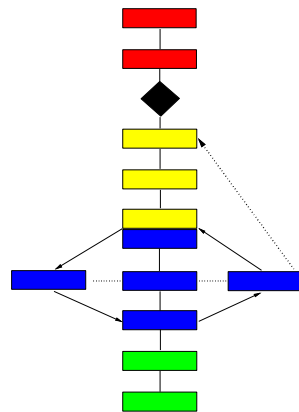


Planning and Estimating Guide

MITP
v5.1



Document Number MICG1PLN



Planning and Estimating Guide

Edition Notice

First Edition (September 1995)

This edition applies to Version C5.0 of Managing the Implementation of the Total Project (MITP), and to all subsequent releases and modifications until otherwise indicated in new editions.

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PREFACE About This Document

This guide describes the process for creating plans and estimates for a project. This guide integrates the planning guide and the estimating guide from earlier releases.

In addition, this guide highlights the following:

- Hierarchical nature of planning and estimating.
- Need for the Project Manager to manage cost as well as effort and time.
- Pressure on the Project Manager (especially in proposal projects) to produce as good an estimate as possible in a time which does not permit completion of detailed task-by-task estimating.

Note: MITP planning and estimating relies heavily on the use of Work Breakdown Structure, so the associated Work Breakdown Structure Guide must be read in conjunction with this guide.

Exclusions

Though some of the content may be of use in other circumstances, specifically excluded from this guide are the following:

- Benefits (and so Business Case). For detailed information about benefits and business case, see the MITP Project Endorsement Guide.
- Details of esoteric estimating techniques. These apply to specialised types of project, where the Project Manager must rely on a specialist to produce the estimate.
- Work which is not project-based; for example, continuous processes.

For information about the MITP life cycle, the key techniques, and the support techniques, see the MITP Handbook. A glossary of terms may be found at the back of the MITP Handbook

Who Should Read This Document

This document has been written especially for the following people:

- Planner
The planner must schedule the production of the deliverables of the project.
- Estimator
The estimator is charged with producing an estimate of the resources, costs and time required to produce the deliverables.
- Validator
The validator must check quality and accuracy.
- Standards specialist
The Standards specialist needs to be aware of and comply with the requirements of MITP in planning a specialized type of subproject (such as, system test, client/server development).
- Project Manager
The Project Manager must co-ordinate the production of the project's plans--and often has to perform one or more of the above roles as well.



How to Use This Document

The table of contents provides a clear roadmap to the main topics outlined in this document.

"What is MITP Planning and Estimating?" in topic 1.0 gives a general background to the MITP Planning and Estimating process. This will be of most use to the first-time reader.

"When You Plan and Estimate" in topic 2.0 describes how planning and estimating fit into the four phases of a project.

"How You Plan and Estimate" in topic 3.0 explains how to start the planning and estimating process.

"Planning and Estimating a MITP Project" in topic 4.0 describes how you plan and estimate.

"The Project Plan and Estimate" in topic 5.0 describes the specific process to be used, amplifying the Procedures described in the MITP Project Control Book Guide.

"Presenting The Estimate" in topic 6.0 provides guidelines on presenting the project estimate to all concerned parties.

"Further Guidance" in topic 7.0 provides more background information on particular aspects of planning and estimating.

"Estimating Checklist" in topic A.0 provides a checklist to assist in the planning and estimating process.

"What the Estimator Must Consider" in topic B.0 provides detailed instructions for the estimator.

ISO9000 Control Information

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1 What is MITP Planning and Estimating?

This topic provides a general introduction to the MITP Planning and Estimating technique.

In project management, the words "plan", "estimate" and "schedule" are often used interchangeably. In MITP we distinguish between them, as follows:

Plan This is concerned with deliverables and production:

- What must be done
- Who is responsible
- When it will be done
- How it will be done

Estimate This is about resources and consumption:

- What resources (including money and time) are needed
- Who will supply them
- When they are needed
- How long they are needed for.

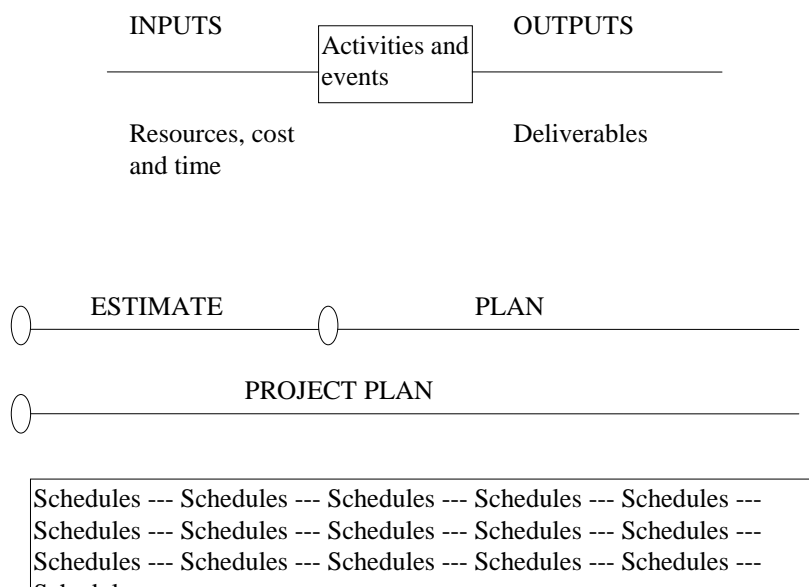
Schedule This states the time and sequence of events and activities:

- What will be done
- When it will be done

In this view, plan and estimate are distinct entities, though clearly linked and interdependent. While schedule seems more closely bound, it is a necessary part of plan and estimate.

To avoid the long-winded title "Project Plan and Estimate", however, the term "Project Plan" is used in this guide. When the term "estimate" is used, this means the statement about resources needed.

