BSB41507 Certificate IV in Project Management

Open Colleges code 30014A

Student Workbook

› Apply Time Management Techniques (BSBPMG402A)
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About the unit

The unit – BSBPMG402A Apply Time Management Techniques describes the performance outcomes, skills and knowledge required to assist with project scheduling activities, the application and monitoring of the agreed schedule and evaluation of time management effectiveness for the project.

Sections in this student workbook

This Student Workbook is designed to provide you with the information you need to complete this unit and consists of the following sections:

Learning

This section provides background information to support this unit of competency, guidance on where to find further information. It may also include case studies to illustrate the unit of competency in practice.

Throughout the learning material the following icons may appear. The icons indicate when you are required to undertake an activity, refer to the required text, do research, watch a video or complete a case study. The icons are:

- **Learning Activities**
  Learning activities are tasks and exercises that assist you in gaining a clear understanding of the content in this workbook and required text. It is important for you to undertake these activities, as they will enhance your learning.

- **Case Studies**
  Case studies help you to develop advanced analytic and problem-solving skills; they allow you to explore possible options and/or solutions to complex issues and situations, and to subsequently apply this knowledge and these newly acquired skills to your workplace and life.

- **Discussions/Live chat**
  Whether you discuss your learning in an online forum or in a face-to-face environment, discussions allow you to create and consolidate new meaningful knowledge.

- **Readings**
  Throughout this Student Workbook you may find references to suggested readings. Suggested reading provides supplementary information that may assist you in completing the unit.
Getting Started

Reference
A reference will refer you to a piece of information that will assist you with understanding the information in the Student Workbook or required text. References may be in the required text, another textbook or on the internet.

Self-check
A self-check is an activity that allows you to assess your own learning progress. It is an opportunity to determine the levels of your learning and to identify areas for improvement.

Appendices
The Appendix section located at the back of the student workbook and may provide templates, examples or other sample documents to help illustrate some aspects of the unit of competency.

Templates
Helpful templates from the appendices of your Student Workbook are available in Word format under Additional Resources in OpenSpace.

References
Throughout the student workbook you will be directed to suggested reading and websites for additional information. Given that web addresses can change you will need to cut and paste the link into your Internet address line. If the link does not work use search tools to find updated links.

Glossary
A glossary of terms is included in the Student Workbook as an Appendix when required.

Compiling your own resources
As you work through this Student Workbook, compile a resource kit (electronic and/or paper-based), which you can use to assist with your learning. This could include, for example, information that you print out or ‘bookmark’ from websites and research, resources you download, newspaper articles about project management and answers to completed activities. What you decide to put in your resource kit is up to you. Over time, it can become your resource companion containing information about current project management work practice and ideas. The resource kit is for your own professional development and is different to any portfolio or file that you might keep for assessment purposes, although some resources may be included in both.
Choice of Assessment

In each Unit of Competency there are assessments for students who are working which require the compilation of a portfolio of documents from projects you may be involved with at work as well as answering questions relating to those projects. For students who aren't currently working or whose work doesn't involve them in projects, there are different assessments which are based on applying project management techniques to a hypothetical case study. The assessments for the different types of student are clearly marked.

Therefore students have a choice of which assessment they will complete. The choices are:

1. For those students currently employed you may use a current or completed project from your workplace or
2. For those students who are not employed you will need to complete the Case Study assessment.

Both assessments are located in the Assessment Section on OpenSpace. Please make sure that you complete the correct assessment according to your choice.

Assessment procedures and advice

Students are expected to refer to the following information, in conjunction with information regarding assessment, at Open Colleges published in “Open Colleges Assessment Policy and Procedures” available via the Open Colleges website at http://www.opencolleges.edu.au/policies.aspx#PoliciesProcedures

You may download an electronic copy of your assessment(s) from your unit on OpenSpace.

Presentation of Assessment Tasks

Assessment tasks should be submitted online via OpenSpace.

You should present all your written work (unless otherwise instructed) so that:

- it is easily printed on A4 size paper
- the total word count indicated in each assessment is acknowledged
- there is at least a 2 cm margin around the text on each page for comments from the assessor
Submission details

All students are required to submit assessments (appended with any required evidence) via the unit on OpenSpace. If you are unable to submit your assessments online, you can print and post your assessment to:

Open Colleges
PO Box 1568
Strawberry Hills, NSW 2012.

Please ensure that you use the Open Colleges Assessment Cover Sheet (available in the Student Lounge in OpenSpace). Where assessments are submitted by post, grades and feedback will be released in OpenSpace.

Assessment file-naming convention

Please ensure that you use the following file-naming convention when you save your assessment tasks in MS Word.

1. Your file should be named and saved to your computer’s hard drive using your:
   
   student number assessment number.doc
   
   For example:
   
   12345678_21850a_01.docx or
   
   12345678_21888a_01.doc

   Your student number allows your assessor to identify to whom the assessment belongs and the assessment number indicates which assessment is being submitted.

Tips to study success

Below are some links that may help you to improve your study skills:

- Webspiration – free online mind mapping tool. Watch a video on how to use Webspiration on YouTube [http://www.youtube.com/watch?v=ToEXLbQC_F8&feature=related](http://www.youtube.com/watch?v=ToEXLbQC_F8&feature=related)
- Bubbl-us – free online mind mapping tool [https://bubbl.us/](https://bubbl.us/)
- Mind 42.com – free online mind mapping application [http://mind42.com/signin](http://mind42.com/signin)
- Study Stack – Online flash cards: use the ones available or create your own [http://www.studystack.com/](http://www.studystack.com/)
Getting Started

- Basic Study Skills - ALISON Online Training Course – http://alison.com/courses/Study-Skills
- Math Help and Tutorials by Subject and/or Topic – http://math.about.com/od/mathhelpandtutorials/Math_Help_and_Tutorials_by_Subject_and_or_Topic.htm
- Computer basics – http://www.gcflearnfree.org/computers
- Writing essays – http://www.greatsource.com/iwrite/educators/e_forms.html
  (University of Canberra)

Suggested Reading


You do not need a copy of this text to complete the learning. The suggested reading provides supplementary information that may assist you in completing this unit.
Project time management techniques: Topics and learning activities

The materials in this Student Workbook are designed to provide a range of learning and assessment activities to support delivery of the unit (BSBPMG402A) *Apply time management techniques*. They are not intended to be exhaustive. Extensive use has been made of examples and scenarios representing real life projects. However since there are many different types of work places and projects, it would have been impossible to represent them all in these materials. Consequently activities require learners to reflect on their own situations and to provide evidence of application within their own workplaces.

Although this Student Workbook is organised around topics that relate to each of the main project management skill areas in the qualification, a holistic approach to assessment is recommended. To support this, three detailed case studies have been provided that cover all aspects of project management and provide a basis for learning and assessment activities.

Since project management is rarely an entry qualification into work, it is assumed that learners will already have prior training and qualifications, so learning and assessment activities are designed to be self-directed and self-paced.
About project time management

Project time management consists of eight activities preceded by a planning effort reflected in the project scope statement. Figure 1 shows a structured framework for the activities involved in the project time management.

The project scope statement sets the constraints and methodologies to be used in managing the project’s schedule. The first step involves defining the project’s activities, before analysing the sequential relationships between tasks.

Once the sequence is confirmed, resources and duration estimates for each task are made, followed by the development of the schedule itself. Once implemented, the schedule needs to be monitored and controls taken where necessary to alter any deviations from the planned schedule. Finally, a review of the time management activities is conducted in the completion phase of the project.

The application of time management techniques is vitally important to ensure project objectives are completed in a timely fashion. Failure to develop, implement and control a realistic, accurate, achievable schedule may result in significant time overruns, in turn affecting the cost of the project.
Definitions and main activities in project time management techniques

Project time management involves using the processes described above to complete a project in a timely fashion. Once the project has been scoped and approved, the project manager develops a project schedule with the assistance of the project team members. The time management processes interact with each other and are closely linked to other project objectives such as cost estimation, human resources and procurement and contracting. Monitoring and control activities should be consider the effects of schedule variation on other project objectives. A summary of what is required in each component of project time management is described below:

- **Project Scope Statement** – this contains a schedule management plan which outlines the processes, tools and techniques that will be used to develop and control the project schedule. It also identifies the time and other constraints which affect the schedule.

- **Activity Definition** – breaking down the work that has to be done in a project (a ‘Work Breakdown Structure’) into smaller components (called ‘schedule activities’) using a technique called decomposition and creating an activity list.

- **Activity Sequencing** – identifying and documenting the logical relationships between schedule activities using manual or computer techniques so that the schedule is realistic and achievable.

- **Activity Resource Estimation** – deciding on the type and quantities of resources (human, physical, material) are required to perform each schedule activity. This process is closely aligned with the cost estimation and procurement and contracting project objectives.

- **Activity Duration Estimation** – utilises the project’s scope document, sequencing and resource estimations to estimate the amount of work effort required to complete each scheduled activity in the Work Breakdown (WBS) structure.

- **Schedule Development** – this involves determining the planned start and finish dates for each scheduled activity based on a through analysis of the activity sequence, duration and resource estimates and project constraints.

- **Schedule Implementation** – once developed, the schedule should be implemented in accordance with the project scope statement.

- **Monitoring and controlling the schedule** – monitoring the schedule is important to determine the current status of the schedule, diagnose which schedule activities are ahead or behind schedule, and determine whether the schedule has altered. Armed with this information, steps can be taken to influence factors affecting the schedule, plan strategies and implement changes to the schedule to ensure timely completion of the project.

- **Reviewing time management activities** – while monitoring and controlling the schedule and in the final review of the project, the effectiveness of the time management tools, techniques and processes used is evaluated to identify lessons learned for future projects.
As a project team member, you will be required to take responsibility for ensuring the project is completed on time. Your contribution is essential in assisting the project manager to achieve this goal.

