LEARNER MANUAL

DEMONSTRATE AN UNDERSTANDING OF ESTIMATING A UNIT OF WORK AND THE IMPLICATIONS OF LATE DELIVERY

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NOTIONAL HOURS: 50

Table of Contents

This manual was compiled by SM Support on behalf of the training provider.

HOW TO USE THIS GUIDE

This workbook belongs to you. It is designed to serve as a guide for the duration of your training programme. It contains readings, activities, and application aids that will assist you in developing the knowledge and skills stipulated in the specific outcomes and assessment criteria. Follow along in the guide as the facilitator takes you through the material, and feel free to make notes and diagrams that will help you to clarify or retain information. Jot down things that work well or ideas that come from the group. Also, note any points you would like to explore further. Participate actively in the skill practice activities, as they will give you an opportunity to gain insights from other people's experiences and to practice the skills. Do not forget to share your own experiences so that others can learn from you too.

ICONS

PROGRAMME OVERVIEW

PURPOSE

At the end of this training session you will be able to demonstrate an understanding of estimating a unit of work and the implications of late delivery

LEARNING ASSUMPTIONS

The credit value of this unit is based on a person having the prior knowledge and skills to:

- Demonstrate an understanding of fundamental mathematics (at least NQF level 3)
- Demonstrate PC competency skills (End-User Computing unit Standards, at least up to NQF level 3.)

HOW YOU WILL LEARN

The programme methodology includes facilitator presentations, readings, individual activities, group discussions, and skill application exercises.

HOW YOU WILL BE ASSESSED

This programme has been aligned to registered unit standards. You will be assessed against the outcomes of the unit standards by completing a knowledge assignment that covers the essential embedded knowledge stipulated in the unit standards. When you are assessed as competent against the unit standards, you will receive a certificate of competence and be awarded 5 credits towards a National Qualification.

SESSION 1: DEMONSTRATE THE ABILITY TO INTERPRET GIVEN COST/BENEFIT ANALYSIS DOCUMENTATION.

On completion of this section you will be able to demonstrate the ability to interpret given cost/benefit analysis documentation.

1. The demonstration identifies different parts of a cost/benefit analysis.
2. The demonstration explains the purpose of the different parts of a cost/benefit analysis.

1.1 INTRODUCTION

Cost-benefit analysis (CBA) is a technique used to compare the total costs of a programme/project with its benefits, using a common metric (most commonly monetary units).

This enables the calculation of the net cost or benefit associated with the programme.
As a technique, it is used most often at the start of a programme or project when different options or courses of action are being appraised and compared, as an option for choosing the best approach. It can also be used, however, to evaluate the overall impact of a programme in quantifiable and monetised terms.

CBA adds up the total costs of a programme or activity and compares it against its total benefits. The technique assumes that a monetary value can be placed on all the costs and benefits of a programme, including tangible and intangible returns to other people and organisations in addition to those immediately impacted. As such, a major advantage of cost-benefit analysis lies in forcing people to explicitly and systematically consider the various factors which should influence strategic choice.

Decisions are made through CBA by comparing the *net present value* (NPV) of the programme or project's costs with the net present value of its benefits. Decisions are based on whether there is a net benefit or cost to the approach, i.e. total benefits less total costs. Costs and benefits that occur in the future have less weight attached to them in a cost-benefit analysis. To account for this, it is necessary to 'discount' or reduce the value of future costs or benefits to place them on a par with costs and benefits incurred today.

The 'discount rate' will vary depending on the sector or industry, but public sector activity generally uses a discount rate of 5-6%. The sum of the discounted benefits of an option minus the sum of the discounted costs, all discounted to the same base date, is the 'net present value' of the option.

1.2 DIFFERENT PARTS OF A COST/BENEFIT ANALYSIS.

Prior to erecting a new plant or taking on a new project, prudent managers conduct a cost-benefit analysis as a means of evaluating all the potential costs and revenues that may be generated if the project is completed. The outcome of the analysis will determine whether the project is financially feasible or if another project should be pursued.

Cost Benefit Analysis Components

A CBA application includes the following stages:

General description of the project:
This part includes an explanation on the environment under which each analysis is done such as the objectives, the assumptions, the project/decision life etc.
List of alternative scenarios: In order to decide which is the best option in the CBA we have to consider the costs and the benefits for each of these options. This section lists the options considered during the analysis.

Identify Benefits and Costs:
In this part, the application lists the exact benefits and costs met in each of the alternative scenarios. The application divides these into two kinds: The ones that are relatively straightforward to be measured and the ones that are not very easy to be measured. Many factors must be considered during the process of estimating the costs associated with competing alternatives in a CBA.

- All costs for the full system life cycle for each competing alternative must be included. The following factors must be addressed: Activities and Resources, Cost Categories, Personnel Costs, Direct and Indirect Costs (Overhead), Depreciation, and Annual Costs.

- Benefits are the services, capabilities, and qualities of each alternative system, and can be viewed as the return from an investment. To estimate benefits, first identify the benefits for both the customers and the organization that provides the service(s) to the customers. Benefits to customers are improvements to the current IT services and/or the addition of new services. Some possible benefits for the servicing organization are productivity gains, staffing reductions, or improved organizational effectiveness. After the benefits are identified, the user has to establish performance measures for each benefit. The final step is to estimate the value of the benefits. If a benefit cannot

reasonably be assigned a monetary value, it should be valued using a more subjective, qualitative rating system (which assigns relative numerical values for the competing alternatives). All benefits for the full system life cycle for each competing alternative must be included.

Schedule Benefits and Costs:

For each of the alternatives defined in step 2, the user now identifies the value of each benefit and cost for each year through the life cycle of the decision beginning from Year 0, which is the start of the decision life. After the costs and benefits for each year of the system life cycle have been estimated, convert them to a common unit of measurement to properly compare competing alternatives. That is accomplished by discounting future values, which transforms future benefits and costs to their "present value." The present value (also referred to as the discounted value) of a future amount is calculated with the following formula:

$$PV = FV \times \frac{1}{(1-i)^n}$$

Where: *PV* = Present Value, *FV* = Future Value, *i* = Interest Rate, and *n* = number of years.