The scope of these words is summarized in the figure below.





Subtopics

- 1.1 Terminology
- 1.2 The Nature of Planning and Estimating
- 1.3 Founding Principles
- 1.4 MITP Planning and Estimating Method
- 1.5 Why You Plan and Estimate
- 1.6 Who Plans and Estimates

1.1 Terminology

MITP uses the following definitions:

Project plan

A documented (1) statement of how a project will be executed successfully. (2) A subproject plan is that for a subproject; the project plan is for the whole project.

Consolidated plan

The high-level plan which summarizes the subproject plans.

Milestone

A significant event (achievement) in the project or subproject, and the means by which management will monitor progress against plan and consumption against budget. The project schedule in the consolidated plan will be based on milestones. (A level 1 milestone is at the first level of work breakdown, level 2 at the second, and so on.)

Baseline plan

The version of a plan, with its associated estimate, which has been agreed and accepted as part of the Project Manager's contract and which is now subject to change management.

Estimate

A documented statement of the resources which will be needed to complete a project successfully. An estimate must be readily translatable into money terms.

Resource

Any necessary item which may be directly used in and charged to the project, or is in sufficiently scarce or slow supply that it must be ordered ahead or otherwise reserved for use in the project. For example,

- Money expenditures, whether to be invoiced by an external supplier or to be cross-charged by another department
- Manpower, whether making, supporting, reviewing or managing
- Consumable resources, such as supplies and machine time
- Equipment and office facilities
- Travel and accommodation expenses
- Overtime payments

Target project

The project which is to be planned and estimated, as distinct from the project within which planning and estimating is done. The two may frequently be different.

Scope (of a project)

A statement of the work to be done within the project, and of all deliverables to be produced. The scope must include a sufficient definition of the project's boundaries and, for items included, must be sufficiently precise to allow accurate definition of all work to be done.

Project baseline

The set of documents which together provide the necessary precision and detail on the following:



Planning and Estimating Guide

- Project deliverables
- User requirements
- Technical solution
- Development environment
- Management processes
- All other major factors on which the baseline project plan is founded.

Development of this project baseline is directed towards achieving precision in the scope of the project.

Validation

The work of independently assessing a project plan and estimate in order to provide expert reassurance that they are fundamentally sound and achievable.

1. In the context of these definitions, "documented" means not only that there is a record, but also that it is attributable (to who produced it) and in sufficient detail to be independently verifiable and later revisable.
2. "Successfully" means that the quality or completion criteria are defined, so that success can be judged.

1.2 The Nature of Planning and Estimating

MITP is designed to cope not with one but with all of the following types of project:

- Application development
- Package customization
- Training
- Construction of offices and computer rooms
- Business process re-engineering
- Transport and distribution
- Communications networks
- Corporate databases
- Maintenance
- Human relations, and so on

The number of project types is, for practical purposes, limitless. MITP planning and estimating has to allow for the different estimation methods used in each project type.

Further, the degree of novelty in projects varies greatly. For example, if a project is dealing with brand new technologies, or methods, or teams, or organizations, or different cultures, then no reliable estimating process with a proven base of historical data is at hand to help the estimator.

Projects are, after all, unique!

1.3 Founding Principles

Estimates are usually incomplete; it is always possible to do more work on them. So the "finished" estimate is invariably a compromise.

In addition, some estimates are comprehensive, whilst others rely on a much more superficial analysis. For example, in estimating a proposal project, the work may be broken down by only one level, to the subprojects.

In contrast, when estimating the delivery project which is the subject of the proposal, the work breakdown may be carried to three or four levels--in some cases, down to the individual tasks. This is perfectly valid, because the purpose and proposed use of the estimate must determine the amount of detail needed.

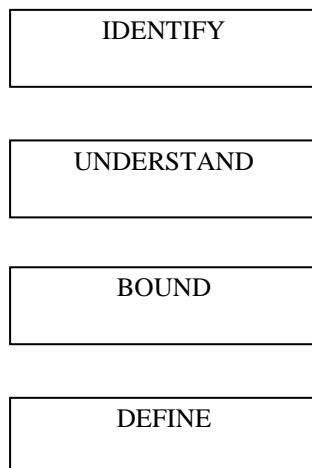
The MITP Planning and Estimating technique is therefore based on the following principles and propositions, which amount to a set of requirements:

- The Project Manager needs a single overall process, not different ones for different sorts of project.
- The Project Manager must be able to control--and therefore plan and estimate--all types of resource; people and their effort, purchased goods and services, facilities, costs (internal and external, direct and indirect), and time.
- An early understanding of where costs arise is necessary to developing a solution which is economical or price-competitive, and an essential input to value management.
- The best current estimate for the target project must itself be monitored during the planning and estimating project.
- Task-by-task estimating, when properly done by experienced people, is the most reliable method for planning and estimating projects. In some cases, though, a project team will have insufficient time to prepare a detailed estimate using this method. So other methods must fit into the overall process.
- The Work Breakdown Structure (WBS) provides the best basis for developing, representing and controlling the database of work elements, with their associated costs and times.
- Project Network Techniques (PNT's), with associated resource allocation, provide the best basis for developing schedules for any but the simplest and shortest of projects.
- Every quantity of resource (direct or overhead) required by the project must appear in the WBS and attach to one or other of its elements.
- Many subprojects may be very similar across projects, so a library of standard Work Breakdown Structures tested in past projects will be beneficial.
- A base of historical data, actual versus plan, from past projects provides the best base for estimation of future ones.
- Those who have had solid experience in estimating this sort of project will tend to produce much better estimates than those who have not.

