned value management

What is EVM and why use it?

EVM is a project control process based on a structured approach to planning, cost collection and performance measurement. It facilitates the integration of project scope, time and cost objectives and the establishment of a baseline plan of performance measurement (APM BoK).

It is a method of controlling a project by tracking performance against agreed plans and identifying any significant differences so that corrective action to meet defined objectives can be taken.

Earned Value (EV) is a measure of progress that expresses costs committed and work achieved in the same units (APM BoK).

Example: A task is planned to cost £10,000. Once the task has started, progress is checked, and it is found that 30% of the task has been completed. The EV is therefore £10,000 x 0.3 (30%) = £3,000. This represents the 'value' of the work done. Value can also be expressed in man/hour units.

This concept becomes very powerful when the EV at a point in time is compared to what was planned to be achieved at that same point and what the actual cost of that achievement was. These comparisons allow cost variance (CV) and schedule variance (SV) to be calculated as well as efficiencies and productivity. This in turn, allows final cost and duration to be predicted.

A project manager may use EVM because:

- It is superior to separate tracking of spend or work achieved as it provides opportunities to look at efficiency of spend (through the cost performance indicator - CPI) and productivity (through the schedule performance indicator - SPI). By progressively monitoring these, trends can be understood and used to predict outcomes.
- It can also be used as an incentivised way of paying suppliers based on EVM performance measurements. Because the EV is percentage complete x planned value, a supplier will try and maximise revenue and improve cashflow by improved performance. This approach often combined with key milestones drives a collaborative approach which results in a win-win outcome.
- It improves project control by using a structured approach to planning, cost collection and performance measurement. Costs are established at a work package level to ensure that budget is allocated and monitored at an appropriate level. It establishes a baseline for cost, schedule and scope against which actual performance is measured. It also ensures that changes to scope are subject to a formal revision which minimises scope creep.

A project manager may update plans based on EVM information because:

- The forecast of time and cost outcomes may indicate that the project is due to overspend and overrun. This would entail updating the budget and the schedule to inform stakeholders of the likely outcome and prepare them accordingly. While this may cause initial conflict, it will help manage their expectations.
- They may have to add more resources to the plan to bring the project back on schedule. The resourced schedule will be updated in this case and assist in

procuring the necessary resources (e.g. labour). This in turn may cause the risk plan to be updated due to increased activity on the project (e.g. potential safety incidents and available skills).

- The forecast of time and cost outcomes may indicate that the project is due to underspend and be delivered early. This would entail updating the budget and the schedule to inform stakeholders of the likely outcome and prepare them accordingly. This will help manage their expectations.

Interpretation of EVM data

One way that EVM can be understood is by use of an example:

A project is to build a 10-km highway in 10 months (at a rate of 1-km/month).

The agreed cost [the budget at completion (BAC)] is £100million.

The EV of every kilometre (10% of the total length) is £10m, regardless of how much it actually costs to build (EV = actual work done in percentage-complete terms x BAC)

At month 5, 4km of highway has been laid:

- The planned budget is £50m
- the EV is £40m (40% complete x BAC)
- the actual cost is £30m

The project manager wants to know the following:

- Planned percentage complete and actual percentage complete
- Schedule and cost variances
- The final estimated cost if things continue
- When the highway will be completed

Percentage complete

The project should be 50% complete (planned budget of £50m / BAC of £100m (expressed as a percentage)

The actual percentage complete is 40% (EV of £40m / BAC of £100m expressed as a percentage)

Schedule and cost variances (at month 5)

Cost variance = EV (£40m) – actual cost (£30m) = £10m

Schedule variance (in cost terms) = EV (£40m) – planned budget (£50m) = - £10m

Negative variances show that the project is underperforming while positive variances show that the project is overperforming.

Final estimated cost (EAC*)

First the ‘efficiency’ of the project must be calculated:

Cost performance index (CPI) = EV (£40m) / actual cost (£30m) = 1.33 (i.e. 133% efficient)

EAC = BAC (£100m) / CPI (1.33) = £75m (equating to £25m under budget)

*Estimate at Completion

The project is costing less than the value it is generating. The project manager should investigate why this is and recommend action. It may be that the original estimate was

inaccurate or that resources are costing less than the original estimates. The project manager should also look at the work remaining to assess whether this higher than planned rate of efficiency is likely to continue. The project manager's response should, however, consider the forecast of completion.

A CPI greater than 1 means the task is forecast to underspend while a CPI of less than 1 means the task is forecast to overspend its budget. Tracking the CPI is a very powerful way of monitoring the project and spotting trends.

Completion forecast

First the productivity must be calculated:

SPI = EV (£40m) / planned budget (£50m) = 0.8

Estimated final duration = 10 months / 0.8 = 12.5 months

This means that that the project is likely to overrun by 2.5 months

The project can now consider spending more money (see EAC above) to accelerate the project and bring it in on time.

A SPI greater than 1 means the task is forecast to be completed earlier than planned while a SPI of less than 1 means the task is forecast to be completed later than planned. Tracking the SPI is a very powerful way of monitoring the project and spotting trends.