Comparison of alternatives:

In this part the application compares the alternative solutions. The comparison is illustrated with tables and graphs so as to facilitate decision making. When the costs and benefits for each competing alternative have been discounted, compare and rank the discounted net value (discounted benefit minus discounted cost) of the competing alternatives. When the alternative with the lowest discounted cost provides the highest discounted benefits, it is clearly the best alternative.

Sensitivity Analysis:

In this part the application helps the user define how sensitive the results are to changes in the costs and benefits. This sensitivity involves costs and benefits whose definition is not straightforward or is not easy to be exactly defined. Sensitivity analysis tests the sensitivity and reliability of the results obtained from the cost-benefit analysis. Since the CBA is normally the key document in the investment review process, reviewers want assurance that the analysis is reliable. Sensitivity analysis identifies those input parameters that have the greatest influence on the outcome, repeats the analysis with different input parameter values, and evaluates the results to determine which, if any, input parameters are sensitive. If a relatively small change in the value of an input parameter changes the alternative selected, then the analysis is considered to be sensitive to that parameter. If the value of a parameter has to be doubled before there is a change in the selected alternative, the analysis is not

considered to be sensitive to that parameter. The estimates for sensitive input parameters should be re-examined to ensure that they are as accurate as possible.

SESSION 2: PREPARE A TIME ESTIMATE FOR AN ELEMENT OF WORK.

On completion of this section you will be able to prepare a time estimate for an element of work.

1. The time estimate is based on a breakdown of the component in the logical parts for estimating.
2. The time estimate is based on an understanding that the estimate should include the implementation/testing of interfaces to other components where applicable.

2.1 TIME ESTIMATE FOR AN ELEMENT OF WORK.

Accurate time estimation is a skill essential for good project management. It is important to get time estimates right for two main reasons:

1. Time estimates drive the setting of deadlines for delivery and planning of projects, and hence will impact on other people's assessment of your reliability and competence as a project manager.
2. Time estimates often determine the pricing of contracts and hence the profitability of the contract/project in commercial terms.

Time estimates are important as inputs into other techniques used to organise and structure all projects. Using good time estimation techniques may reduce large projects to a series of smaller projects.

Why Estimate Time Accurately?

Accurate time estimation is a crucial skill in project management. Without it, you won't know how long your project will take, and you won't be able to get commitment from the people who need to sign it off.

Even more importantly for your career, sponsors often judge whether a project has succeeded or failed depending on whether it has been delivered on time and on budget. To have a chance of being successful as a project manager, you need to be able to negotiate sensible budgets and achievable deadlines.

2.1.1 HOW TO ESTIMATE TIME ACCURATELY

Use these steps to make accurate time estimates:

Step 1: Understand What's Required

Start by identifying all of the work that needs to be done within the project. Use tools such as

- Business Requirements Analysis
- Work Breakdown Structures
- Gap Analysis
- Drill-Down

This will help you do this in sufficient detail. As part of this, make sure that you allow time for meetings, reporting, communications, testing and other activities that are critical to the project's success.

Step 2: Order These Activities

Now, list all of the activities you identified in the order in which they need to happen.

At this stage, you don't need to add in how long you think activities are going to take. However, you might want to note any important deadlines. For example, you might need to get work by the finance department finished before it starts work on "Year End."

Step 3: Decide Who You Need to Involve

You can do the estimates yourself, brainstorm Add to My Personal Learning Plan them as a group, or ask others to contribute.

Where you can, get the help of the people who will actually do the work, as they are likely to have prior experience to draw upon. By involving them, they'll also take on greater ownership of the time estimates they come up with, and they'll work harder to meet them.

Step 4: Make Your Estimates

You're now ready to make your estimates. We've outlined a variety of methods below to help you do this. Whichever methods you choose, bear these basic rules in mind:

- To begin with, estimate the time needed for each task rather than for the project as a whole.
- The level of detail you need to go into depends on the circumstances. For example, you may only need a rough outline of time estimates for future project phases, but you'll probably need detailed estimates for the phase ahead.
- List all of the assumptions, exclusions and constraints that are relevant; and note any data sources that you rely on. This will help you when your estimates are questioned, and will also help you identify any risk areas if circumstances change.
- Assume that your resources will only be productive for 80 percent of the time. Build in time for unexpected events such as sickness, supply problems, equipment failure, accidents and emergencies, problem solving, and meetings.
- If some people are only working "part-time" on your project, bear in mind that they may lose time as they switch between their various roles.
- Remember that people are often overly optimistic, and may significantly underestimate the amount of time that it will take for them to complete tasks.

2.1.2 METHODS FOR ESTIMATING TIME

We'll now look at different approaches that you can use to estimate time. You'll probably find it most useful to use a mixture of these techniques.

Bottom-Up Estimating

Bottom-up estimating allows you to create an estimate for the project as a whole. To analyze from the "bottom up," break larger tasks down into detailed tasks, and then estimate the time needed to complete each one.

Because you're considering each task incrementally, your estimate of the time required for each task is likely to be more accurate. You can then add up the total amount of time needed to complete the plan.

Top-Down Estimating

In top-down analysis, you develop an overview of the expected timeline first, using past projects or previous experience as a guide.

It's often helpful to compare top-down estimates against your bottom-up estimates, to ensure accuracy.

Comparative Estimating

With comparative estimating, you look at the time it took to do similar tasks, on other projects.

Parametric Estimating

With this method, you estimate the time required for one deliverable; and then multiply it by the number of deliverables required.

For example, if you need to create pages for a website, you'd estimate how much time it would take to do one page, and you'd then multiply this time by the total number of pages to be produced.