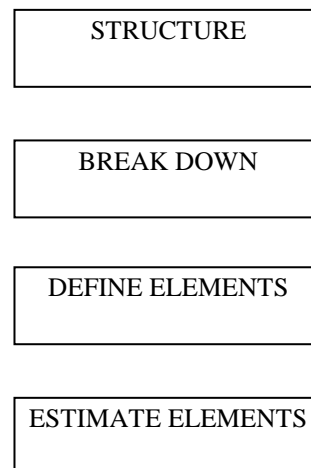
1.4 MITP Planning and Estimating Method

MITP planning and estimating can be viewed as two parallel and interdependent methods:

Defining the project baseline



Planning and estimating the detail



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Defining the project baseline is that set of activities, undertaken during and in parallel with planning and estimating, whose purpose is to achieve a precise, documented definition of all that may affect the work, other resources, schedule and costs of the project, including the following:

- Scope
- Detailed requirements
- Technical solution
- Conditions imposed

The two most important products of this are a library of the project baseline documents, and a documented set of assumptions to fill the gaps.

Planning and estimating the detail is the method by which the developing project baseline, amplified by agreed assumptions, is estimated in successive levels of detail. This requires the use of the Work Breakdown Structure technique.

The project is firstly broken down to level 1 and, possibly, to level 2; then a preliminary estimate is developed by the planning team.

In the next iteration, each of the current lowest level work elements in the WBS is then broken down further, if this will improve the accuracy of the estimate to the required standard; and so on. The areas requiring most breakdown are those where the risk or the technical uncertainty are considered greatest.

1.5 Why You Plan and Estimate

This topic lists the fundamental reasons for planning and estimating a project.

There are many potential uses for both plans and estimates. In most cases, however, they are used for the following reasons:

- To show how and when and, therefore, that the project is achievable.
- To indicate the cost price.
- To assign clear responsibilities for achievement.
- To provide a shopping list for resources.
- To provide the model against which the Project Manager can control both achievement and consumption.



Planning and Estimating Guide

1.6 *Who Plans and Estimates*

This topic lists the responsibilities for planning and estimating within a project management team.

The main parties and responsibilities in the planning and estimating process are as follows:

Project Manager

The person with responsibility for executing the project successfully, according to the contract. Often this may also be the engagement manager.

Subproject Managers

Controlling particular subprojects within the overall project, and so responsible for their planning and estimating.

Project Sponsor

Responsible for agreeing all aspects of the plan, and so the Project Manager's contract to deliver.

Client

The person or persons who will accept the deliverables under the contract.

Validator

Responsible for reviewing the plan for weaknesses and advising on improvement.

Planners and estimators

Those who develop the plans and estimate the resource requirements. They must invariably be people with experience of planning and estimating, preferably in the project area. They should properly be those who will be responsible for the work, though in the early, high-level, stages of estimating this may not be possible.

In addition there will frequently be:

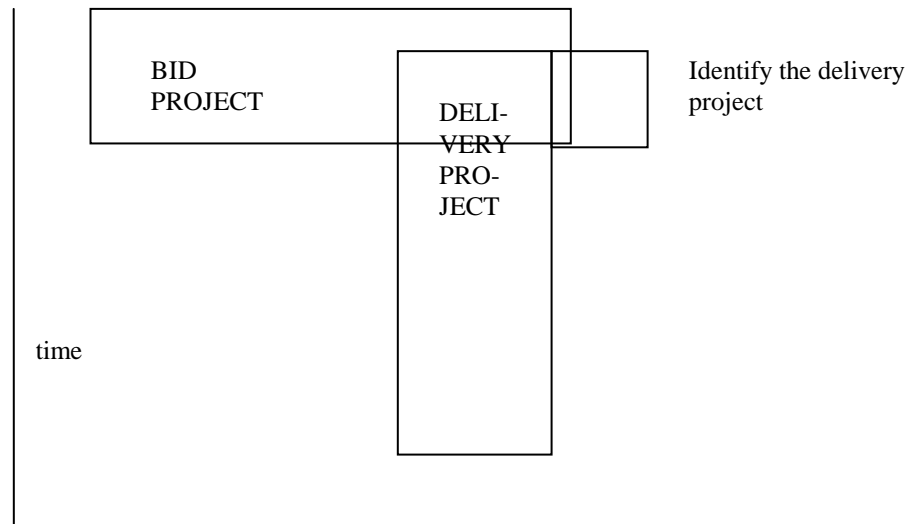
Suppliers (Third Parties)

Under separate contracts, providing deliverables, resources, or facilities.

2 When You Plan and Estimate

This topic provides details of the planning and estimating method for the four phases of a project. Details are provided for both proposal projects and for delivery projects.

The work involved in estimating varies according to the type of project and to the phase in the MITP life cycle. The diagram below shows related Proposal and Delivery Projects.



Sutopics

2.1 Estimating by Phase

2.2 Timescales and the Level of Detail

2.1 *Estimating by Phase*

2.1.1 Identifying The Project

The major job here is to ensure that the estimates supporting the contract or business case are valid, and that they have not been compromised in the negotiations.

2.1.2 Establishing the Project

In establishing the project, there are two main aspects:

- The estimates will be reviewed and used as input to the project plan; detailed activity plans for the early stages, and higher level plans for later.
- The estimates will also be used in support of the negotiations with subcontractors.

2.1.3 Managing the Project

The estimate used as the basis for the project plan must be reviewed as the project progresses. Any change to the estimate is subject to change control for it is likely to affect both the work and the terms of the contract.