This Student Workbook aims to provide you with practise using project time management techniques which will enable you to assist in the design and development of project schedules, apply those techniques in your workplace and participate in evaluating the effectiveness of those techniques in achieving project outcomes. In doing this, you will become familiar with the four main time management techniques:

- Work Breakdown Structure (WBS)
- Program Evaluation Review Technique (PERT)
- Critical Path Analysis
- Gantt Chart

The relationship between time management activities and project phases

Project time management techniques are applied at all stages of the project life cycle. The summary below provides information on considerations at the different stages that impact on learning and assessment activities. Figure 2 shows the project management activities from Figure 1, breaks them down into their components and shows how they relate to the various project phases.

**Proponent phase – before a project proposal is submitted (initiation/concept phase)**

In the conceptual phase, the project is assigned starting and finishing dates that define the lifespan of the project. The time available to complete the project will be determined by the project’s constraints, documented in the project scope statement. The source of these constraints may come from either external or internal sources. For example, a construction company building a new motorway may have a three-year completion deadline imposed on it by the government. Organisational constraints such as available financing or human resources will also affect the time available to complete the project. As a result, several alternative start/finish times are offered for consideration in the proponent phase.

The time available to complete a project also has an interdependent relationship with other project objectives. For example, reducing the time available to complete a project requires more resources at greater cost to achieve the earlier deadline. Delaying the completion date may mean some resources are reassigned to other projects in greater need of those resources, or costs increase because scheduled activities stretch out to a longer completion date.

Other important considerations during the proponent phase include deciding whether there is any benefit in completing the project ahead of schedule, what contingencies must be built in, and what risks may impact on the successful completion of the program.
**Approval phase – once a project is approved (planning/development)**

Once the project has been approved, the next step is to develop the schedule. There are five stages that need to be completed before the schedule can be developed. Analysis of these five activities in combination with the project constraints is required before a schedule can be developed:

1. Activity definition – it must be worked out what needs to be done,
2. Activity sequencing in what order,
3. Activity cost estimation how much it will cost,
4. Activity resource estimation what resources are required, and
5. Activity duration how long each task will take.

The activities required to deliver the project objectives are listed in a Work Breakdown Structure (WBS). Important activities representing significant points in the project’s life are identified as milestone points. Each activity is broken down, or decomposed, into smaller, more discrete activities, called schedule activities. A picture of the schedule activities is then drawn using a technique known as “Program Review Evaluation Technique” (PERT), also referred to as a ‘network diagram’ or ‘precedence diagram’. This tool analyses the logical and sequential relationships between schedule activities, to determine whether the activity sequence is possible and realistic.

The schedule revealed by the PERT diagram is analysed using a Critical Path Analysis to check that the PERT network is accurate and to determine the tasks that must start and finish on time to avoid delaying the project’s completion. With the logic and the schedule confirmed, estimates are then made for the resources and duration required to complete the schedule activities. Estimating the resources includes considering the type, quantity and availability of human, physical and material resources needed, while duration estimates determine the amount of work effort required to complete scheduled activities.

**Implementation phase – when the project is underway (delivery)**

Once the project commences the schedule should be implemented in accordance with the planned schedule. Monitoring is important throughout the project to determine whether the current status of the project is on time, ahead or behind schedule and to detect variations in the schedule. This allows the project manager to decide whether any action is required to address the variation.

Tools and techniques use to monitor and control the schedule throughout the project life cycle include regular progress meetings, statistical analyses of schedule variance, tracking of schedule status using software, and bar chart comparisons. Due to the interdependent relationship between the schedule and other project objectives such as cost, procurement and risk, failure to control the schedule accurately can have significant impact on the realisation of the project’s overall objectives.
Completion phase - review (finalisation)

At the conclusion of any project is it important to reflect upon how the time management activities impacted on the realisation of the project’s objectives. Team members should assist in reviewing the effectiveness of the time management tools, techniques and approaches used. The review of the project outcomes may include such things as reviewing milestone completion dates, whether key deliverables were delivered on time, or whether the project team members were adequately skilled in the usage of time management monitoring techniques. Any problems, issues or positive responses should be reported to the project manager for inclusion in project’s final report, and to contribute to the organisation’s knowledge base for application on future projects.

Figure 2 – Time management activities and project phases
Responsibilities for managing project time management

The responsibilities for people within the project team are contained in the table below.

<table>
<thead>
<tr>
<th>PERSONNEL</th>
<th>RESPONSIBILITY</th>
</tr>
</thead>
</table>
| Project manager       | • Creates a time management plan based on the project scope statement  
                        • Determines the activities, duration, effort, sequence and dependencies of tasks  
                        • Allocates resources and work effort to complete schedule activities  
                        • Creates the schedule  
                        • Seeks input and approval for the schedule from stakeholders and senior management  
                        • Selects which tools, techniques and methods will be used to create, implement, monitor, control and review time management activities for the project.  
                        • Analysis monitoring data to identify schedule variations and takes action to deal with discrepancies in conjunction with senior management.  
                        • Compiles a report at the conclusion of the project evaluating time management activities |
| Authorising agent/agency | • Directs project managers in the use of tools, techniques, and processes to plan, conduct, monitor, control and review time management activities across multiple projects  
                           • Provides specialist advice and recommendations on how resources should be allocated and costed, refining the schedule where necessary  
                           • Agrees, formalises and communicates project schedule to stakeholders  
                           • Develops, implements and modifies time management monitoring, controlling, recording and reporting systems for project schedules across multiple projects  
                           • Performs ongoing analysis of variances and trends in schedule activities and develops responses to ensure project is completed on time  
                           • Reviews time management status across several projects concurrently  
                           • Authorises responses to perceived, potential or actual changes to project schedule to ensure project objectives are maintained  
                           • Reviews project records and outcomes to determine effectiveness of time management processes and communicates lessons learned to higher authorities |
| Project team member(s) | • Contributes to time management planning, activity sequencing, activity duration and resource estimation activities for a project  
                          • Uses project scheduling tools and techniques to establish time management aspects of the schedule, resource allocation and costings  
                          • Contributes to the communication of time management plan and activities to stakeholders  
                          • Applies techniques to monitor progress of activities, report variances between planned and actual schedule to project manager  
                          • Implements agreed changes and updates schedule accordingly  
                          • Assists in reviewing the effectiveness of time management techniques tools and processes used in achieving project objectives |
Stakeholder involvement in project time management

The input of stakeholders is vitally important in finalising the schedule, agreeing the tools and techniques to create and monitor the schedule, and agreeing to procedures to make modifications to the schedule. Stakeholders' views should be contained in the project scope document.

The time available to complete a project is a finite resource, which must be managed well to ensure the project’s objectives are achieved. Project time management is about applying techniques, tools and processes to achieve timely completion of a project. It involves defining the activities which need to be performed to produce the project’s deliverables, working out their sequence, and estimating the resources and time required to achieve them.

Once this information is gained a schedule is developed which serves as the baseline against which the project’s actual performance is measured and compared, with action taken to remove any discrepancies. At the conclusion of the project, an analysis is conducted to evaluate the effectiveness of time management techniques used in the project and to learn lessons which can be used on future projects. This Student Workbook provides you with the opportunity to practise and demonstrate the tools, techniques and methods to contribute to effective time management of a project.

Principles of project time management

Very few projects proceed according exactly to schedule. Delays inevitably occur, despite the most thorough planning. People get sick; a shipment of materials is delayed at sea, and unforeseen events occur which cause delays. To avoid these delays impacting heavily on project objectives flexibility must be built into the initial project schedule and modified regularly throughout the project to take these factors into account.

Several alternative project schedules are usually developed in the planning stages of the project. A ‘best’, ‘worst’ and ‘most likely’ scenario schedule are developed individually then averaged to form a realistic project schedule. Considerations on how each alternative schedule will affect other project objectives, such as cost, risk human resources and procurement, must be determined due to the interdependency between project time management and other project objectives.

There are a wide variety of tools and techniques which can be used to assist with project time management. The specific tools and techniques used will depend largely on the expertise of the team members, the preference of the organisation managing the project, and the complexity of the project.

It is important that all project team members contribute to ongoing monitoring of the project schedule throughout the project and constantly monitor its status so that problems can be rectified. Regular progress meetings should be held throughout the project, where the project’s time status is discussed, analysed and corrective action decided and acted upon if necessary.
Topic 1: Assist in the development of project schedules

Learning outcomes covered in assisting in the development of project schedules are:

› Applying project scheduling tools and techniques
› Communicating project scheduling to stakeholders

The following information and activities are designed to provide you with the opportunity to practise using tools and techniques to create a project schedule. The areas covered in this section are represented in the shaded areas of Figure 3, showing the first six stages of time management in projects. Although shown as discrete stages, in practise these are interrelated.
TOPIC 1 | Assist in the development of project schedules

Figure 3 – Time management planning

**Proponent Phase**

- **Activity Definition**
  - Activity list
  - Milestone list
  - Decomposition
  - Work breakdown structure

- **Activity Sequencing**
  - PERT
  - Critical path analysis
  - Network analysis

- **Activity Resource Estimation**
  - Human resources
  - Material resources
  - Quality availability, type
  - Resource calendar

- **Activity Duration Estimation**
  - Most likely
  - Best Case
  - Worst Case

- **Schedule Development**
  - Analyse sequence, duration, resources and constraints

**Approval Phase**

- **Time management planning**
  - Project scope statement outlines processes, tools and techniques to develop, monitor and control schedule
1.1 Time management planning

Time management activities are preceded by a planning effort conducted by the project team members, which is part of the project scoping process, conducted in the proponent phase of the project. This section deals with the shaded area in Figure 4.

Consultation with stakeholders and consideration of other project objectives such as quality, risk and cost identifies the constraints which will affect the scheduling of the project. An example of a constraint includes scheduled milestone completion dates imposed by management or the client. At this stage, the tools, techniques, processes, policies and procedures to be followed in developing, implementing, monitoring, controlling and reviewing the schedule are agreed upon by the team, along with any underlying assumptions. It is not unusual for several alternative time management proposals to be submitted in the proponent phases. The results are documented in the project scope statement, which is consulted throughout the project when conducting time management activities.