Three-Point Estimating

To build in a cushion for uncertainty, you can do three estimates – one for the best case, another for the worst case, and a final one for the most likely case.

Although this approach requires additional effort to create three separate estimates, it allows you to set more reasonable expectations, based on a more realistic estimate of outcomes.

2.1.3 PREPARING YOUR SCHEDULE

Once you've estimated the time needed for each task, you can prepare your project schedule Add to My Personal Learning Plan. Add your estimates to the draft activity list that you produced in the second step, above.

You can then create a Gantt Chart Add to My Personal Learning Plan to schedule activities and assign resources to your project; and to finalize milestones and deadlines. If your project is complex, you might find that identifying the critical path Add to My Personal Learning Plan on your plan is helpful. This will help you highlight the tasks that cannot be delayed if you're going to hit your deadline

2.1.4 PERT CHART

Before any activity begins related to the work of a project, every project requires an advanced, accurate time estimate. Without an accurate estimate, no project can be completed within the budget and the target completion date.

Developing an estimate is a complex task. If the project is large and has many stakeholders, things can be more complex.

Therefore, there have been many initiatives to come up with different techniques for estimation phase of the project in order to make the estimation more accurate.

PERT (Program Evaluation and Review Technique) is one of the successful and proven methods among the many other techniques, such as, CPM, Function Point Counting, Top-Down Estimating, WAVE, etc.

How to Create a PERT Chart

Here are the steps to put PERT into practice on your project. There are software programs that can automate the calculations and generate PERT charts.

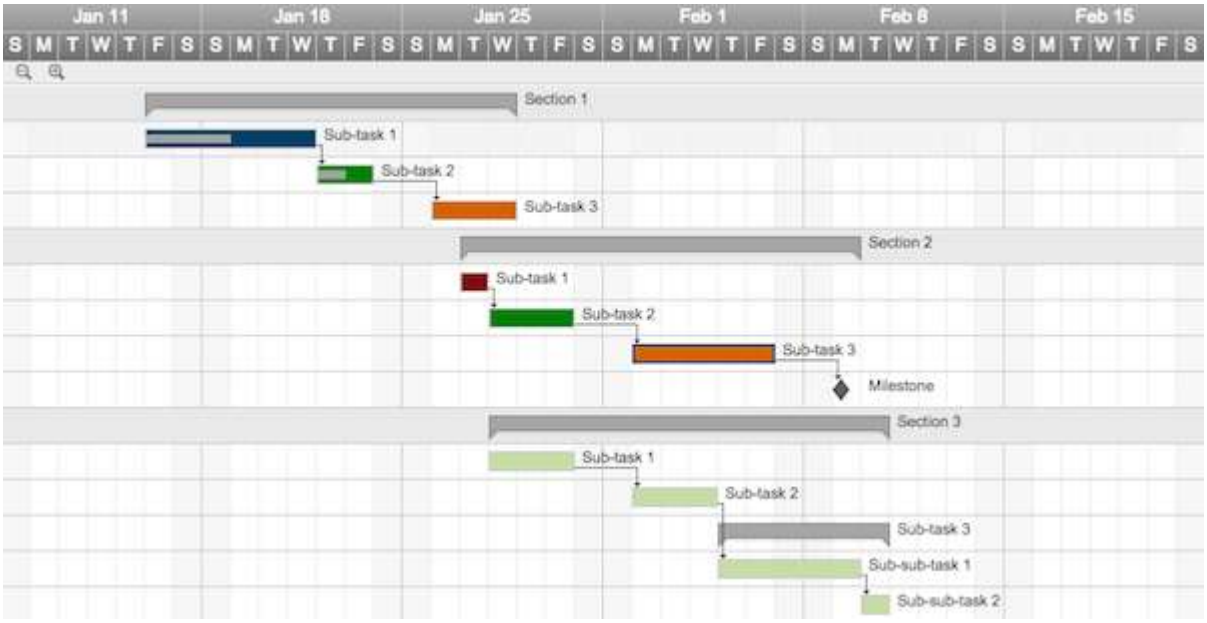
1- **List all the tasks required for your project and the order of completion.** Some tasks may be able to happen simultaneously (called non-dependent or concurrent tasks) while others cannot begin until a predecessor task is finished (called dependent or sequential).
2- **For each task, give three time estimates in days:** the most optimistic completion time (O), the normal/most likely time (M), and the pessimistic time (P)
3- **Calculate expected time** (TE) using the formula (O + 4*M + P) / 6 = TE.

See the examples below to understand how to calculate TE.

Task	Predecessor	Time Optimistic	Time Normal	Time Pessimistic	Expected Time
A	–	2	4	6	4.00
B	–	1	5	7	4.66
C	A	6	9	12	9
D	B, C	5	7	8	6.83

4- **Once you calculate TE, you can create a** Gantt chart, a way of visualizing a project schedule using horizontal bars representing time duration across a calendar.

5- **Now you can draw your PERT chart.** If you are doing this by hand, you will likely need to work through a few drafts. PERT charts are most commonly network diagrams in which the tasks or major activities are nodes (boxes) with arrows connecting them.



6- **Draft out the tasks.** It can be helpful to create a card or box for each task containing the activity name, duration, slack (read on for details on this), start and end dates.

Activity Name		
	Start Date	End Date
Duration		
Slack		

7- **Lay the activities out in sequence from left to right.** There are two different conventions for connecting the tasks with arrows - activity on arrow (AOA) and activity on node (AON)

8- **Calculate how long the project will take.** Add up the likely durations of all the tasks to get the expected length of the project. You can then identify start and end dates. Working with your optimistic and pessimistic time estimates, you can also forecast the soonest possible and latest possible completion dates. If it is imperative your project finish by a certain date, choose that as the completion date and work backwards using the most pessimistic time estimates.

9- **Figure out the critical path and slack.** The critical path is the sequence that takes the longest to complete. Slack is the amount of time an activity can be delayed without delaying the overall project (it is calculated as the difference between the earliest possible start time and the latest possible start time or between the earliest finish time and the latest finish time). Any activity with a slack time of zero is on the critical path.