2.1.4 Ending the Project

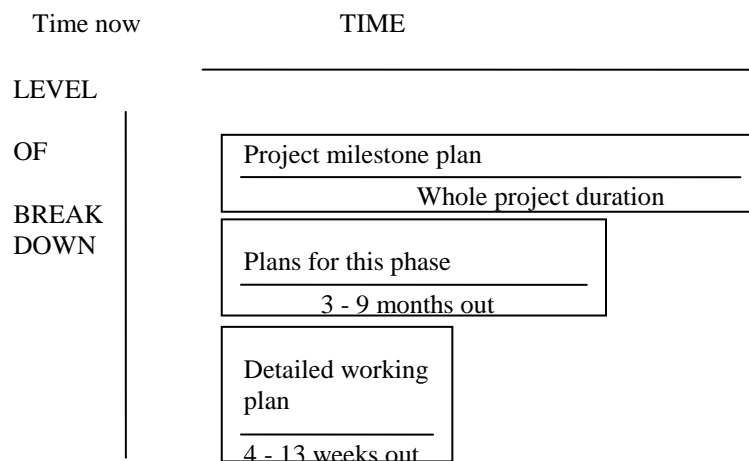
The estimate, and subsequent changes, may be needed as part of the input for proving satisfactory completion. Ensure that nothing is discarded prematurely.

The information, on estimates versus actual experience, should be captured to become input to the estimating data-base, in the service or business unit.

2.2 *Timescales and the Level of Detail*

The transparency of the future is poor; the further one tries to foresee, the more one's perception of detail deteriorates. Worse still, it may not happen as forecast! Plans and estimates should not therefore be at a consistent level of detail, except for the shortest of projects.

The "shape" of a plan drawn against time can be seen as portrayed in the diagram below.





This diagram is, of course, only schematic. Depending upon the size of the project, there may be more than three steps. In addition, the level of breakdown may be more detailed for areas where risk is high.



3 How You Plan and Estimate

This topic provides an introduction to the details of planning and estimating.

Subtopics

- 3.1 Planning Methods
- 3.2 Estimating Methods
- 3.3 Validation Methods

3.1 Planning Methods

The essentials of planning a project are as follows:

List of tasks

This is more suitable for a morning's shopping than for planning a typical MITP project, though it is valuable at a detailed level.

Gantt chart

Scheduling a list of tasks on a bar chart. While visually direct, it can be used as the primary planning method only on the most simple projects with few tasks, simple interdependencies, and a minimal number (one) of resources whose consumption must be scheduled. It is, however, the best means for communicating schedules.

Work Breakdown Structure

Essential to MITP planning and estimating, this is a key and parallel MITP technique.

Project Network Techniques

There is a family of these techniques, to which the terms Critical Path Analysis and PERT are often applied. Specifically, the methods break down into the following:

- Activity on Arrow networks
- Activity on Node networks, including Precedence Diagrams
- Line Of Balance, for repetitive scheduling.

General PM planning tools

There is now a host of PC, server and mainframe tools which permit the development of a project plan.

3.2 Estimating Methods

The different ways of producing an estimate are sometimes classified as follows, although these classes are arbitrary and overlap one another.

Guess Of questionable reliability, this may involve only seconds of thought--sometimes no more than the duration of a spoken sentence. Guessing should be used sparingly, because of the risk of setting expectations that later prove to be too optimistic.

Rules of Thumb

These may be stated as ratios, percentages, or rates. For example, "System test takes 15-30% of total project effort."

Note: A complicated rule of thumb appears in the guise of an algorithm, so verging on the parametric method below. There is, however, an essential difference between the two. The parametric method is backed up by clear and auditable historical data, whereas the provenance of a rule of thumb may be questionable, but not always answerable.

Comparison

Other completed projects showing some similar characteristics (similar type of work, similar project team) are used as a base for estimating this project. There are, of course,

many factors which will make the supposedly similar projects significantly different, and it is the job of the estimator to identify and try to quantify those differences.

Experience

The estimator derives an estimate from his or her own personal experience of past projects. This may be dangerous, for the estimator is never the average man or woman, and often not the person who will execute the work.

Expert Judgment

Several authorities work together, either informally or by some formalized technique such as the Delphi method, to produce a solution.

Parametric

Key features of the project, or of its deliverables, are counted, and formulas applied to derive a figure. Sometimes known as algorithmic. For example, Function Points. The essential factor is that the parameters, variables and calculations have been based on analysis of a database of real data on past projects.

Models and tools

There are now several estimating tools in the market which are designed to run on PCs. These are primarily aimed at the application development community. These tools depend upon algorithms that have been validated by experience from a large number of projects, and the best of the products allow the user to tune the algorithms from her own experience.

Task-based

The work to be done is broken down into tasks which are then individually estimated. Overheads are added and an aggregate estimate calculated.

Prediction (or projection)

This method can be used when tasks are so small, repetitive and similar (such as pouring concrete or laying bricks) that variation is minimal. Tables will be available which are standard for the company or industry, though often hedged with the caution that in project, the numbers may prove to be different.

Broadly speaking, these methods are progressively more formal, require more effort, and give more accuracy. The penultimate one specifically looks at project internals, that is, at the way in which the project will be organized and run.

3.3 Validation Methods

Validation can take several forms, but which one to be used depends upon the degree of confidence wanted, the unknowns and risk in the project, the time available, and the skills available.

The following list is of validation methods, in decreasing order of effort:

Full independent plan and estimate

The validator independently estimates the project. This is unusual, for it amounts not to validation of the first estimate but provision of a second by someone who has the required skills and experience.



Detailed scrutiny

Every aspect of the planning and estimating work is examined.

Comparison or check

The Project Plan is compared with those for similar projects,

Sampling scrutiny

In selected areas of most risk or uncertainty the project plan is checked to see that its derivation is sound. This check is not a complete one, but sufficient to generate confidence.

Review of the method

The planning and estimating methods are reviewed to see whether they are the most appropriate for the project.

Review meeting only

The project planners present to a review meeting. The experience and skills of the reviewers in the meeting are of paramount importance.

Generally, validation needs to be done by someone skilled in planning and estimating projects of the same scale and complexity. For further details, see "Validating The Estimate" in topic 4.4.