1.2 Activity Definition

Having consulted the project scope statement, project time management planning begins with defining what activities need to be done to achieve the project’s deliverables. This section deals with the shaded area in Figure 5.
Activity Definition involves identifying the activities required to achieve the project’s deliverables. This process begins by compiling an Activity List, which forms the basis of a Work Breakdown Structure (WBS), a list of all the activities required to complete a project subdivided into more manageable components. Tasks are divided and subdivided into ever smaller tasks using a technique called ‘decomposition’. When tasks can be broken down no further, their sequential relationships are analysed before the project’s duration, effort, resource requirements and costs can be estimated.

The Activity List is the basis for developing a WBS. A WBS may be depicted in a variety of ways, including a table, and outline, or a tree diagram. The WBS begins with the overall project objective at the top and then uses the activities in the Activity List to break the project down into several smaller, more manageable tasks.

The process of creating a WBS will now be described in greater detail using the example of building a shed. Fred’s Sheds is a successful franchise in the home building industry. Fred’s Sheds build specific purpose sheds for home gardens, farms and industrial storage facilities. The shed building process is described in detail in Case Study 2. The main activities to build a shed are depicted in Figure 6. This Activity List forms the basis for the WBS.

Some of the listed tasks can be grouped together as they are related to each other or are completed around the same time as other tasks. For example, obtaining council approvals and signing the contract are all activities that take place in preparation for the job commencing. As a result, these activities can be grouped together into a “Preparation” phase. Similarly, establishing the site amenities, checking existing boundaries and checking underground cable locations form part of the “Construction” phase.
Phases generally represent the major stages in completing the project’s deliverables and are usually marked by management progress checkpoints. Figure 7 shows the Activity List grouped into Phases.

Figure 7 - Phases for building one of Fred’s sheds

<table>
<thead>
<tr>
<th>Preparation phase</th>
<th>Design Shed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obtain council approvals</td>
</tr>
<tr>
<td></td>
<td>Sign Contract</td>
</tr>
<tr>
<td>Construction Phase</td>
<td>Establish site services and amenities</td>
</tr>
<tr>
<td></td>
<td>Check existing boundaries</td>
</tr>
<tr>
<td></td>
<td>Check underground cable locations</td>
</tr>
<tr>
<td></td>
<td>Excavate site</td>
</tr>
<tr>
<td></td>
<td>Pour Concrete</td>
</tr>
<tr>
<td></td>
<td>Install Shed</td>
</tr>
<tr>
<td>Completion Phase</td>
<td>Connect utilities to shed</td>
</tr>
<tr>
<td></td>
<td>Clean up site</td>
</tr>
<tr>
<td></td>
<td>Hand over keys and warranties</td>
</tr>
<tr>
<td></td>
<td>Final Payment</td>
</tr>
</tbody>
</table>

Task activities can be broken down into smaller activities using a process called decomposition. The activities required for building a shed can be broken down into smaller, more discrete activities. For example, in the preparation phase, the task of designing the shed can be broken down into several smaller tasks such as consulting with the client to establish their requirements, drafting a design, submitting the design for review, completing a revised design and gaining final approval from the client. Obtaining council approvals can be broken down into submitting a Development Application, submitting a construction certificate, and obtaining Home Owner’s Warranty Insurance. In the construction phase, establishing the site services and amenities involves checking the water meter prior to construction starting, connecting electricity to the site, erecting a temporary site fence and hiring a temporary toilet.

These tasks can be broken down even further. For example, connecting the electricity involves hiring an electrician to connect the power, gaining written permission from the site owner to erect a temporary electricity supply, and organising a meter reading. The greater the level of decomposition, the more precise the resource, duration and cost estimates will be. Deciding on the detail of decomposition performed in the WBS is determined by several factors. These include the project’s complexity, the amount of risk involved, and the amount of management control and desired accuracy of estimates. This information should be contained in the project’s scope statement. Personal experience, expert opinion or levels of decomposition of similar, previously completed projects are also useful in determining how many levels a WBS should be decomposed.
Tasks can be grouped together as discrete work packages, separated from other work packages by milestones. Milestones are points in a schedule where significant events or deliverables occur. Larger milestones can occur between phases of a project, or at the conclusion of smaller work packages as in the example above. An example of a milestone list is depicted in Figure 8 below:

Figure 8 - Milestone List

<table>
<thead>
<tr>
<th>MILESTONE LIST</th>
<th>DATE COMPLETED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Preparation activities completed</td>
<td>12/1</td>
</tr>
<tr>
<td>Site preparation activities completed</td>
<td>15/1</td>
</tr>
<tr>
<td>Construction activities completed</td>
<td>25/1</td>
</tr>
<tr>
<td>Close out activities completed</td>
<td>31/1</td>
</tr>
</tbody>
</table>

**LEARNING ACTIVITIES**

**ACTIVITY 1**

**Draw a WBS**

Create a WBS for going on a holiday. Group similar activities together into phases. Then decompose (break down) each activity into smaller activities.

Keep dividing the tasks up until you can no longer break the activities up any more.

Assign each task an identification number.

Assign milestones to your project at points where significant events or project deliverables have to occur (e.g. deciding on destination, paying deposits).

Put your WBS in a table such as the one provided below:

<table>
<thead>
<tr>
<th>PHASE</th>
<th>TASK NO.</th>
<th>TASK NAME</th>
<th>MILESTONES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proponent</td>
<td>1</td>
<td>Decide on destination</td>
<td>Agreement reached by family of holiday date</td>
</tr>
<tr>
<td>Approval</td>
<td>2</td>
<td>Submit annual leave forms</td>
<td>Approval forms for holidays signed</td>
</tr>
<tr>
<td>Implementation</td>
<td>3</td>
<td>Fly to destination</td>
<td>Arrival at destination</td>
</tr>
<tr>
<td>Completion</td>
<td>4</td>
<td>Fly Home</td>
<td>Arrive at home airport</td>
</tr>
</tbody>
</table>
1.3 Activity Sequencing

Activity Sequencing is represented in the shaded portion of Figure 9.

The Activity List captures the tasks necessary to complete the project. However, it does not provide any information about whether the relationships between tasks are logical or possible. Having decomposed the project activities, the next step is to work out the logic of the sequential relationships between tasks. Establishing the proper precedence relationships between tasks ensures that the project schedule will be realistic and achievable. There are four types of task precedence relationships:

1. **Finish – Start** - where a task cannot begin until its predecessor is completed. If the first task is delayed, then the second task will also be delayed, therefore the completion of these tasks must be monitored closely or the project will not finish on time. An example of a finish-start relationship is the requirement to obtain council approvals before site preparation activities can begin when building a house. This is the most common type of relationship found in project management. Because of the linear relationship between the tasks, they are said to occur ‘in series’.

2. **Finish - Finish** – where a task cannot finish until its predecessor is finished. An example is when a contractor delivering a new computer application completes final testing before the whole project can be declared completed. Because there is some overlap between when the activities are completed, they are said to occur ‘in parallel’.

3. **Start-Start** – where a task cannot start without another task commencing. An example is the commencement of a project triggering the start of financial tracking systems. These tasks also occur in parallel.

4. **Start – Finish** – where a task cannot finish until its predecessor starts. The commencement of the first task results in the completion of the second task. An example is when nurses start an afternoon shift, allowing the morning shift staff to go home. These tasks occur in series.
LEARNING ACTIVITIES

ACTIVITY 2

Predecessor relationships
1. Using the Activity List for building from Figure 6, list the predecessor tasks that must be completed before each task can commence.
2. Then list what kind of precedence relationship exists between them.
3. Which tasks can occur at the same time (in parallel), and which of them have to be completed in series?

To analyse the logic of the relationships when sequencing work tasks, a tool known as the “Program Evaluation Review Technique” (PERT) is used. Also known as a ‘network diagram’, ‘precedence diagram’ or ‘logic network’, the PERT diagram organises and sequences the project tasks and their logical relationships in a schematic diagram. Figures 10 and 11 show examples of PERT diagrams; one for activities occurring ‘in series’ and one for activities occurring ‘in parallel’.

Figure 10 – PERT diagram ‘in series’

![Figure 10 – PERT diagram ‘in series’](image)

Figure 11 – PERT Diagram ‘in parallel’

![Figure 11 – PERT Diagram ‘in parallel’](image)

When drawing a PERT diagram, time flows from the left to the right of the diagram, depicted by the arrows on the lines between the boxes. Activities are listed in the order in which they occur in the WBS. The lines connecting the boxes in the diagram, which are known as activity boxes, show the relationships between the activities. Each activity box has at least one line going in and out of it, except the initial and final project activities.
Once a PERT diagram is drawn, it should be checked for errors in logic. The two most common errors found are “dangling” and “looping tasks”. A dangling task is one that does not have a successor activity in the PERT diagram. It is not connected to a completed project path or the finish of the project. In Figure 12 below, if Task D is the finishing project activity, then Task E is a dangling task as it is not connected to the finishing activity (Task D).

Figure 12 – Dangling tasks

The other most common error in PERT diagrams is looping tasks. These are groups of tasks which are dependent on each other and recur without progression towards a successor activity. In Figure 13, Tasks C, E, and F are looping tasks.

Figure 13 – Looping tasks

Drawing a PERT diagram is often easier if drawn on a whiteboard. This allows you to easily erase and redraw tasks and their relationships. Another alternative is to use Post-it notes on a wall to depict the project’s sequence of tasks activities and tasks. Using these methods also makes it easier to spot errors in logic more easily.