2.2 IMPLEMENTATION/TESTING OF INTERFACES

Project managers are driven by dates. Customers, senior managers and stakeholders all want to know how long it will take to complete a project. And as project management professionals, you are also measured by the ability to predict the future and be right about predictions—despite the many unknowns. To answer the "*how long*" question, we have to plan the project, define tasks and gather estimates from the team.

The aim of effective project management is to bring the project to completion on time and on schedule. Estimating project duration is a key function of scheduling. Individual activities make up the schedule, and the estimates of their duration determine the project timetable. The accuracy of the overall schedule depends on the accuracy of these estimates.

Work Breakdown

Sometimes an activity is too large or complex for a reliable duration estimate. Project guidelines state that an individual activity that takes up more than 10 percent of the project schedule has to be broken down. A project manager uses a work breakdown technique to reduce the activity to smaller tasks. Ideally, the project manager can estimate the duration of tasks that individual workers perform more accurately than the whole activity.

Historical

An effective way of estimating activity duration is to use historical data. If data on the duration of the same activities is available, project managers take the average duration of the

historical records and use that in the project schedule. For small businesses which have not completed many projects, other methods are preferable.

Analogy

Use of analogous activities can generate reliable estimates. If the company has carried out a similar activity, it may be possible to adapt the duration to the current case. Project managers have to study the similarities of the two activities and adjust for any features that may result in differences in duration. Even small businesses can often find such similar activities on which to base estimates.

Expert Judgment

If expert judgment is available at reasonable cost, a project manager will often use such duration estimates as superior to internally generated ones. Expert judgment means using specialists who have a reputation for knowledge of the particular field and experience in estimating activity duration within it.

Effort

A project manager who knows what resources are necessary for an activity may calculate the effort the activity requires and arrive at a duration. He adds the amount of time it takes to obtain materials to the labor time it takes to complete the tasks. Such an estimate has the advantage that it allows the project manager to track resource use and compare it to the estimate.

Units

Calculation based on units of activity is a method available to both the largest and smallest businesses. Typical units are numbers of products or size of the product. Project managers can calculate how much time it took to produce a certain number or a certain size and adjust for the number or size they want to produce. Project managers have to adjust for economies of scale for these calculations.

SESSION 3: PREPARE A COST ESTIMATE FOR AN ELEMENT OF WORK.

On completion of this section you will be able to prepare a cost estimate for an element of work.

1. The cost estimate is based on a breakdown of the component in the logical parts for estimating.
2. The cost estimate is based on an understanding that the estimate should include the implementation/testing of interfaces to other components where applicable.
3. The cost estimate demonstrates an understanding that being assisted by other resources or people could escalate the costs.

3.1 LOGICAL COMPONENTS FOR COST ESTIMATION

A cost estimate is the approximation of the cost of a program, project, or operation. The cost estimate is the product of the cost estimating process. The cost estimate has a single total value and may have identifiable component values. A problem with a cost overrun can be avoided with a credible, reliable, and accurate cost estimate.

In a world of limited funds, as a project manage you're constantly deciding how to get the most return for your investment. The more accurate your estimate of project cost is, the better able you will be to manage your project's budget. Therefore, estimating a project's costs is important for several reasons:

- It enables you to weigh anticipated benefits against anticipated costs to see whether the project makes sense.
- It allows you to see whether the necessary funds are available to support the project.
- It serves as a guideline to help ensure that you have sufficient funds to complete the project.

The challenge with estimating is that it always involves some uncertainty. Some of the factors that contribute to this uncertainty include...

- **Experience with Similar Projects:**
  The less experience you have with similar projects, the greater the uncertainty. If you've managed similar projects, you will be able to better estimate the costs of the project.
- **Planning Horizon**:
  The longer the planning horizon, the greater the uncertainty. The planning horizon you are considering may be the whole project or just a certain phase. Either way, you will be able to better estimate costs for the time periods that are closer to the present.
- **Project Duration:**
  The longer the project, the greater the uncertainty. This is similar to planning horizon in the sense that if a project is of a shorter duration you are more likely to account for most of the costs.
- **People:**
  The quantity of people and their skill will be a huge factor in estimating their costs. Early in the project, you may not even know the specific people that will be on the project. That will increase the uncertainty of your cost estimates.

Fortunately, there are some tools and techniques used by professional project managers that you can use to develop more accurate cost estimates.

Expert Judgment	**Expert judgment** uses the experience and knowledge of experts to estimate the cost of the project. This technique can take into account unique factors specific to the project. However, it can also be biased.
Analogous Estimating	**Analogous estimating** uses historical data from similar projects as a basis for the cost estimate. The estimate can be adjusted for known differences between the projects. This type of estimate is usually used in the early phases of a project and is less accurate than other methods.
Parametric Estimating	**Parametric estimating** uses statistical modeling to develop a cost estimate. It uses historical data of key cost drivers to calculate an estimate for different parameters such as cost and duration. For example, square footage is used in some construction projects.
Bottom-Up Estimating	**Bottom-up estimating** uses the estimates of individual work packages which are then summarized or "rolled up" to determine an overall cost estimate for the project. This type of estimate is generally more accurate than other methods since it is looking at costs from a more granular perspective.
Three-Point Estimates	**Three-point estimates** originated with the *Program Evaluation and Review Technique (PERT)*. This method uses three estimates to define an approximate range for an activities cost: Most Likely (Cm), Optimistic (Co), and Pessimistic (Cp). The cost estimate is calculated using a weighted average: Cost Estimate = (Co + 4Cm + Cp)/6
Reserve Analysis	**Reserve analysis** is used to determine how much contingency reserve, if any, should be allocated to the project. This funding is used to account for cost uncertainty.
Cost of Quality	**Cost of Quality (COQ)** includes money spent during the project to avoid failures and money spent during and after the project due to failures. During cost estimation, assumptions about the COQ can be included in the project cost estimate.
Project Management Estimating Software	**Project management estimating software** includes cost estimating software applications, spreadsheets, simulation applications, and statistical software tools. This type of software is especially useful for looking at cost estimation alternatives.