4 Planning and Estimating a MITP Project

Planning and estimating for a project is itself a project.

This topic describes the project and amplifies what can be found in the Project Control Book and in the standard Work Breakdown for Planning and Estimating, within the WBS technique.

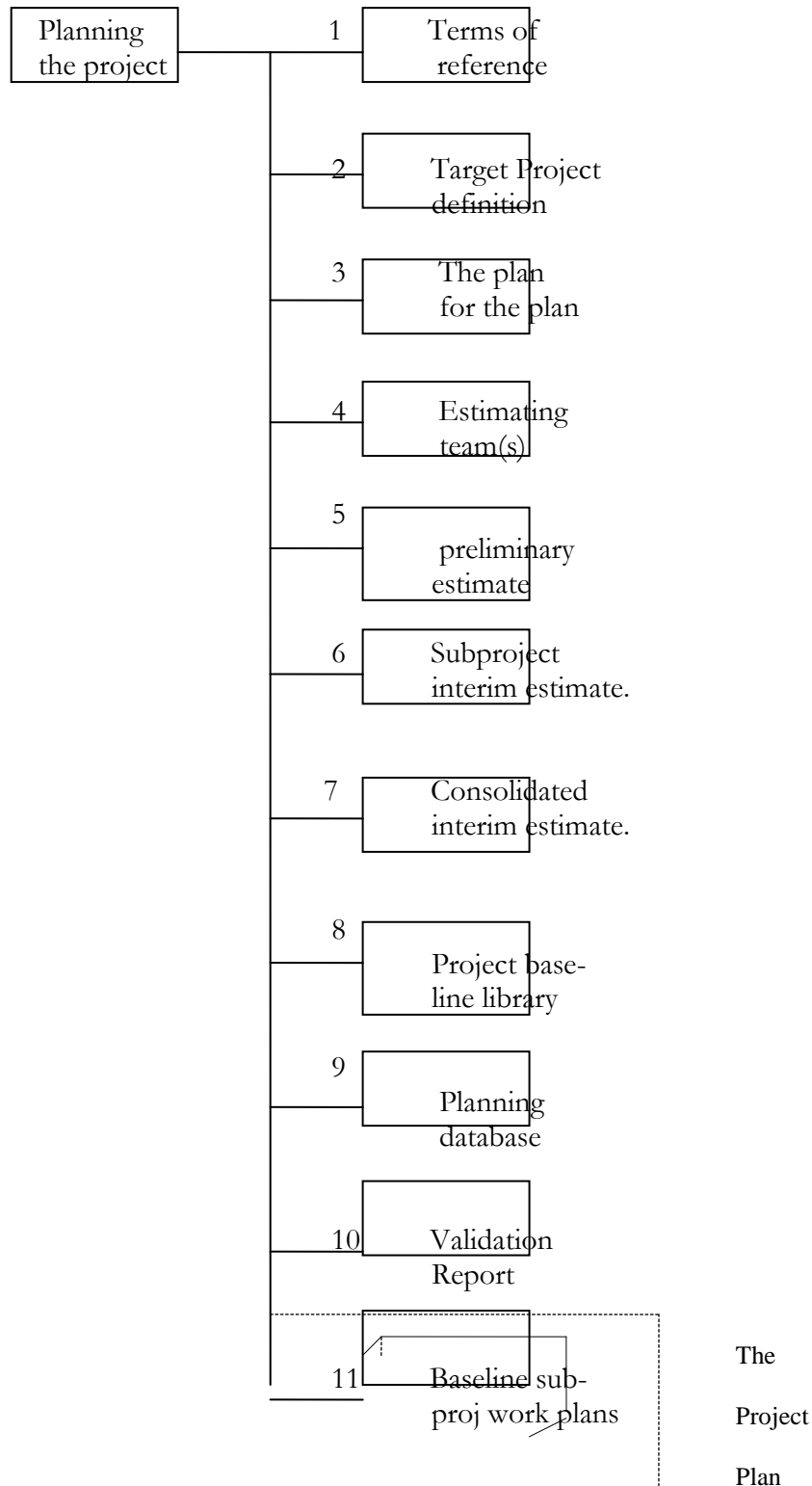
Subtopics

- 4.1 Deliverables and the Work Breakdown Structure
- 4.2 The Network
- 4.3 The Project Plan Report
- 4.4 Validating The Estimate
- 4.5 Relationship with Other MITP Techniques

4.1 Deliverables and the Work Breakdown Structure

The high-level WBS for the Planning and Estimating subproject is illustrated in Figure 1.

In this figure, each of the work elements 1-12 represents an item to be delivered by the Planning and Estimating project. For details of each of the work elements, see "The Project Plan and Estimate" in topic 5.0.