Figure 14 shows a PERT diagram for building a shed. For ease of illustration, the PERT has been broken down according to the phases used in Figure 7. Note that each task is contained in a box. These are known as activity nodes. The arrows signify the precedence relationships between tasks, moving from a left to right direction. Note that there are no looping or dangling tasks.
TOPIC 1 | Assist in the development of project schedules

Figure 14 – PERT diagram for building a shed

![PERT diagram for building a shed](image)

LEARNING ACTIVITIES

**ACTIVITY 3**

**Drawing a PERT diagram**

Using the WBS you created for planning a holiday, draw a PERT diagram for the tasks involved in going on holiday. It may help to draw the PERT on a whiteboard or using Post-It notes. Check the PERT for any errors in logic, dangling or looping tasks and make any adjustments accordingly.
1.4 Activity Resource Estimation

Having established the predecessor relationships between the tasks in the WBS and checked that they are logical in the PERT diagram the next step in developing the project’s schedule is to estimate the resources required to perform each activity. This requires the project team to determine what types of resources are required, such as personnel, equipment and materials, what quantity is needed and when they are required by the project.

Activity resource estimating is done in close coordination with the cost estimation process. Expert judgement, published resource lists, organisational resource databases and project management software are some examples of the tools and techniques which may be used to create resource estimates. Consideration must be given to the availability of project resources when creating resource estimates also.

Learning Activities

Activity resource estimation

Ask the project manager of a project you are currently working on or worked on previously for a copy of the Activity Resource estimates. After you have read them, answer the following questions:

1. What documents were used to assist with activity resource estimation (e.g. activity lists, project scope document)?

2. What tools and techniques were used to assist with the resource estimate (e.g. expert judgement, published resource data)?

3. How significant was the cost of resources in making decisions in choosing the required resources?

You may like to interview the project manager to obtain more information before answering these questions.
1.5 Activity Duration Estimation

Activity Duration estimation seeks to determine the amount of work required to complete each activity listed in the WBS. It is usually preceded by Activity Resource estimation because the availability of resources assigned to WBS tasks will in turn influence the duration of those tasks. For example, the allocation of more construction staff to building a shed will reduce the time taken to install it.

Organisations may have historical reference data from other projects containing duration estimates from similar projects which may be used, along with expert opinion and previous experience, to develop the estimate.

Often three estimates are made for activity durations - a best, worse and most likely scenario - with the results averaged to provide a more accurate estimation of the duration for each activity.

Additional time is often built into the duration estimates to take unforseen risks into consideration.

CASE STUDIES

Activity duration estimation

For the construction of Mr Jones’ shed in Case Study 2, estimate the time required to complete each activity in the WBS. Make sure that the total duration of the tasks fits with Mr Jones’ specification.
### 1.6 Completed Work Breakdown Structure

Having defined the project’s activities, determined and checked the sequential relationships between tasks, and formulated estimates for the resources and duration of each task in the WBS, a full WBS can be completed. A completed WBS for building a shed is shown in Figure 17 on the following page.

#### Figure 17 – Sample WBS for Building a Shed

<table>
<thead>
<tr>
<th>TASK NUMBER/ID</th>
<th>TASK DESCRIPTION</th>
<th>PREDECESSOR RELATIONSHIP (SEQUENCE)</th>
<th>TIME IN DAYS</th>
<th>RESOURCES (PEOPLE AND MATERIALS REQUIRED TO COMPLETE THE TASK)</th>
<th>COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Design Shed</td>
<td>N/A</td>
<td>3 days</td>
<td>Designer</td>
<td>$1000</td>
</tr>
<tr>
<td>1.2</td>
<td>Obtain council approvals</td>
<td>1.1</td>
<td>14 day</td>
<td>Project manager to submit engineering, design specifications and construction certificates</td>
<td>$500</td>
</tr>
<tr>
<td>1.3</td>
<td>Sign Contract</td>
<td>1.1, 1.2</td>
<td>.2 day</td>
<td>Project manager</td>
<td>$0</td>
</tr>
</tbody>
</table>

**2. Construction Phase**

<table>
<thead>
<tr>
<th>TASK NUMBER/ID</th>
<th>TASK DESCRIPTION</th>
<th>PREDECESSOR RELATIONSHIP (SEQUENCE)</th>
<th>TIME IN DAYS</th>
<th>RESOURCES (PEOPLE AND MATERIALS REQUIRED TO COMPLETE THE TASK)</th>
<th>COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Check existing boundaries</td>
<td>1.1, 1.2</td>
<td>1 day</td>
<td>Surveyor</td>
<td>$1500</td>
</tr>
<tr>
<td>2.2</td>
<td>Check underground cable locations</td>
<td>1.1, 1.2</td>
<td>1 day</td>
<td>Project manager to contact utilities</td>
<td>$100</td>
</tr>
<tr>
<td>2.3</td>
<td>Establish site services and amenities</td>
<td>1.1, 1.2</td>
<td>2 days</td>
<td>Fence construction team (2), electrician, plumber, require hired toilet, fencing materials</td>
<td>$6000</td>
</tr>
<tr>
<td>2.4</td>
<td>Excavate site</td>
<td>2.1, 2.2</td>
<td>3 days</td>
<td>Excavation team (3)</td>
<td>$7500</td>
</tr>
<tr>
<td>2.5</td>
<td>Pour Concrete and wait for it to set</td>
<td>2.4</td>
<td>2 days</td>
<td>Construction team (4)</td>
<td>$8000</td>
</tr>
<tr>
<td>2.6</td>
<td>Install Shed</td>
<td>2.5</td>
<td>2 days</td>
<td>Construction team (4)</td>
<td>$15000</td>
</tr>
</tbody>
</table>

**3. Completion Phase**

<table>
<thead>
<tr>
<th>TASK NUMBER/ID</th>
<th>TASK DESCRIPTION</th>
<th>PREDECESSOR RELATIONSHIP (SEQUENCE)</th>
<th>TIME IN DAYS</th>
<th>RESOURCES (PEOPLE AND MATERIALS REQUIRED TO COMPLETE THE TASK)</th>
<th>COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Connect utilities to shed</td>
<td>2.6</td>
<td>2 days</td>
<td>Electrician, Plumber</td>
<td>$2500</td>
</tr>
<tr>
<td>3.2</td>
<td>Clean up site</td>
<td>2.5</td>
<td>3 days</td>
<td>Construction team (2)</td>
<td>$3500</td>
</tr>
<tr>
<td>3.3</td>
<td>Hand over keys and warranties</td>
<td>3.2</td>
<td>1 day</td>
<td>Project Manager</td>
<td>$0</td>
</tr>
<tr>
<td>3.4</td>
<td>Final Payment</td>
<td>3.3</td>
<td>0 days</td>
<td></td>
<td>$0</td>
</tr>
</tbody>
</table>

NB: Precision to check timelines and costs and cross-reference with Case Study, Network and PERT analyses
**Completing the WBS**

Complete the WBS you started for planning a holiday by:

1. Estimating the resources required for each activity
2. Estimating the duration of each activity.
3. Estimating the cost of each activity.

Document your completed Work Breakdown Structure for going on a holiday in the table below.

<table>
<thead>
<tr>
<th>TASK NUMBER/ID</th>
<th>TASK DESCRIPTION</th>
<th>PREDECESSOR RELATIONSHIP (SEQUENCE)</th>
<th>TIME REQUIRED</th>
<th>RESOURCES</th>
<th>EQUIPMENT</th>
<th>MATERIAL</th>
<th>HUMAN</th>
<th>COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.7 Critical Path Analysis

A Critical Path Analysis is a technique which identifies the essential tasks that must be completed on time and avoid delaying the realisation of project objectives. If tasks along the critical path are delayed, then the project will not be completed on time. The critical path of a project represents the longest sequence of activities through the network depicted in the PERT diagram.

Figure 18 shows a PERT diagram of the Completion phase for building one of Fred’s sheds. Two paths are required to accomplish this phase.

Figure 18 – Critical path for building a shed

The first path consists of installing the shed, connecting the utilities, handing over the keys, and receiving final payment to complete the job. The second involves installing the shed, cleaning up the site, handing over the keys, receiving the final payment and completing the job. The first path takes 6 days, whereas the second path takes 7 days.

The second path is the critical path because it is the longest path through the network. A delay of as little as one day in installing the shed, cleaning up the site, handing over the keys will guarantee that the handover of the keys and completion of the job will be delayed. However, in comparison, if the connection of the utilities is delayed by one day, then this will not cause the whole project to be delayed, because it has a spare day, known as ‘float’, awaiting the completion of the site clean-up, before the next stage of the project, handing over the keys, is delayed from starting.
Learning Activities

Activity 6

Working out the Critical Path

Given the following Work Breakdown Structure, draw a PERT diagram, work out the critical path for the project listed below. Identify where any float time is in the project.

<table>
<thead>
<tr>
<th>TASK</th>
<th>DURATION</th>
<th>PREDECESSOR TASK</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4 days</td>
<td>N/A</td>
</tr>
<tr>
<td>B</td>
<td>4 days</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>5 days</td>
<td>A</td>
</tr>
<tr>
<td>D</td>
<td>6 days</td>
<td>B</td>
</tr>
<tr>
<td>E</td>
<td>7 days</td>
<td>C</td>
</tr>
<tr>
<td>F</td>
<td>2 days</td>
<td>D, E</td>
</tr>
</tbody>
</table>

Remember that every task has to be completed in a project for the project to be completed, so concentrating solely on those tasks that are part of the critical path will not ensure the project will be finished on time.

Identifying and analysing the critical path can be very complex. For further information about Critical Path Analysis, refer to a project management text such as *Project Management: A competency based approach*, or *A Guide to the Project management Body of Knowledge*, which are both in the reference list.

1.8 Leads and Lags

For each task in a project, the completion of the first task in a sequence (the predecessor task) may allow the following successor task to commence. This is called lead time. A lead is the acceleration of a successor task so that it commences prior to the predecessor task’s completion. For example, when building a shed, the clean up of a site can begin before the installation of the new structure.

Applying lead time to a schedule can result in earlier completion of the project. Another example is when you are writing a report (the predecessor task), you can commence editing (the successor task) before you complete writing the first draft. Successor tasks may also be delayed by applying a lag, which is a delay in the start of a successor activity. An example of a lag is waiting a week after the contract is signed to commence construction of a shed. Another example is waiting an extra day after the concrete has set before installing the shed.