Vendor Bid Analysis	**Vendor analysis** can be used to estimate what the project should cost by comparing the bids submitted by multiple vendors.

Whereas the execution of appropriate cost estimation techniques certainly contributes to the accuracy of cost estimates, other project management knowledge areas also play an important role in cost estimation accuracy. For example:

- **Quality Management** – If team members do not agree clearly upon deliverable quality criteria early in the project, they may take longer to meet expectations, unnecessarily resulting in a schedule delay and corresponding cost overruns.
- **Communications Management** – If team members do not clearly understand their roles and responsibilities on the project, project work may take longer to complete, thus delaying the schedule and increasing costs.
- **Scope Management** – If requirements are ambiguous, team members may deliver products that do not meet expectations, resulting in unnecessary rework, schedule delays, and corresponding cost overruns.
- **Human Resource Management** – If team personnel do not possess the required skills or experience to perform project work, it may take them longer to complete the work, causing schedule delays and cost overruns.
- **Risk Management** – If team members do not proactively conduct risk management, cost impacting issues that could have been prevented may emerge.
- **Procurement Management** – If procurements do not include terms and conditions that proactively mitigate State risk (such as fixed-price contracts and deliverable acceptance criteria), the project may experience increased costs later in the project due to changing project and market conditions.
- **Time Management** – If team members do not accurately estimate the time to perform activities, the project may experience schedule delays and cost overruns.

3.2 INCLUSIONS ON COST ESTIMATING

A project budget is a detailed, time-phased estimate of all resource costs for your project. You typically develop a budget in stages — from an initial rough estimate to a detailed estimate to a completed, approved project budget. On occasion, you may even revise your approved budget while your project is in progress.

Your project's budget includes both direct and indirect costs.

Direct costs include the following:

- Salaries for team members on your project
- Specific materials, supplies, and equipment for your project
- Travel to perform work on your project
- Subcontracts that provide support exclusively to your project

Indirect costs fall into the following two categories:

- **Overhead costs:** Costs for products and services for your project that are difficult to subdivide and allocate directly. Examples include employee benefits, office space rent, general supplies, and the costs of furniture, fixtures, and equipment.
- You need an office to work on your project activities, and office space costs money. However, your organization has an annual lease for office space, the space has many individual offices and work areas, and people work on numerous projects throughout the year. Because you have no clear records that specify the dollar amount of the total rent that's just for the time you spend in your office working on just this project's activities, your office space is treated as an indirect project cost.
- **General and administrative costs:** Expenditures that keep your organization operational (if your organization doesn't exist, you can't perform your project). Examples include salaries of your contracts department, finance department, and top management as well as fees for general accounting and legal services.

Suppose you're planning to design, develop, and produce a company brochure. Direct costs for this project may include the following:

- **Labor:** Salaries for you and other team members for the hours you work on the brochure
- **Materials:** The special paper stock for the brochure
- **Travel:** The costs for driving to investigate firms that may design your brochure cover
- **Subcontract:** The services of an outside company to design the cover art

Indirect costs for this project may include the following:

- **Employee benefits:** Benefits (such as annual, sick, and holiday leave; health and life insurance; and retirement plan contributions) in addition to salary while you and the other team members are working on the brochure
- **Rent:** The cost of the office space you use when you're developing the copy for the brochure
- **Equipment:** The computer you use to compose the copy for the brochure
- **Management and administrative salaries:** A portion of the salaries of upper managers and staff who perform the administrative duties necessary to keep your organization functioning

BASE ESTIMATE

The base estimate is the estimate produced before project risk is taken into account. On large projects, the person producing the estimate will often be a specialist estimator. On smaller projects, it might be prepared by a business analyst, some project manager or other personnel.

Estimating rules

Some organisations demand lean project estimates, with no allowances for anything not explicitly detailed in the estimate inputs. Others expect the estimator to produce an estimate that is the most likely outcome for each part of the cost, failing to understand that this will not usually produce a total estimate that is the most likely outcome of the total cost.

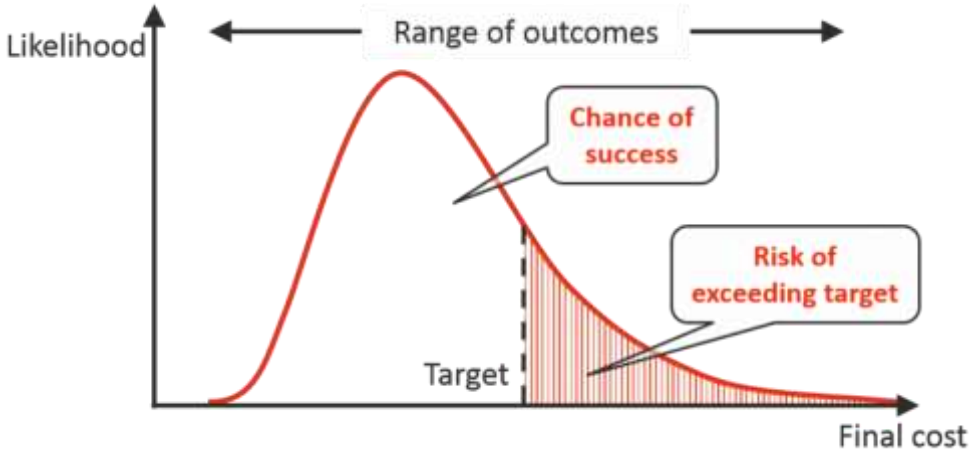
This is an important misconception. Without going into the detail here, when a set of quantities with uncertain costs are added up, under most conditions the mean value of the total will be the sum of the mean values of the individual components.