Summary of SPI, CPI, SV and CV

CPI>1 = Forecast underspend, CPI<1 = Forecast overspend

SPI>1 = Forecast early delivery, SPI<1 = Forecast late delivery

SV>0 = Value to date more than scheduled, SV<0 = Value to date less than scheduled

CV>0 = Value to date greater than actual cost, CV<0 = Value to date less than actual cost

Sample responses to EVM data

If a project has a CPI of over 1 and an SPI of under 1 then more money can be spent on resources to speed the project up.

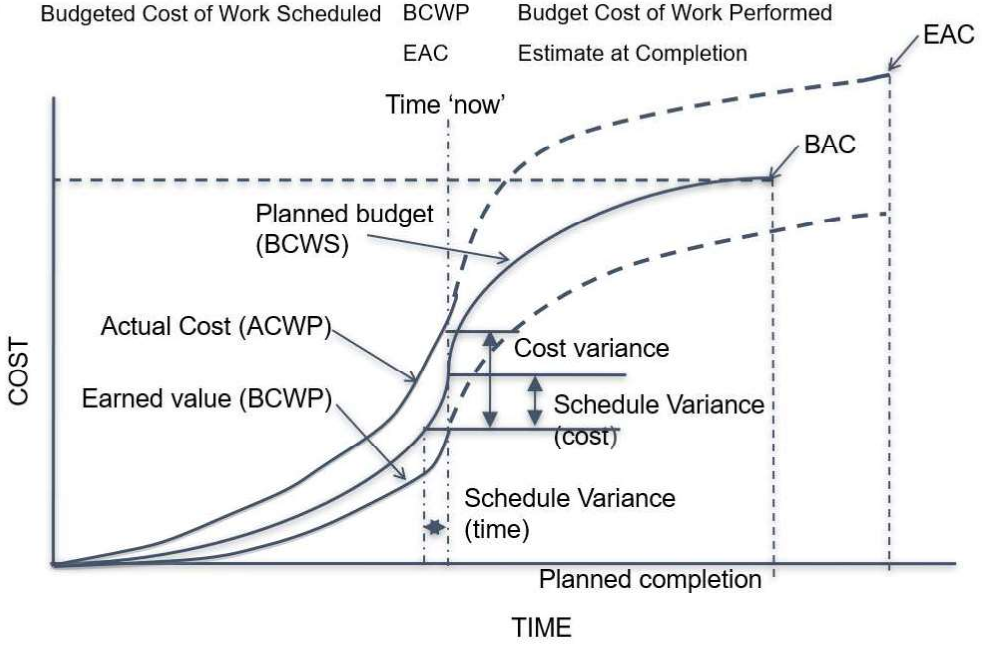
Conversely, if a project has a CPI of under 1 and an SPI of over 1 then resource can be potentially reduced to reduce cost and allow time to be extended.

If both CPI and SPI are under 1 then there may be a number of viable options including reducing scope, increasing efficiency and applying for more resources.

If both CPI and SPI are both over 1 then resources can be reduced to slow the project down.

Graphical representation of EVM

BAC	Budget at completion	ACWP	Actual Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled	BCWP	Budget Cost of Work Performed
		EAC	Estimate at Completion



Benefits of using the interpretation of earned value data

- Provides consistent reporting so that, at a senior management level, project progress can be compared across a set of projects that are of different size and complexity. This supports portfolio management and project governance. This will allow senior management to investigate projects that are performing poorly and provide appropriate support as required. This can include additional resources such as people and equipment.
- Supports better forecasting against time and budget. By using and correctly interpreting EV data, forecasts are based on objective analysis rather than a subjective approach (e.g. an individual view). By using actual data (based on evidence of progress) and the efficiency of work in progress (using CPI, SPI), likely outcomes can be visually plotted graphically. This assists with reporting.
- Allows incentivised payments to be made to suppliers based on what they have achieved rather than on costs alone. This in turn improves performance and supplier cash flow.
- Allows trends to be understood and outcomes predicted. It provides opportunities to look at efficiency of spend (through the cost performance indicator - CPI) and productivity (through the schedule performance indicator - SPI). By progressively monitoring these, trends can be used to drive actions where there is under/over performance.

Learning Objectives

You should now have an understanding of project monitoring and control including:

- What project monitoring and control is
- What effective reporting looks like
- What EVA (earned value management) is and its attendant terminology
- What cost control consists of

Unit 17 – Handover and closure

Unit 17 - Learning Objectives

To gain an understanding of:

- The activities conducted as part of handover and project closure
- The benefits of closing a project efficiently

Handover and closeout overview

Handover and closeout is the fourth and final phase in the project life cycle. During this phase final project deliverables are handed over to the sponsor and users. Closeout is the process of finalising all project matters, carrying out final project reviews, archiving project information and redeploying the project team (APM BoK).