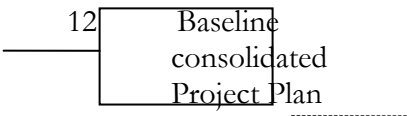
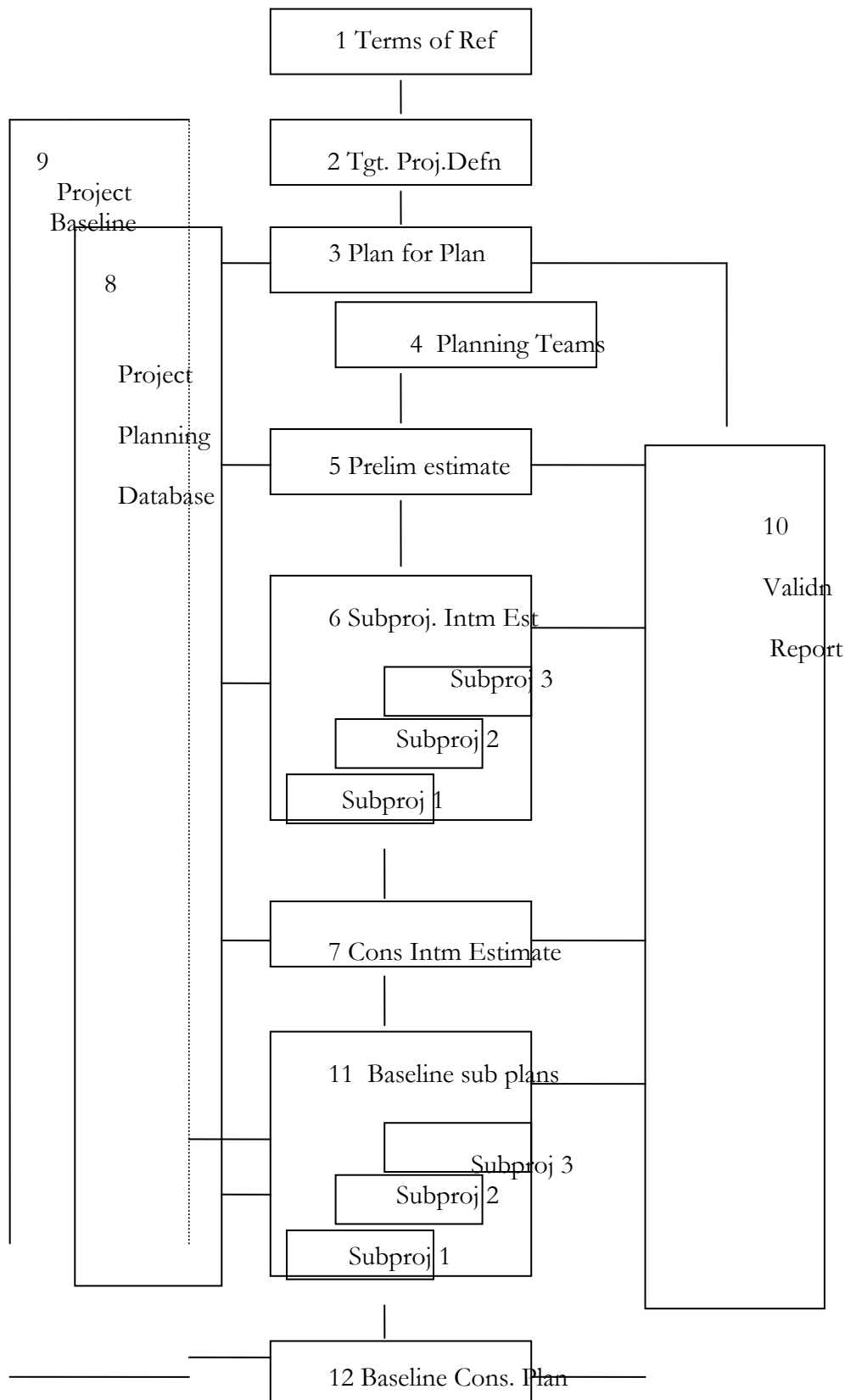


Figure 1. Planning the project.

4.2 The Network

The following schematic diagram, which uses the same work elements as the preceding WBS, approximates to a milestone network for the Planning and Estimating project.





4.3 The Project Plan Report

A single report format is used to document both the Project and each Subproject Plan, though for the subproject plan some sections may be unnecessary (for example, "Goals"). The table below shows the report structure and also which of the Planning and Estimating work elements of Figure 1 in topic 4.1 updates each chapter or section.

Project plan Section	WBS Deliverable											
	1	2	3	4	5	6	7	8	9	10	11	12
MANAGEMENT SUMMARY												
Goals and Objectives		x										
Key Deliverables		x										
Key Milestones and Dates		x									x	x
Estimate Summary					x		x					x
Major Risks		x								x		x
Issues					x		x					x
PROJECT OVERVIEW												
Summary of Scope		x					x					x
Deliverables		x					x					x
Milestone network					x	x	x				x	x
Project Organisation		x										x
Project Cost Structure		x					x					x
CATALOG OF PROJ BASELINE DOCS												
Source Documents								x			x	x
Clarifying Corresp. & Minutes								x				
DELIVERY (OUTPUT)												
SCHEDULES												
Milestone Schedule					x	x	x				x	x
Detailed network(s)						x					x	
Detailed schedule(s)						x					x	
RESOURCE (INPUT)												
SCHEDULES												
Costs						x	x		x		x	x
Staffing						x	x		x		x	x
Hardware						x	x		x		x	x
Software						x	x		x		x	x
Consumables						x	x		x		x	x
Other facilities						x	x		x		x	x
Scaling Factors used						x	x		x		x	x
CRITICAL FACTORS												
Items not Estimated						x	x				x	x
Assumptions: Project Baseline						x	x	x			x	x
Assumptions: not Project Baseline						x	x		x		x	x
Dependencies		x				x	x				x	x
Constraints		x				x	x				x	x
Risks		x				x	x				x	x
Other Considerations						x	x				x	x

ESSENTIAL REFERENCE DOCUMENTS												
Related Plans and Estimates				x	x	x					x	x
Validation Report										x		
WBS, DEFINITIONS AND ESTIMATES												
Work Breakdown Structure				x	x	x		x			x	x
Work Specifications and Estimates				x	x	x		x			x	x
Project plan Section	WBS Deliverable											
	1	2	3	4	5	6	7	8	9	10	11	12
RESOURCES AND AVAILABILITY												
Catalog of Required Resources		x		x	x	x		x			x	x
External Suppliers		x			x	x					x	x
Staff Specifications				x	x	x					x	x
Other Resource Specifications				x	x	x					x	x
THE PLANNING PROJECT												
Terms of Reference for Planning	x											
P & E WBS			x								x	x
P & E Team			x	x							x	x
Planning Approach			x								x	x
Methods of Planning and Estimating			x								x	x
Level of detail achieved			x								x	x
Quality checks; Verification			x								x	x
Validation										x	x	x
Catalogue of the Plan Components									x			
Other References and Sources					x	x					x	x
Time, effort and cost summary			x									
HISTORY OF ESTIMATES				x	x	x					x	x

4.4 Validating The Estimate

Estimates should be developed by people with experience in the specific tasks being estimated. Ideally, the person developing the estimate should also be the person who is ultimately responsible for executing the task.