Risk and variation from the base estimate

Uncertainty in each of the components of a project estimate results in uncertainty in the total estimate value. The chances of achieving a targeted cost outcome depend on the relationship

between this uncertainty in the total cost and the target that is selected, as illustrated in the diagram below. The area under the cost distribution either side of the target value is a measure of the chance of success to the left and the risk of failure to the right.

Chance of success - target in relation to uncertainty



If an organisation can choose where to set the target project cost, it can influence its chances of meeting the target. It can vary how much confidence it will have in being successful and how much risk it will have of failure, depending on what target cost it sets.

In reality, with a dynamic environment and active involvement of the project management team, a forecast such as this made at the start of a project is only a guide to the final cost and the risk of failing to meet a target. It is a valuable starting point, though, and a useful basis for deciding how to balance the desire to meet the target against other pressures, such as commercial and business performance goals, that tend to drive the target cost down. It also provides a basis for seeking approval for the project budget.

3.3 COST CONTIGENCIES

Project plans and estimates are generally developed by breaking the full scope of the project into work packages or cost areas, estimating the cost of each of these and then adding them up to derive a total cost.

There are several inputs that might be used to estimate these component costs, including:

- A list of parts and tasks required to complete the work, at anything from the most detailed level to a high level description;
- Quotations from suppliers, which might be casual indications provided without commitment, detailed binding agreements or something between these two extremes;
- The cost estimate or lump sum value of related work estimated or carried out for another job, or another part of the same job, adjusted for differences in quantities or other factors;
- A parametric model based on the scale and other characteristics of the work;
- A lump sum based on direct assessment by experienced personnel.

Until the project is complete, no one can be certain exactly how much the cost will be. The basis for the estimate and the calculations used to turn that information into a cost are both uncertain. Other factors may come into play as well, such as unexpected changes in the design, the scope of work, or the way work is to be carried out.

Allowances and uncertainty

Some of the component costs making up an estimate will include allowances for items that the estimator knows, or suspects, have not been included in the initial development of the estimate because the inputs are not complete. Typical examples include:

- Small items such as pipe joints, supports, or hand rails in structural steel and pipe costs;
- Connections and minor light fixtures in electrical costs;
- Drainage connection pits or minor earthworks and small concrete pours in civil engineering costs;
- Meetings, documentation and software in management costs;
- Administration terminals and licenses in software development costs;
- Days lost to wet weather for construction work;
- Days lost to sickness;
- Additional training and induction arising from staff turnover and poor attendance at training sessions; or,
- Relocation and travel costs for specialist personnel recruited outside the region in which the project is to be conducted.

Experienced estimators build in these allowances, not as cover for risk but as costs they expect will be incurred based on experience. They might aim to make their estimate lean (i.e. low, with few additional allowances), a likely outcome or conservative (i.e. high, including most additional allowances), depending on their personal nature, organisational policy or management pressure.

Estimators' allowances overlap with what are regarded as project risks in a cost estimate. An allowance might be made for wet weather but there could be more or less wet weather than expected. An equipment cost might include provision for air freight not included by the supplier but, when the project is planned in detail, it may be possible to use lower-cost sea freight for delivery.

The fact that estimators make allowances for the same kinds of variations as appear in a risk assessment can create confusion. To gain a clear view of the cost and all the uncertainties affecting it, it is essential to look carefully at the base estimate and how it was produced.

SESSION 4: THE EFFECT OF LATE DELIVERY OF AN ELEMENT OF WORK.

On completion of this section you will be able to demonstrate an understanding of the affect of late delivery of an element of work.

1. The demonstration confirms the understanding that an element delivered is often a subset of a bigger deliverable.
2. The demonstration explains the affect of late delivery on other related components.

4.1 MANAGING DELIVERABLES

A deliverable is any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project. A deliverable usually has a due date and is tangible, measurable and specific. A deliverable can be given to either an external or internal customer and satisfies a milestone or due date that is created and produced in the project plan

Organize your project tasks around the deliverables

A project can have one or many deliverables. You can organize your project's tasks around the deliverables in several ways:

- Assign each deliverable to a separate phase of the project, and use a milestone that represents the completion of both the deliverable and the phase simultaneously.
  For example, a project to construct a building can have one phase with a deliverable of "finish the exterior of the building," and the deliverable for a later phase may be "complete the landscaping."
- Group similar deliverables or deliverables with the same stakeholders in a phase. This method allows you to schedule a team to work on a project until the deliverable is handed off. Then the team can move on to other projects.
  For example, all routine maintenance tasks can be organized in one phase of the project, corresponding to the dates when they need to be performed. The maintenance engineers can be assigned to multiple projects containing the different maintenance jobs they are assigned to.
- Group deliverables that are worked on during the same time period into phases that span that time period. This is useful for projects where trade-offs can be made in the scope and quality of the deliverable to meet a fixed finish date.
  For example, if the conversion of a factory production line must be completed by the date that the first product is delivered to suppliers, there may be phases for each month leading up to the finish date that contain the tasks that must be started or completed during that month. So that slipped tasks don't affect the overall progress of the project, tasks that are not finished by the end of the phase are often completed separately after the team moves on to the next phase.
- Create inter-project dependencies on deliverables from other projects. For example, a project to construct a building may not be able to begin until another project, to design a series of buildings, delivers the blueprints. You can create an inter-project dependency between a task in the construction project and the specific blueprint deliverable for that building.

Define the Deliverables

To achieve the desired outcome from the project, you must define what things (or products) are to be delivered by the end of the project. If your project is an advertising campaign for a new chocolate bar, then one of the deliverables might be the artwork for a newspaper advert. So, you need to decide what tangible things are to be delivered and document in enough detail what these things are. At the end of the day, someone will end up doing the work to produce the deliverable, so it needs to be clearly and unambiguously described.

Once you have defined the deliverables, you will need to have the key stakeholders review the work and get them to agree that this accurately and unambiguously reflects what they expect to be delivered from the project. Once they have agreed, you can begin to plan the project. Not defining the deliverables in enough detail or clarity is often a reason why projects go wrong.