Lags may come about for various reasons, including the unavailability in resources or delays to other tasks. It is wise to build in lag time to the project schedule to plan for these sorts of contingencies. Leads and lags will be discussed again when discussing how to depict the project schedule on a Gantt chart.
1.9 Network Analysis

The critical path analysis identified which tasks are critical and non-critical for the completion of the project. While tasks along the critical path must start and finish on time to ensure the project is completed on time, non-critical tasks have some flexibility in their starting and/or finishing date, without delaying the finish. Performing a network analysis enables you to determine the earliest and latest starting and finishing times for non-critical tasks. Figure 19 (below) depicts the PERT diagram used in Figure 18 with a completed network analysis shown.

Figure 19 – Network Analysis – Building a shed

Note that two sets of numbers have been recorded— the numbers across the top of each activity box in blue and the ones in red below. The blue numbers represent a network analysis conducted from left to right, called a “forward pass analysis” and the red numbers from right to left, a “backward pass analysis”.

In a **forward pass analysis**, the earliest possible starting and finishing times for a project are determined.

In a **backwards pass analysis**, the latest possible start and finishing times for each task can be worked out.

Both a **forward** and **backward** pass analysis should be conducted in the network analysis to identify discrepancies between possible start and finish dates (discussed in more detail below).

Looking at the blue numbers in Figure 19, the number at the top left of each box indicates the earliest possible starting time for each task, with the earliest possible finishing time on the top left. Conversely, for the red numbers, the number at the bottom left of the activity box represents the latest possible starting time on the left and the latest possible finishing time on the right.
Conducting a forward pass analysis in Figure 20 (the blue numbers going from left to right across the top of the activity boxes), you can see that if the installation of the shed takes 2 days, commencing on 1/1, the earliest possible finishing time is the 2/1 (2 working days). Connecting the utilities commences the next working day, on the 3/1, also takes two days, finishing at the close of business on the 4/1. There is a gap of one day before the next stage of the process begins, because the task on the other path, cleaning up the site, takes three days. This spare day is called a ‘float’ and is important because it provides us with an option as to when we wish to schedule this task. It also indicates that connecting the utilities is not a critical task, thus confirming our earlier assumption about the critical path. When the site is cleaned up a day later, the keys are handed over and the job is completed on the 6/1.

A backwards pass analysis highlights the latest possible starting and finishing dates for each task without jeopardising the project’s finishing date. Working from the bottom right corner of the activity boxes in Figure 19 in a right to left direction, the latest possible finishing date for the project is the 6/1. Handing over the keys takes one day, so the latest possible finishing date for this task is the morning of 6/1. The network then branches out into two separate branches. The latest possible finishing time for both connecting the utilities and cleaning up the site is the close of business on the 5/1. The latest possible starting date for connecting the utilities is the morning of 4/1 (2 days), while for cleaning up the site, which takes 3 days, is the 3/1. Working backwards, the latest possible finishing date for installing the shed is the 2/1, leaving the latest possible starting date of 1/1.

Having completed the analysis you should now look for the discrepancies between the early and late start and finishing times for each activity. For installing the shed, there is no difference between the early and late starting times or the early and late finishing times. This indicates that it is a critical task, because it simply must start on the 1/1 and finish on the 2/1. However, for the connection of the utilities, the early start time is 3/1 and the latest start time is 4/1 - a 1-day difference. This means that connecting the utilities is not a critical task, and it also allows the project scheduler to decide whether to start connecting the utilities on the 3/1 or the 4/1.

The network analysis has enabled you to confirm the critical path, identify where float lies in the schedule, and allows the project scheduler some flexibility in deciding the project’s planned schedule.
LEARNING ACTIVITIES
ACTIVITY 7

Network Analysis
Given the WBS below, construct a PERT diagram, identify the Critical Path, and perform a network analysis to identify the early and late starting and finishing times for each activity. Then answer the questions below. Assume the project commences on 1/2/05.

<table>
<thead>
<tr>
<th>TASK</th>
<th>DURATION</th>
<th>PREDECESSOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task A</td>
<td>1 day</td>
<td>-</td>
</tr>
<tr>
<td>Task B</td>
<td>1 day</td>
<td>Task A</td>
</tr>
<tr>
<td>Task C</td>
<td>2 days</td>
<td>Task A</td>
</tr>
<tr>
<td>Task D</td>
<td>1 day</td>
<td>Task B</td>
</tr>
<tr>
<td>Task E</td>
<td>2 days</td>
<td>Task C</td>
</tr>
<tr>
<td>Task F</td>
<td>1 day</td>
<td>Tasks D and E</td>
</tr>
</tbody>
</table>

1. What date does the project end?
2. What is the latest possible starting date for Task D?
3. What is the earliest possible finishing date for Task E?
4. Are there any gaps between the early and late starting times? If so, where are they located?
5. Are there any gaps between the early and late finishing times? If so, where are they located?
6. How many days float is there?
7. Which tasks are critical to the project’s completion?
8. Which tasks are non-critical to the project’s completion?
1.10 Gantt Charts

The next step in developing the project’s schedule is to construct a graphical representation of the work activities using a tool known as a Gantt chart. A Gantt chart lists the project timelines and tasks in parallel. It is usually derived from the PERT diagram. Gantt charts are relatively easy to construct and provide a highly effective visual overview of the project schedule. It is also a handy tool to check the project’s current status, and provides a useful tool for monitoring the progress of the schedule.

Figure 20 shows an example of what a Gantt chart looks like.

Figure 20 – Example of a Gantt chart
Each bar represents the duration of the task, while the lines and arrows show the relationships between tasks. The diamonds represent milestones.

In Figure 20, for example, Task A goes from Monday to Thursday (4 days). Completion of Task A allows its successor activity, Task B, to commence on Friday of the first week. This task lasts 4 working days, ending on the Wednesday in the week beginning the 8/1/05. Task C commenced 1 day before the conclusion of Task B, meaning there is on day’s lead time between Tasks B and C. Task C, commencing on Wednesday, lasts 5 working days. Upon completion of Task C, Task D begins, lasting two days, until the end of the project, shown as a black diamond on the Gantt chart, is reached.

Analysis of the Gantt chart reveals the relationships between tasks. Remember earlier in this guide when learning about Activity Sequencing (2.3.3) you learnt about four types of task relationships. These were:

1. **Finish – start** relationships (where a task begins after its predecessor task finishes)

2. **Finish – finish** relationships (where a task cannot finish till its predecessor task finishes)

3. **Start – start** relationship (where a task cannot start without another task commencing)

4. **Start – finish** relationship (where a task cannot finish until its predecessor starts)

Figures 21-24 show how these relationships are depicted on a Gantt Chart:

**Figure 21 – Finish – Start Relationships**

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Week Beginning 1/1/05</th>
<th>Week Beginning 8/1/05</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Task A</td>
<td>M T W F S S</td>
<td>M T W T F S S</td>
</tr>
<tr>
<td>2</td>
<td>Task B</td>
<td>M T W F S S</td>
<td>M T W T F S S</td>
</tr>
</tbody>
</table>

Example: When building, obtaining a council permit (Task A) enables site preparation to begin.

**Figure 22 – Finish – Finish Relationships**

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Week Beginning 1/1/05</th>
<th>Week Beginning 8/1/05</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Task A</td>
<td>M T W F S S</td>
<td>M T W T F S S</td>
</tr>
<tr>
<td>2</td>
<td>Task B</td>
<td>M T W F S S</td>
<td>M T W T F S S</td>
</tr>
</tbody>
</table>

Example: The completion of testing (Task A) allows the project manager to complete the closeout phase of a project to install a new computer system.
TOPIC 1 | Assist in the development of project schedules

Figure 23 – Start – Start Relationships

Example: The commencement of a project (Task 1) allows financial tracking activities (Task 2) to begin.

Figure 24 – Start – Finish Relationships

Example: The start of Nurse’s afternoon shift allows the morning staff to finish their shift and go home.

Figures 25 and 26 show examples of what a lead and a lag look like or a Gantt chart.

Figure 25 – Lag depicted on a Gantt chart

Example: Task B (the successor activity) starts 2 days prior to the completion of Task A.
LEARNING ACTIVITIES

ACTIVITY 8

Gantt Chart Analysis

Having seen how the various task relationships, leads, lags and milestones have been depicted on a Gantt chart, analyse the Gantt chart in Figure 27 (below) and answer the following questions:

1. What is the relationship between:
   a) Task A and Task B?
   b) Task A and Task C?
   c) Task D and Tasks B & E?
   d) Task D and Task E?
   e) Task E and F?

2. How much lead-time is there for Tasks B and C respectively?

3. Is there any lag time depicted in this schedule? If so, where is it, and how long is it?

4. Assuming the project commenced on 1/1/05, when did it conclude?

5. Which tasks comprise the Critical Path?

6. What does the black diamond represent?
Figure 27 – Gantt chart to be analysed for Activity 8

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Task A</td>
</tr>
<tr>
<td>2</td>
<td>Task B</td>
</tr>
<tr>
<td>3</td>
<td>Task C</td>
</tr>
<tr>
<td>4</td>
<td>Task D</td>
</tr>
<tr>
<td>5</td>
<td>Task E</td>
</tr>
<tr>
<td>6</td>
<td>Task F</td>
</tr>
<tr>
<td>7</td>
<td>Task G</td>
</tr>
</tbody>
</table>
Creating a Gantt chart

1. Given the following WBS for building a house, depict the project’s schedule on a Gantt chart.
   a) Consider which activities could occur simultaneously and which tasks could be completed before another task can begin.
   b) Consider also applying leads and lags to the schedule.
   c) Check the predecessor relationships between tasks as well.

Assume that working days are Monday to Saturday inclusive and that the project commences on 1/1/2005.