Where appropriate, the estimate should be reviewed and validated by an independent validator--someone who was not involved in preparing the original estimate. The objective of the validation is to confirm the accuracy, completeness and reasonableness of the estimate.

Validating estimates consists of more than just confirming that the arithmetic used to calculate the estimate is correct. It is also designed to do the following:

- Confirm that the appropriate estimating techniques have been used.
- Establish that the estimators had the required experience and knowledge to develop the estimate.



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- Examine the experience and history data used to create the estimate to ensure it is appropriate and relevant.
- Verify that all parameters and metrics used in preparing the estimate are suitable for the work being estimated.
- Ensure that the skills and experience of the people required have been identified and are reasonable and available.
- Review all technical elements to ensure that all components have been included and that no items have been overlooked.
- Determine that all tasks have been included and that their estimates are realistic.
- Confirm that the overall estimate have been well constructed from the detail and that it is consistent with previous experience.

4.4.1 Validation Guidelines

Some guidelines that could be used by the validators are as follows:

- Use the same information and assumptions that were used as input to the original estimate.
- Determine whether the assumptions and expectations are realistic, given the information available regarding the project, the client and the environment in which the project will operate. Establish whether the assumptions and expectations can be validated before the estimate will be presented.
- Review the proposed project approach and schedule to determine if they are reasonable and that the expectations can be met.
- Duplicate the estimating process using the approach used by the estimators, compare the results and reconcile the differences.
- Consider whether it might be appropriate to validate the estimate by using an estimating tool or method different from that used by the estimators.
- Look for omissions (tasks or deliverables), errors or duplications.
- Work with the estimators to reconcile any discrepancies or variations between the results.

The validation will confirm the estimate and is necessary prior to presenting the estimate to others.

Note: In high-risk projects, a complete, separate task-by-task estimate may be developed by an independent estimating team. This estimate should then be reconciled with the original at a detailed level so as to resolve differences.

Where appropriate, a validation report should be produced. The validation report is much simpler than the Project Plan, allowing the validator freedom to work within a flexible structure. An outline contents list for a validation report is shown in Figure 2.

Introduction	
Terms of Reference	
Effort, time and cost	
Validation Approach	
Emphasis	
Areas of Concentration	
Areas not Validated	
Methods Adopted	
Conclusions	
Recommendations	
Appendix: Detailed Findings	

Figure 2. Outline of a validation report

4.5 Relationship with Other MITP Techniques

Several other techniques within MITP interact with Planning and Estimating, and all of these are documented separately within MITP.

The following techniques have an important interface with Planning and Estimating.

4.5.1 Work Breakdown Structure

The Work Breakdown Structure is of paramount importance, because Planning and Estimating depends on and uses it.

It is assumed and required that all work, resources and costs estimated for the target project will be represented in the appropriate elements of the project's WBS. The WBS is the catalogue of the project and definition of all work, resources and costs.

4.5.2 Definition

Definition supplies the following to the Planning and Estimating team:

- Goals and objectives
- Project scope
- Major deliverables
- Milestones
- Project organization--people and subprojects
- Resources--an early view
- The cost structure
- Risks
- The management system, which itself will produce deliverables and consumes resources

Phase 1 of the project (Identifying the project) also provide these items. For example, many of the above items would come out of the Project Identification Workshop.

4.5.3 Progress Tracking

Planning and Estimating supplies the following to Progress Tracking:

- Schedules for work starts and completions
- Plan dates for deliverables and milestones
- Schedules of planned resource consumption
- S-curves for cumulative Earned Value on costs, effort, starts and completions

All are the current baseline versions.

4.5.4 Business Case

Business Case supplies an early view of the costs, and may provide an early WBS. Guidance on producing business cases can be found in the Project Endorsement Guide.

4.5.5 Financial Management

All estimated costs are stored in the WBS within the Planning Database.



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In the other direction, Planning and Estimating supplies a more detailed and accurate estimate of probable costs.



4.5.6 Change Management

Planning and Estimating supplies the following:

- Baseline Plans
- Project Baseline Library
- Planning Database

The impact of each Change Request is evaluated using the above items, and approved Changes result in revisions to them.

4.5.7 Risk Management

Risk Management uses the Planning Database to assess the effect of realized risk on the project. Early risk containment plans are included in the Baseline Project Plan.

4.5.8 Project Completion

The Planning Database supplies the plan figures for comparison with actuals.

5 The Project Plan and Estimate

This topic explains how you create detailed plans and estimates for your project. This guide concentrates on planning and estimating activities during the first two phases of a project:

- Identifying the project
- Establishing the project

Phase 3 of a project demands development of plans in more detail, over a short timeframe, to schedule the work of individuals. This is largely a further ongoing development of plans and estimates made in Phases 1 and 2.

The following topics give detailed information regarding the twelve steps shown in Figure 1 in topic 4.1.