Handover consists of:

- Formal accepted by those responsible for using/ operating the product (a formal transfer of ownership is essential)
- Handing over of all associated product documentation e.g. manuals and certification
- Completion of commercial settlements
- Support such as training and warranties

Closeout consists of:'

- Completion of all project documentation and archiving it as agreed
- Closing down the project team and associated infrastructure
- Reviewing project performance (hold post-project review/end project review)
- A final capture, consolidation and dissemination of lessons (lessons learned)
- A final project report to the sponsor
- Final a gate review to accept the final report and confirm the project closure

This phase serves the important function of allowing the project to enter into the operational environment. This decision will be based on the projects deliverables having achieved the agreed acceptance criteria; this will take place prior to the handover. By applying tests and checks to ensure that the deliverables are of an acceptable standard the project manager reduces the chances that the deliverables will be deemed unacceptable by the end user.

Generally a project manager will require the end user to sign a certificate of acceptance, this will confirm that the deliverables have been handed over and are acceptable. This "transfer of ownership" of the deliverables can be vital for contractual purposes.

During closeout the project manager will ensure that surplus project materials are disposed of. The project manager will ensure that contracts and purchase orders are finalised along with finalising project accounts. Project documents will require completion and archiving and the post-project reviews are carried out (which will become part of the projects lessons learned). The project manager will carry out performance appraisals of the team, the team will then be redeployed in a controlled manner.

Although handover and closeout is characterised as the final phase of the project life cycle these activities will go on throughout the project. Within each phase of the project there will be a specific piece of work that will be carried out. To move successfully to the next phase that piece of work will need to have been done to an acceptable standard, allowing the project to pass through the gate into the next phase.

This will require testing to ensure that the phase's deliverables have reached the agreed acceptance criteria and end of phase reports will be required which can then be fed into the end of project reports.

From a project control perspective, a substantial effort is necessary to track and record the testing and hand-over of the works. Meeting schedule requirements and complying with the sequential nature of bringing a process unit on stream in a logical and orderly manner requires the coordination of all resources through detailed planning.

From a cost control viewpoint, the Taking-Over certificate forms part of the documentary evidence supporting full and final settlement of al contract costs.

Benefits of handover and closeout

Efficient completion of this phase of a project is important for many reasons including:

- Ensuring that there is a clear transference of product ownership from the project team to the operational team
- Project costs are closed off
- Lessons are captured for the organisation to learn from and improve future project activities
- To celebrate success among those involved in the project
- To ensure that there is an audit trail of decisions and documentation
- To ensure that all commercial activities are completed and warranties etc. are in place

Learning Objectives

You should now gained an understanding of:

- The activities conducted as part of handover and project closure
- The benefits of closing a project efficiently

Unit 18 – professionalism and ethics

Unit 18 - Learning Objectives

To gain an understanding of the following:

- What professionalism and ethics are in a project context

Overview

According to the PMI:

"Honesty, responsibility, respect and fairness are the values that drive ethical conduct for the project management profession," according to the Project Management Institute (PMI). PMPs are held to a code of ethics (PDF) to ensure decisions and actions are always honourable and in the best interest of stakeholders.

For the project professional:

- this means they have a responsibility to hold themselves accountable for their own successful or failed decisions and actions, as well as any repercussions.
- It means being respectful and demonstrating a high regard for oneself, others, and any resources entrusted with.
- It means fostering excellence through mutual respect, trust, confidence, cooperation, and diversity.
- It means the views of others are encouraged and valued.
- It means practicing fairness at all times, making decisions, and remaining impartial and objective. Behaviour must be free from self-interest and self-gain, prejudice, or favouritism.
- It means demonstrating honesty through words and conduct at all times.

Professional and social responsibility is often broken down into the following categories:

- Responsibility
- Respect
- Fairness
- Honesty

Responsibility includes:

- Maintaining confidentiality
- Complying with laws and regulations
- Acting in ways that are consistent with policies and procedures.
- Making decisions and conducting themselves with actions that take ownership of decisions.

Respect includes:

- Treating yourself, and others, with dignity
- Promoting diversity and mutual sharing of ideas
- Showing respect to others even in situations when it is not received in return
- Facing conflict directly in the face and not running from it

Fairness includes:

- Making decisions objectively in a non-abusive, and non-discriminatory manner
- Demonstrating transparency, or clear and open communication, in the decision-making process
- Promoting trust
- Examples of project management transparency include:

- Status reports
- Clear meeting minutes

Honesty includes:

- Conducting yourself with truthful behaviour in verbal and written communications
- Examples include:
- Providing accurate information
- Making commitments with the intent of meeting them
- Having courageous conversations about negative information when it may not be received well.
- Avoid blaming others, base decisions on information that is reliable and accurate, and avoid taking credit for a job well done when others were responsible for the achievement.

Other considerations:

- Having project experience and feeling equipped to deliver what's required
- Believing the project schedule is achievable
- Having the authority necessary to fulfil your responsibilities
- Believing that financial decisions are the optimum for your and the client
- Understanding and taking into account your stakeholders needs including communication
- Understanding the true cost of ownership by full lifecycle costing, from sourcing materials to disposal
- Dealing fairly, openly and honestly during the project
- Taking responsibility for your work and not blaming others
- Understanding and complying with legislation and regulations
- Raising concerns and doing the right thing under pressure

Learning Objectives

You should now have an understanding of the following:

- What professionalism and ethics are in a project context