<table>
<thead>
<tr>
<th>TASK NO.</th>
<th>TASK NAME</th>
<th>DURATION (DAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quote client</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Finalise design and negotiate contract</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Sign contract</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Obtain council approvals and insurances</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Order materials</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Set up temporary site facilities</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Allocate workers to job</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Mark out site</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Dig foundations</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Erect formwork</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Pour concrete foundations and await for it to set</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>Strip formwork</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Erect house frame</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>Install roof</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>Insert fixtures and fittings</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>Install and connect services (electricity, plumbing)</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td>Install windows, doors, heating</td>
<td>5</td>
</tr>
<tr>
<td>18</td>
<td>Complete internal fit out</td>
<td>5</td>
</tr>
<tr>
<td>19</td>
<td>Landscape garden</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>Clean up site</td>
<td>7</td>
</tr>
<tr>
<td>21</td>
<td>Remove temporary site facilities</td>
<td>5</td>
</tr>
<tr>
<td>22</td>
<td>Final tidy up</td>
<td>2</td>
</tr>
<tr>
<td>23</td>
<td>Hand over keys</td>
<td>1</td>
</tr>
</tbody>
</table>
Having considered the project constraints, developed a WBS, checked the logic of task relationships, and estimated the required resources and duration for the project, the next step is to create the schedule.

Figure 28 – Schedule development

Schedule Development determines the planned start and finish dates for each project activity. It may require resource and duration estimates to be reviewed before the baseline schedule is created against which the project’s actual schedule is tracked.

Developing a project schedule is continued and repeated throughout the project’s life cycle as work proceeds, new risks emerge, risks are realised or the project’s scope changes.

A variety of techniques can be used to develop a project schedule. Among these include conducting a critical path analysis, a network analysis, applying leads and lags, and depicting the schedule using a Gantt chart.

The following information and activities will enable you to practise using these tools so that you can analyse the project constraints, task relationships, resource and duration estimates to create a project schedule.
Topic 2: Apply agreed schedules

Learning outcomes covered in determination of human resources requirements are:

- using techniques to measure, record and report progress in relation to agreed schedules and plans including variances between actual and planned progress
- forecasting the impact of changes on the schedule and analysis of options
- implementing agreed changes to the schedule to accommodate changing situations throughout the project.

2.1 Schedule Implementation

This section deals with Schedule implementation.

Figure 29 – Schedule implementation
Once the schedule has been developed it must be implemented. During the implementation phase, techniques are used which measure, record and report the process of activities and how they are affecting the schedule. The progress of the schedule may be recorded in things such as a list of potential schedule events, the project diary, incident logs, and project records. Computer software programs may be used to conduct an analysis of the variance between the planned and actual schedule. A comparison Gantt chart is a useful way of displaying any discrepancies between the planned and actual schedule.

**LEARNING ACTIVITIES**

**ACTIVITY 10**

**Schedule Implementation**

Answer the following questions about a project you are currently working on or have worked on in the past.

a) What techniques, tools or methodologies is the project manager currently using to measure and record the progress of the project’s schedule?

b) What activities do you perform to assist the project manager, measure, record and review the schedule?

c) What process do you follow to report the progress of scheduled activities?

d) Who do you report discrepancies in the schedule to?

e) What happens when those discrepancies are reported?
Topic 3: Review project time management activities

Learning outcomes covered in determination of human resources requirements are:

- reviewing of project outcomes to determine the effectiveness of time management tools, techniques and approaches used
- reporting scheduling and time management issues for application in future projects.

This section deals with review project time management techniques.

Figure 30 – Review project time management techniques
At the conclusion of a project it is also important for team members to participate in a review of the time management activities, tools and processes used in the project so that future projects can benefit from the lessons learned during the project. This information can add to an organisation’s store of knowledge, lead to modifications and improvements in policies and procedures, tools and techniques so that the organisation as a whole benefits from better time management practices in the future. A thorough review of the effectiveness of the time management tools, techniques and approaches used, combined with identifying the scheduling and time management issues, should be reported to the project manager, who compiles a report containing lessons for future projects. This forms an important part of the quality assurance process of project management and leads to improved organisational performance.
Appendices

Templates

Sample PERT diagram for building a shed
Sample Work Breakdown Structure (WBS)

<table>
<thead>
<tr>
<th>TASK NUMBER/ID</th>
<th>TASK DESCRIPTION</th>
<th>PREDCESSOR RELATIONSHIP</th>
<th>TIME IN DAYS</th>
<th>RESOURCES (PEOPLE AND MATERIALS REQUIRED TO COMPLETE THE TASK)</th>
<th>COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Design Shed</td>
<td>N/A</td>
<td>3 days</td>
<td>Designer</td>
<td>$1000</td>
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<tr>
<td>1.2</td>
<td>Obtain council approvals</td>
<td>1.1</td>
<td>14 days</td>
<td>Project manager to submit engineering, design specifications and construction certificates</td>
<td>$500</td>
</tr>
<tr>
<td>1.3</td>
<td>Sign Contract</td>
<td>1.1, 1.2</td>
<td>2 day</td>
<td>Project manager</td>
<td>$0</td>
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<tr>
<td>2.1</td>
<td>Check existing boundaries</td>
<td>1.1, 1.2</td>
<td>1 day</td>
<td>Surveyor,</td>
<td>$1500</td>
</tr>
<tr>
<td>2.2</td>
<td>Check underground cable locations</td>
<td>1.1, 1.2</td>
<td>1 day</td>
<td>Project manager to contact utilities</td>
<td>$100</td>
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<tr>
<td>2.3</td>
<td>Establish site services and amenities</td>
<td>1.1, 1.2</td>
<td>2 days</td>
<td>Foreman construction team (2), electrician, plumber, require hired toilet, fencing materials</td>
<td>$6000</td>
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<td>2.4</td>
<td>Excavate site</td>
<td>2.1, 2.2</td>
<td>3 days</td>
<td>Excavation team (3)</td>
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<td>2.5</td>
<td>Pour Concrete and wait for it to set</td>
<td>2.4</td>
<td>2 days</td>
<td>Construction team (4)</td>
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<td>2.6</td>
<td>Install Shed</td>
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<td>2 days</td>
<td>Construction team (4)</td>
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<td>3.1</td>
<td>Connect utilities to shed</td>
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<td>2 days</td>
<td>Electrician, Plumber</td>
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<td>3.2</td>
<td>Clean up site</td>
<td>2.5</td>
<td>3 days</td>
<td>Construction team (2)</td>
<td>$3500</td>
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<td>3.3</td>
<td>Hand over keys and warranties</td>
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<td>Final Payment</td>
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Template: Work Breakdown Structure (WBS)

<table>
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<tr>
<th>TASK NUMBER/ID</th>
<th>TASK DESCRIPTION</th>
<th>PREDECESSOR RELATIONSHIP (SEQUENCE)</th>
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<th>RESOURCES</th>
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Sample critical path for building a shed

Template Critical path Analysis

Template Network Analysis

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<tr>
<th>TASK</th>
<th>DURATION</th>
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<tr>
<td>Task B</td>
<td>1 day</td>
<td>Task A</td>
</tr>
<tr>
<td>Task C</td>
<td>2 days</td>
<td>Task A</td>
</tr>
<tr>
<td>Task D</td>
<td>1 day</td>
<td>Task B</td>
</tr>
<tr>
<td>Task E</td>
<td>2 days</td>
<td>Task C</td>
</tr>
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<td>Task F</td>
<td>1 day</td>
<td>Tasks D and E</td>
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Sample Gantt Chart

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<td>Task C</td>
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<td>Task C</td>
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Case Studies

Case Study 1 Event Management

Asian Tsunami Benefit Cricket Match

On December 26th 2004, an earthquake measuring 9.0 on the Richter scale occurred in the Indian Ocean just off the western coast of northern Sumatra, Indonesia. The sudden vertical rise in the seabed by several metres displaced massive volumes of water, which resulted in a tsunami that devastated the shores of Bangladesh, Burma, Indonesia, Malaysia, the Maldives, South India, Sri Lanka, Thailand and as far away as Kenya and Somalia. The earthquake and tsunami were thought to have caused over 200,000 deaths, while whole sections of coastline were devastated, destroying the businesses and homes of millions, triggering a widespread humanitarian response. Throughout Australia many appeals were launched to raise money for humanitarian agencies to provide relief to the many injured and traumatised survivors.

The international cricket community launched one such appeal. With cricket being a popular sport in many of the affected countries, especially India, Sri Lanka and Bangladesh, and several Sri Lankan players’ families injured in the tsunami, the cricket community decided to organise a charity cricket match to raise funds for the relief effort. The match between an Asian team and “Rest of World” team, featuring some of the world’s best players from Australia, New Zealand, Pakistan, India, Sri Lanka, the West Indies, England and Bangladesh was played at the Melbourne Cricket Ground on January 10, 2005.

Organising the charity match was a remarkable exercise in project management. With a busy international cricket calendar, organising matches between international teams usually takes approximately a year, yet this match was organised in the days immediately after the tsunami struck and played just 15 days later. Cricket Australia, the governing body of cricket in Australia, volunteered to organise and host the match and quickly set about the complicated process of organising the match.

Among the many tasks that needed to be completed were gaining permission from cricket’s world governing body, the International Cricket Council (ICC) to host the match, as well as the blessing of the game’s regional governing body in Asia, the Asian Cricket Council (ACC), and the individual cricketing authorities in each of the countries who provided players for the match. The next step was to gain support from the International Cricket Players’ Association. This was quickly obtained, as the players were keen to support the match. Organising the teams proved to be a difficult exercise. Although Australia, Pakistan and the West Indies were playing in Australia at the time, the New Zealand, Indian and Bangladeshi players were at home, as were Sri Lankan players who had cancelled the remainder of their tour to New Zealand after the tsunami struck. The majority of the English team and all of the South African players were engaged in a cricket series in South Africa at the time, and unfortunately the best players from these two teams were unable to participate.