Project Planning

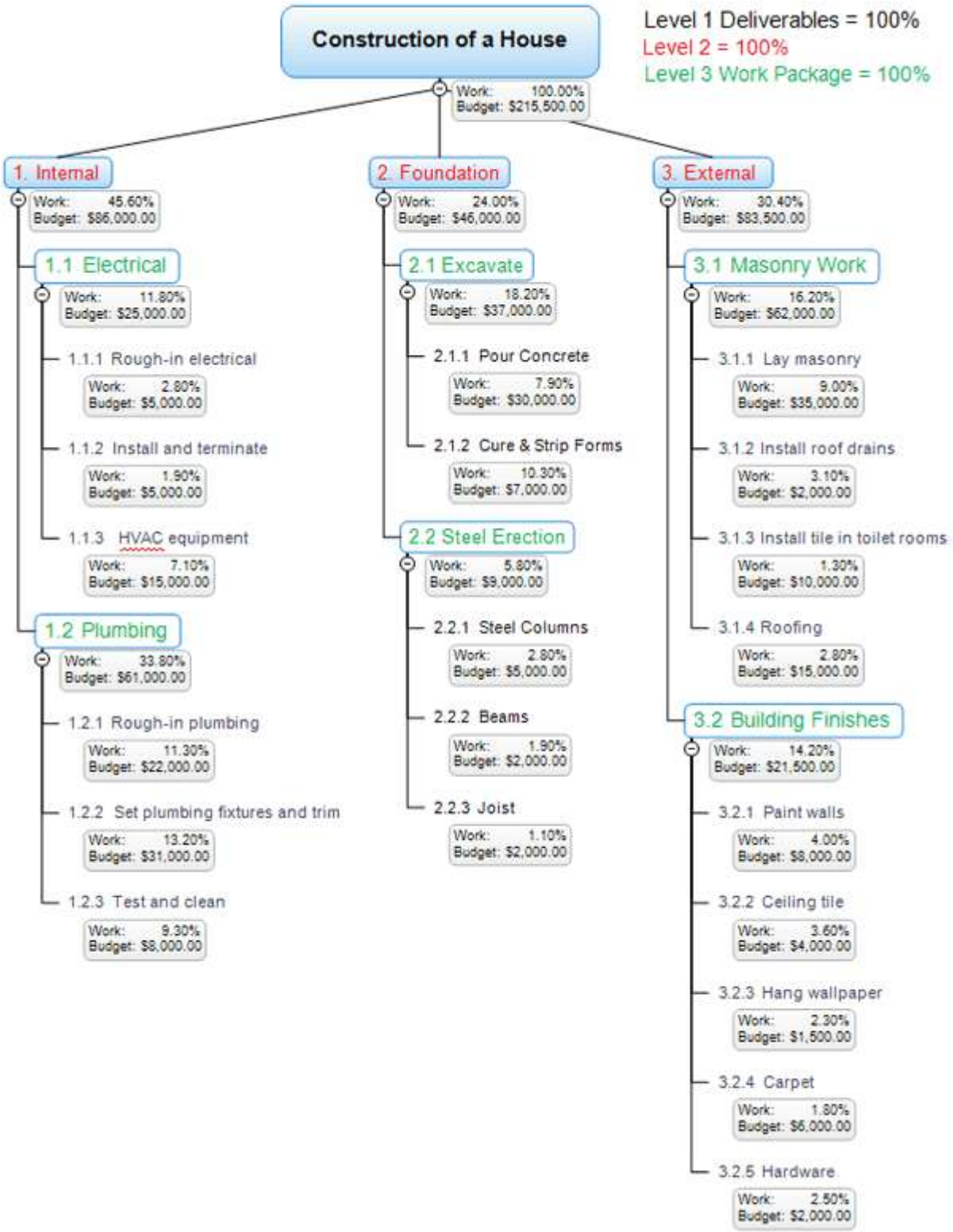
This is the time when you define how you will achieve the desired outcome of the project embodied within the objectives and definition of deliverables. Planning requires that the project manager decides which people, resources and budget are required to complete the project. You will need to decide if you will break up your project into manageable phases, decide which products will be delivered in each phase, and decide the composition of your project team. Since you have already defined the deliverables, you must decide what activities are required to produce each deliverable.

You can use techniques such as Work Breakdown Structures (WBS) to help you to achieve this. You will need to estimate the time and effort required to complete each activity, dependencies between related activities and decide on a realistic schedule to complete the activities. It's always a good idea to involve the project team in estimating how long the activities will take since they will be the ones actually doing the work. Capture all of this into the project plan document. You also need to get the key stakeholders to review and agree to this plan.

Work Breakdown Structure (WBS)

A work breakdown structure (WBS) is a key project deliverable that organizes the team's work into manageable sections. The Project Management Body of Knowledge (PMBOK) defines the work breakdown structure as a "deliverable oriented hierarchical decomposition of the work to be executed by the project team." The work breakdown structure visually defines the scope into manageable chunks that a project team can understand

The diagram below depicts a sample work breakdown structure with three levels defined.



The project team creates the project work breakdown structure by identifying the major functional deliverables and subdividing those deliverables into smaller systems and sub-deliverables. These sub-deliverables are further decomposed until a single person can be assigned. At this level, the specific work packages required to produce the sub- deliverable are identified and grouped together. The work package represents the list of tasks or "to-dos" to produce the specific unit of work. If you've seen detailed project schedules, then you'll

recognize the tasks under the work package as the "stuff" people need to complete by a specific time and within a specific level of effort.

4.2 EFFECT OF LATE DELIVERY ON OTHER RELATED COMPONENTS

The project can be delayed at any time during the five phases of project management. These phases are:

1. Conception and initiation
2. Definition and planning
3. Launch and execution
4. Performance and control
5. Close (that is, the client may be dissatisfied with the results so re-execution may be necessary)

As a project manager, you should be well aware of the possible causes of delay as well as their appropriate preventive and remedial measures at each phase. Your team members should also actively participate in the identification, resolution and prevention of the causes of delays.