Among the many other tasks that had to be completed were gaining permission from the Melbourne Cricket Ground’s owners, the Melbourne Cricket Club, to use the stadium for the match and arranging to get the players to Melbourne from all around the world at short notice.
Publicising the match via television and print media, preparing a pitch, issuing tickets, and designing and making players’ uniforms, tasks that usually take months to prepare, were all accomplished promptly. A wide range of sponsorships were organised, including a 1 million dollar naming rights sponsorship, and hundreds of corporate boxes were sold at short notice during the traditional summer holiday period.

Negotiations were also required to be undertaken with construction unions and building contractors to stop work for a day, as the Melbourne Cricket Ground was in the middle of a redevelopment in preparation for the Melbourne 2006 Commonwealth Games. In addition, enough staff to run a match with a crowd of 70,000, such as ground staff, curators, security personnel, catering staff and cleaners needed to be obtained.

The match proved to be a tremendous success, raising over $15 million for the relief agency World Vision’s Asia Tsunami Appeal.

Case Study 2 Construction

Fred’s Sheds
Fred Smith, the founder and chief executive of Fred’s Sheds, received a phone call one afternoon from a local farmer, Mr Jones, requesting a quote to design and build a large storage shed on his property. Fred asked Mr Jones what size and type of shed he would like, when he wanted work to commence, and when he wanted it completed. Mr Jones told him that he required a large shed, big enough to store his tractor and utility vehicle, and spaces for a workbench, tools and fertilisers.

He also specified that the shed must have power, water and a toilet. He requested that the shed be made of high quality materials, because twice in the previous ten years some of the other sheds on his property had been damaged by inclement weather, costing him many thousands of dollars in repairs. Mr Jones wanted work to commence in 6 week’s time and would like the job completed no more than 3 weeks after that so he would have a place to store his vehicles before the winter rains came.

Mr Jones asked Fred to come up with a design and quote to build his shed and asked him to present them to him at a meeting at his house in a week’s time. He told Fred that he was obtaining three quotes from three different builders, and that he would select his preferred builder based on four criteria. These were quality, the ability to start and finish on time, and cost.

Mr Jones said he would like to spend no more than $40,000 on the shed, but would consider alternate proposals that were a little higher in price if they could exceed his minimum evaluation criteria.

As soon as Fred hung up the phone his mind started to think of all the different tasks he would need to do to win and complete the job. Having built many sheds before, he was confident he had the project management skills to build a shed that met Mr Jones’s extensive criteria. He jotted down some of his thoughts on a notepad so that he would not forget anything.
First of all, Fred knew he would have to come up with a winning design, so he would need to put his designer, Karen, on the job of coming up with some innovative designs. Fred would also have to source higher quality building materials than he usually used because, although Fred always used good materials, he thought he would try to use the best possible materials, if it was cost effective, to give him the edge in meeting Mr Jones’s stringent evaluation criteria over his two competitors.

Fred also knew that he would need to plan the human resources necessary to complete the job in the timeframe required. Some of his other construction projects were nearing completion, so it would not be too much of a problem getting some of his construction workers to start in 6 weeks’ time. However, Fred was not sure about the availability of his subcontractors, Eddie the electrician, Bob the plumber, Gary the glazier and Tony his fencing contractor and odd job man, because business was booming and they were all very busy.

If he was successful in winning the contract, Fred knew that there would still be lots of work to be done. After signing the contract, he would need to submit a Development Application and construction certificate to the local council and await their approval. Mr Jones’s final selections for colour and style of shed materials would need to be finalised and a deposit received prior to commencing work.

Once all that had been accomplished, Fred and his team of four would have to prepare the site for construction. This would involve performing underground cable service checks, and perhaps contracting a surveyor to locate existing boundaries as the shed was going to be built close to the boundary with Mrs Mitchell’s neighbouring property. The site would need to be cleared, temporary site facilities such as a toilet, site fencing, power and water would have to be established, the site set out and the formwork built. Following this, the site would be excavated.

While the excavation was taking place, Fred would need to remember to book a council inspection for the formwork prior to concreting, as well as booking the concrete truck, a date for the shed to be delivered, a date for the shed installation team to put the shed into place, and dates for his subcontractors to come and install power and water.

After pouring the concrete and finish, his team would need to strip the formwork. At this time Fred could invoice Mr Jones for a progress payment as this represented a milestone in the project. Following this the shed could be delivered and installed, Eddie the electrician could be called in to connect the mains power, Bob the plumber could connect the water and install the toilet and Gary the glazier could install the windows. While they were busy doing that, Fred and his team could start clearing the site, removing any rubbish and the temporary site amenities.

Once all these tasks were accomplished, the job would be at practical completion. Fred would then meet with Mr Jones, present him with a final bill and handover the keys to the shed. Fred smiled to himself feeling confident that he would beat his two competitors to the job and thinking that he would soon have another satisfied customer.
Case Study 3 Human Resources Management

Developing a training program
This project involves the design and development of a program to train “Authorised Officers”, or ticket inspectors on a metropolitan Public Transport System. The aim of the program will be to provide Authorised Officers with training in customer relations, communication skills and working in a culturally diverse culture. The government department responsible for public transport has issued a Request for Tender (RFT), inviting bids from suitably Qualified organisations, including TAFE colleges and Registered Training Organisations with expertise and experience in Community Service and Public Service training.

The following RFT details, issued by the government department responsible for public transport, provide an outline of what will be expected of the successful tenderer.

Background
In response to the release of a Parliamentary Law Reform Committee Report, the Minister for Transport, commissioned an independent and comprehensive review of the role, responsibilities, operations and functions (including the training) of Authorised Officers (AOs). The Government and the public transport providers have agreed to use the national training framework as the basis for all future training activity.

An agreement was reached to adopt a competency-based approach for AO’s training. Stakeholders have identified the particular competencies that are to be used, the structure and content of the training program together with the qualifications to be awarded on successful completion of the total training program.

The course structure consists of three stages:
1. Course development
2. Production of assessment instruments
3. Maintenance of a nationally accredited course

Stage one has been identified as requiring a full time training effort, with stages two and three being interspersed notionally over an eighteen month - two year period involving both on and off job training and assessment.

Purpose
In consultation and agreement with stakeholders, develop a curriculum, teaching materials, assessment tools and a maintenance strategy for a AO’s training program. A proposed framework (Attachment A) is included that lists the proposed tasks, actions and outcomes that are required to be completed to meet the requirements of this tender.

Key Deliverables
- Development of curriculum for a 420 hour course;
- Production of teaching and support materials for 14 units of competency; Development of a range of assessment tools, and
- Development of a strategy that will facilitate course evaluation, review and maintenance.
Contracts Proposal
The proposal submitted by the contractor should detail the following:

- the contractor's understanding of the scope and purpose of the assignment and of the key issues which will need to be addressed in its conduct;
- the 'deliverables' from the contractor;
- the name(s) and relevant experience of the contractor;
- the total estimated cost for each stage plus overall cost to deliver the project;
- the availability of the nominated contractor and the potential commencement date; and
- the nature of any information and/or support expected from the Department.

Proposals will be evaluated on the basis of the following criteria:

- understanding of the tasks/appropriateness of the proposed approach/methodology;
- demonstrated expert knowledge and skills in training program development;
- relevant experience of the contractor in training program development;
- extensive national and international knowledge of best practices in the training development field;
- fee rates and estimated total cost for each stage plus overall costs for the project.

Project Duration
Appointment will be considered initially for a period of up to 3 months. The contract management and administration will be undertaken by the Franchise Relationships Branch of the Public Transport Division.

Contractor Agreement
The contractor will be expected to indicate their willingness to execute the standard agreement for the purchase of services (Attachment C). Any proposed departures from these standard conditions are to be identified in the tenderer's response (Attachment D - schedule 13) to the contractor's proposal.

Payments
Payment will be based on total cost for the project. Milestone payments will be made for each stage completed.

Intellectual Property
Material created is Department’s Property. The ownership of all Intellectual Property and all Information created as a result of the provision of Services shall vest in the Department.

The successful tenderer was a business development unit in a TAFE institute, who proposed a budget of $240,000 for an eighteen month project. Below is an extract from their initial planning documents.
Planning Stage One: prepare course proposal

- Map existing units of competency from (TDT30402) Certificate III in T&D (Rail Operations) to the public transport job analysis and develop draft content clusters
- Identify and collate areas of underpinning knowledge and skill to be included
- Meet with [government department] to:
  - Clarify situation regarding the development of new units and
  - Identify workplace documents to be used as training materials
  - Identify any existing preferred training materials
  - Identify key stakeholders and contact personnel

Planning Stage Two: Scope definition

Key tasks for work breakdown schedule

- Document agreed objectives and deliverables
- Finalise timelines and work plans
- Develop scope management plan
- Establish administrative systems
- Confirm and brief project team

Planning Stage Three: Establish quality protocols and implementation parameters

- Set up project steering committee
- Convene first meeting to sign off content clusters and learning sequences
- PSG to review WBS, finalise and sign-off

Case Study 4 Home renovation

Renovating a kitchen

This case study is about a small company – Makeovers R Us that specialises in managing house and garden renovations. Their clients are usually busy couples and families who do not have the time to manage their own renovation projects, and people who are just daunted by the whole idea! Makeovers R Us can source all of the expertise required – including architects, landscape designers, builders, painters, electricians, wreckers, rubbish removalists and interior designers, and manage the entire project from scoping and preparation to completion. Their claim is that they will manage the project “On time; on budget, to your specifications”.

Makeovers R Us has been contacted by Cecile, an accountant, who is looking for someone to manage the renovation of her kitchen. This will be a complete makeover – everything to go – with installation of new stove, sink, fridge, dishwasher, benches and cupboards. Cecile has prepared a list of specifications as follows:
Cecile’s specifications

1. Everything in the kitchen except crockery, food and cutlery is to go; crockery etc will need to be stored somewhere – and I have little storage in the house;

2. I will need somewhere to make a cup of coffee and heat the odd meal throughout the renovations, and somewhere to keep the milk and other fridge things – but I don’t want that huge fridge in the lounge room or anywhere else during the renovations;

3. Paint colour needs to tone with the benches – not sure what finish I want on the benches – I’ll need samples and prices to consider;

4. Stove, fridge and dishwasher – need to be good quality but not over the top prices. I would like you to source options and make recommendations based on price and quality;

5. I don’t know what to do with the cat while the renovations are happening – she usually has the run of the house;

6. Everything MUST be finished in five weeks as my mother is coming to stay!

Cecile does not have a fixed budget for the renovations, but is getting three quotes for the job and will decide who to contract, based on her assessment of which company: is best able to assure her that they can finish the job in five weeks; has the best solution for storing the kitchen equipment during the renovation and can come up with a reasonable temporary kitchen space during the renovations.

Case Study 5 Information Technology

Connect up

A large state government department sought the design and establishment of:

- an intranet facility within and across the department to enable internal communication and reporting

- a secure online facility to enable communications with other departments

- a portal to enable access to specified areas of department functions/information

- a reporting system that would enable costing to be calculated on a user pays basis for external users. This part of the system includes an extensive data base of contracted organisations, including their funding arrangements with the department.

The head of the department approached Aject International to provide a submission that would include a business case for development and implementation of such a system.

Profile of the client

The government department had a newly elected Minister who was required to sign off on the proposal and on the finished product and required periodic reporting. The Minister was under intense pressure at the time to reduce the budget deficit and to report increased efficiencies. This invariably brought resistance and opposition from those who were fearful of losing their jobs.
Project higher authorities
The department was divided into three main areas, with a senior executive at the head of each. The proposal had the strong support of two of the three executives. The third believed the work should be undertaken internally to protect the jobs of the existing staff in the information technology service area.

The Sponsor
The sponsor for the project was a senior staff member from the section of the department managed by the dissenting senior executive.

Quality measures
Success of the project was dependent on winning over the support of departmental staff who wanted to see that it improved existing arrangements, as well as other end users of the system external to the department. They also needed to be consulted about the specifications for the new system.

Timeframe
The project ran for twelve months, and included the design, development and implementation of equipment and infrastructure, trialing and training of all users (no further training was to be delivered once the project was completed). The timeframe was very tight and a key issue was seeking and incorporating feedback from end-users, at a time at which they were unfamiliar with the product.

Project scope
Since no-one internally seemed to have the capacity to understand or scope the requirements for the system, specifications were left fairly open, relying on Aject to provide what they believed to be the best-fit solution to the problem: to increase efficiency across the organisation.

The project team
Aject International agreed to pull together a consortium that included three other companies as subcontractors: AJC, SPS (Software Performance Systems) and Orbit.

- Aject provided the project manager and three of its twenty staff assisted in project administration.
- AJC specialised in designing system architecture and trouble shooting. They had just picked up several large contracts in Asia and were experiencing a substantial demand on their resources so they needed to recruit additional staff to provide the technical expertise to the project.
- SPC was a small but vibrant company that undertook all the communication and consultation activities with stakeholders and the end users of the system throughout the project and provided training to them in the latter stages of the project.
- Orbit specialised in data management systems and designed, installed and piloted software modifications (they used off the shelf software). They were also be responsible for procuring all required hardware and software.
Project communications
Managing project communications across the team was carefully considered since the team members were located in different states and each one had substantial existing business commitments. Throughout the project, team members struggled with implementing the communication processes agreed in the original communications plan. Despite this, the project was able to come in on time but did require some minor modifications to the scope of the final product to accommodate changes in technology between the beginning and end of the project.

Glossary
The introduction to this Student Workbook of materials contains a comprehensive glossary. Particular terms that relate to time management techniques are provided below:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity Definition</td>
<td>The process of identifying the specific schedule activities that need to be performed to produce the various project deliverables.</td>
</tr>
<tr>
<td>Activity Resource Estimation</td>
<td>The process of estimating the types and quantities of resources required to perform each schedule activity.</td>
</tr>
<tr>
<td>Activity Sequencing</td>
<td>The process of identifying and documenting dependencies among schedule activities.</td>
</tr>
<tr>
<td>Backwards Pass Analysis</td>
<td>The calculation of late finish dates and late start dates for the uncompleted portions of all schedule activities. Determined by working backwards through the schedule network logic from the project’s end date. The end date may be calculated in a forward pass or set by the customer or project sponsor.</td>
</tr>
<tr>
<td>Critical Path</td>
<td>Generally, but not always, the sequence of schedule activities that determines the duration of the project. Generally, it is the longest path through the project. However, a critical path can end, as an example, on a schedule milestone that is in the middle of the project schedule and that has a finish – no – later than imposed date schedule constraint.</td>
</tr>
<tr>
<td>Critical Activity</td>
<td>An activity that lies on the critical path.</td>
</tr>
<tr>
<td>Critical Path Analysis</td>
<td>Also known as the Critical Path Method, a Critical Path Analysis is a network analysis method to estimate the project total duration by analysing the durations of each activity in the Work Breakdown Structure and their sequential dependencies.</td>
</tr>
<tr>
<td>Dangling tasks</td>
<td>An activity that has either no predecessors or successors. If it has neither a predecessor or successor task then it is called an isolated activity.</td>
</tr>
<tr>
<td>Decomposition</td>
<td>A planning technique that subdivides the project scope and project deliverables into smaller, more manageable components, until the project work associated with accomplishing the project scope and providing the deliverables is defined in sufficient detail to support executing, monitoring, and controlling the work.</td>
</tr>
<tr>
<td>Finish – Finish relationship</td>
<td>The logical relationship where completion of work of the successor activity cannot finish until the completion of work of the predecessor activity.</td>
</tr>
<tr>
<td>Finish – Start relationship</td>
<td>The logical relationship where initiation of work of the successor activity depends upon the completion of work of the predecessor activity.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
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<tr>
<td>-----------------------------</td>
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<tr>
<td>Forward Pass Analysis</td>
<td>The calculation of the early start and early finish dates for the uncompleted portions of all network activities.</td>
</tr>
<tr>
<td>Gantt Chart</td>
<td>A graphic display of schedule-related information.</td>
</tr>
<tr>
<td>Lag time</td>
<td>A modification of a logical relationship that directs a delay in the successor activity. For example, in a finish-to-start dependency with a 10-day lag, the successor activity cannot start until 10 days after the predecessor activity has finished.</td>
</tr>
<tr>
<td>Lead time</td>
<td>A modification of a logical relationship that allows an acceleration of the successor activity. For example, in a finish-to-start dependency with a ten-day lead, the successor activity can start ten days before the predecessor activity has finished.</td>
</tr>
<tr>
<td>Looping tasks</td>
<td>An error in a network which results in a later activity imposing a logical restraint on an earlier activity, resulting in a group of tasks being dependent on each other on a recurring basis.</td>
</tr>
<tr>
<td>Milestone</td>
<td>A significant point or event in the project.</td>
</tr>
<tr>
<td>Network Analysis</td>
<td>The technique of identifying early and late start dates as well as early and late finish dates, for the uncompleted portions of project schedule activities.</td>
</tr>
<tr>
<td>Network Diagram</td>
<td>A pictorial presentation of project data in logical sequence. Also known as a flowchart, PERT diagram, logic drawing or logic diagram.</td>
</tr>
<tr>
<td>Precedence diagram</td>
<td>A pictorial representation of the project as a network, in which the project activities are represented by activity boxes (also called nodes) and the relationships between them depicted by arrows.</td>
</tr>
<tr>
<td>Schedule Activities</td>
<td>A discrete schedule component of work performed during the course of a project. A schedule activity normally has an estimated duration, an estimated cost, and estimated resource requirements. Schedule activities are connected to other schedule activities or schedule milestones with logical relationships, and are decomposed from work packages.</td>
</tr>
<tr>
<td>Schedule Development</td>
<td>The process of analysing schedule activity sequences, schedule activity durations, resource requirements and schedule constraints to create the project schedule.</td>
</tr>
<tr>
<td>Start – Finish relationship</td>
<td>The logical relationship where completion of the successor schedule activity is dependent upon the initiation of the predecessor schedule activity.</td>
</tr>
<tr>
<td>Start – Start relationship</td>
<td>The logical relationship where initiation of the work of the successor schedule activity depends upon the initiation of the work of the predecessor schedule activity.</td>
</tr>
<tr>
<td>Work Breakdown Structure</td>
<td>A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. It organises and defines the total scope of the project. Each descending level represents an increasingly detailed definition of the project work. The ABS is decomposed into work packages. The deliverable orientation of the hierarchy includes both internal and external deliverables.</td>
</tr>
</tbody>
</table>
References

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Dobson, M. S. 2002, Streetwise project management: how to manage people, processes, and time to achieve the results you need, Adams Media Corp, Avon, MA.


Hartley, S. 2003, Project Management A Competency Based Approach, Pearson Education Australia, Sydney


Martin, P. 2001, Getting started in project management, Wiley, New York ; Chichester [England].


Web Sites

www.projectconnections.com : Practical project know-how for people managing projects and teams. Users gain the wisdom of experts and project management professionals in just minutes from extensive collection of how-to bundles, downloadable templates, problem solving guides and references.

www.projectmanagement.tas.gov.au : This site is the project management website for the Tasmanian State Government. It contains free information on the Tasmanian Government’s project management guidelines, templates, fact sheets, faqs, glossary and knowledge base. Project management is a formalised and structured method of managing change, and this website provides information and tools all project managers, project officers and committee members may required to effectively manage or participate in a project.”

Australian Institute of Project Management www.aipm.com.au

Gantthead www.gantthead.com The online community for Project Managers. White papers, directories and links

www.projectsmart.co.uk Project Smart is the Internet based project management resource that helps managers at all levels to improve their performance. This site provides an important knowledge base for those involved in managing projects of all kinds. With regular updates, it keeps you in touch with the latest project management thinking.