The causes of delays can be categorised as follows, although it must be emphasised that placing the blame on any single group will be counterproductive. The best way to address delays regardless of who and what caused them is to tackle the issues head-on first before making the persons responsible for them be accountable for their actions.

1. Delays caused by subcontractors, product suppliers, and service providers

Third-party entities to the project are usually not privy to the project management plans except for their relevant responsibilities in its execution, such as the delivery of products and services at the right time, in the right place, and with the right quality.

But subcontractors, suppliers, and service providers become the cause of delays when they take on too many projects at once, or they fail to anticipate your project requirements as agreed, or they have been overtaken by outside factors out of their control, among other reasons.

For example, a supplier of materials may have been affected by an employees' strike, thus preventing on-time delivery of the products to your end. A subcontractor may also have taken on several projects including yours, thus spreading his staff too thinly and compromising their delivery to your end, too.

2. Delays caused by changes in climate

Natural disasters, weather disruptions, and other elements of nature will cause disruptions in the project's schedule because of their uncontrollable nature. Even the best laid project management plans will be delayed when Mother Nature decides to wreak havoc in the locality where the project is being implemented or where the subcontractors, suppliers, and service providers are located.

But it is not just weather changes that can cause disruptions in project delivery. Keep in mind that changes in the investment climate, for example global recession, which affected many construction projects in Dubai, and in the political climate, including civil war or radical changes in leadership.

3. Delays caused by the client

Let's face it, the client may well be the most common cause of delays for many reasons. The client may change their mind about the project's parameters, or express their dissatisfaction with the project's progress, or withhold their funding for the project for various reasons including a failure to plan for it.

The client may also request alterations, which means adding to the risk of delays to the project; one single alteration request can result in changes to the entire plan from the present point.

The importance of agreeing to an iron-clad contract with specific terms and conditions cannot be overemphasised to minimise the risks of delays caused by the client.

4. Delays caused by team members

And then there are delays caused by the below par performance of the team members and the project manager. The delays can be caused by a wide range of factors including but not limited to:

- People spending less time on activities than agreed upon.
- People with less experience than required spending more time on the activities than planned.
- People being less productive than you expected them to be.
- People not allowed to learn the tasks beforehand, resulting in repeated mistakes.
- Activities requiring more steps than originally identified in the plan.
- Activities requiring more time than planned.

All of these causes of delays can be attributed to poor planning, implementation, and evaluation.

Addressing project delays

Fortunately the causes of project delays can be minimised, if not prevented, so that the project finishes on schedule, by adopting the following measures.

Set realistic goals, activities and deadlines. Keep in mind that being realistic about the possible causes for delays means greater awareness of the best ways to prevent them from occurring in the first place.

Expect the unexpected. In a certain way, delays in projects are to be expected since there is always the possibility that these will occur, no thanks to uncontrollable factors. But you must expect the unexpected aspect of delays, namely, in terms of their type, source and timing.

Adopt a proactive approach in minimising the unexpected aspect of the delays. Be aware that each project has its unique rhythm such that you should be on the lookout for warning signs of possible delays.

Of course, since people are the main source of delays, you must communicate in an effective, efficient and regular manner with all of the project stakeholders.

Consequences of late delivery

Owners and contractors alike can and usually will lose money when their projects take longer than expected.

An extended project period will cost the contractor the daily cash value of continuing superintendence, security, temporary facilities such as site office, telephone, power, toilets, transportation, fencing, and possibly hoisting and scaffolding. Home office support services must also be continued. In addition there is the interest loss on delayed payments and retainage.

When a contract is not completed on time it is recognized that the owner could also suffer substantial monetary damages such as loss of rental value, interest on invested funds, and rentals on duplicate premises, to name a few.

Some feel that the contractor's actual cash losses do not provide a sufficient economic stimulus for timely completion. Many owners and their legal advisors feel that contractors require some additional financial incentive to complete their projects on time.

When the completion date is of significant economic importance to the owner, additional pressure can be applied by charging the contractor for overrunning the established date or by rewarding early completion. These ends may be accomplished by inclusion of a liquidated damages and/or bonus clause in the agreement.

Time overrun

Time overrun it mean contractor could not carry out their work within contract period. In generally, time overrun can be categories into two group which include excusable delays and non-excusable. Once the project facing time overrun, it will affect the progress of work cannot finish on time. Besides that, the fault party will take the responsibility to pay the relevant parties for damages because of delay.

For instance, during the project almost completed, but at the same time contractor because of exceptionally implement weather cannot completed the project within contract period. In this situation the contractor entitle to claim extension of time. On the other hand, if that contractor cannot complete the work within contract period due to his own fault. So the contractor no entitle to claim extension of time and he need to pay liquated damages.

Cost overrun

During construction stages, the client and contractor always facing of cost overrun. Cost overrun is an unexpected cost incurred in excess of a budgeted amount, due to cost underestimation. Cost overrun is related to time overrun, once a project cannot be done in time, it will also affect the cost of project over budget. Commonly, cost overrun always happen due to contractor own fault such as inaccurate of cost estimate and he need to take responsibility to pay owner loss and expense. For instance, a contractor because of improper cost planning due to cost overrun. Finally, the owner set of his loss and expense from the contractor interim payment.

Total abandonment

Total abandonment it means the whole project stop immediately because of client facing financial difficulties. Some of the current delay project totally abandoned because of client's

or contractor problem which include clients bankruptcy, contractor run away, poor marketing and sales strategies and so on. The effect of project totally abandoned will affect many parties such as contractual parties which include contractor, consultant, sub-contractor, supplier and some other relevant parties. Besides those parties, the purchasers will also suffer in cost damages due to project abandoned.

What have you learnt in this study manual?