Subtopics

- 5.1 Step 1: Terms of Reference (Project Sponsor)
- 5.2 Step 2: Target Project Definition (Project Manager)
- 5.3 Step 3: Plan for the Project Plan (Project Manager)
- 5.4 Step 4: Estimating and Validating Teams (Project Manager)
- 5.5 Step 5: Preliminary Estimate (Project Manager)
- 5.6 Step 6: Subproject Interim Estimates (Subproject Managers)
- 5.7 Step 7: Consolidated Interim Estimate (Project Manager)
- 5.8 Step 8: Project Baseline Library (Project Manager or Project Office)
- 5.9 Step 9: Planning Database (Project Manager or Project Office)
- 5.10 Step 10: Validation Report (Validator)
- 5.11 Step 11: Baseline Subproject Plans (Subproject Managers)
- 5.12 Step 12: Baseline Consolidated Project Plan (Project Manager)

5.1 Step 1: Terms of Reference (Project Sponsor)

This work element requires the Project Manager to formulate and to agree with the Project Sponsor the Terms of Reference for planning and estimating the project.

This will include, for example:

- Purpose of the estimate
- Accuracy required
- Sources of information for the project baseline
- Resources available to the estimating team, including the assigned expert, if any, for this type of project.
- When it must be available
- Whether a preliminary estimate is needed
- What sort of validation is required
- How it will be reviewed
- Who must agree it.

Agreed Terms of Reference are required in the Project Plan, for which a template exists in the Project Control Book.

5.1.1 Guidance

Note the following points:

- Planning and estimating is always done under pressure, sometimes extreme.
To produce a thorough plan and estimate may take up to 5% of the target project effort. In some cases it may be more. Adjust the Project Sponsor's expectations accordingly.
To agree to try and estimate in an impossibly tight timescale, will almost certainly ensure that the resulting estimate is valueless.
- Before commencing an estimate, decide upon and (where relevant) agree with the Project Sponsor what is required, including the level of accuracy. However, it will at this stage be impossible to predict the difficulties and complications to be met in producing the estimate.
Use "Classification of MITP Estimates" in topic 7.1 as a starting point.
- The degree of detail applied to the estimate will be determined by the time available. For urgent estimates, accuracy will not be possible; for smaller projects it may not be necessary.
- The most dangerous estimates, historically, are those produced by people with too little experience of estimating the following:
 - This size of project
 - This type of project

The best estimates are produced by experienced estimators, familiar with the type of project that they are estimating.

Note: It is crucial to the project to secure the services of an experienced estimator. This is especially important in the early, higher-level stages of estimating where errors can be extremely expensive

- The Project Sponsor's current priorities for the project need to be known.
For example, which of the following is most important to the Project Sponsor:



- Meeting a deadline?
- Keeping within budget, or getting the best solution?
- Where would he/she place the "X" in the Cost-Time-Function triangle?
- What sort of leeway does the target project have?

5.2 Step 2: Target Project Definition (Project Manager)

This work element includes the following:

- A Project Definition Workshop (PDW) for the target project.
- Completion of the Project Definition Report (PDR) at least in initial form.
- Familiarization of the planner/estimator with this material and with any risk assessment so far performed.

5.2.1 Guidance

Note the following:

- What is not defined cannot be estimated.
Thus your first job is to run a PDW, if one has not already been run.
- Check the table in "The Project Plan Report" in topic 4.3 to see how much the Project Definition is needed.
- Of particular importance is to identify where the scope is currently imprecise, due to one or more of the following:
 - No proper attempt has yet been made to define it.
 - It is unclear whether an area is included or excluded.
 - The area is included, but is ill-defined, which probably means too briefly documented.
 - The solution is not adequately defined.
- Is the project broken down into phases, with break points? It is hazardous to try and estimate, at the feasibility stage, the cost of development and implementation.
- From this will be understood much more about the specialist estimating skills required, and the areas of particular risk.
- The major deliverables and the subproject structure are vital to help the structure of the estimating plan.
- What part costs will play in this project needs to be understood, and how closely must they be controlled?
The accounting policy and standards for this project will determine the level of detail of the estimate required to account for costs. Also, whether internal staff, or internal facilities are to be cross-charged and, therefore, to be accounted for.
- If there is no Project Definition Report and no sign of one in the required time, then at least a skeletal but sufficient one is required to provide a base for a set of assumptions.

5.3 Step 3: Plan for the Project Plan (Project Manager)

This entails the following:

- Identifying the items to be estimated.
- Estimating the planning work.
- Organizing the planning and estimating work according to the target project breakdown into subprojects.
- Agreeing the availability of those who will perform the estimating work.
- Identifying the areas of the project where estimating work needs to be concentrated.

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- Determining the best estimating approaches for each stage of estimating, within the constraints of the planning time.
- Confirming the level of detail to which the plan and estimate will go.
- Identifying the information which the estimating team will need.
- Scheduling the estimating work.
- Securing the services of a validator.
- Agreeing the Terms of Reference.

5.3.1 Guidance

Note the following:

- The starting point is the set of major deliverables and the subproject structure agreed in the Project Definition. These define the structure of the Project Plan and will be reflected in the plan for producing it.
- For each of the subprojects, according to its size, proximity (see "Timescales and the Level of Detail" in topic 2.2) and how well defined it is, the approach to planning and estimating needs to be decided.
- It will be now that the size of the estimating task really begins to dawn. One or more of the following will need to be done:
 - Agree an extension to the time for the plan and estimate (unlikely).
 - Reduce the expectation of the quality of the estimate; this means reducing the accuracy and increasing the allowance for contingencies.
 - Secure more resources than originally thought when the Terms of Reference were agreed.
- For example, some factors that increase the time and effort to plan and estimate are:
 - Target project is unclear; much time can be spent in trying to precisely define the scope.
 - Much negotiation time is needed, especially where relations with the client are not smooth.
 - Decision making is slow.
 - Resources are scarce for designing the solution.
 - The project will be technically very complex.
- Above all, ensure that those expert estimators are identified, asked for and recruited onto the project, and documented as a major issue if not achieved.
- The Validator identified and the Terms of Reference and availability agreed.
- The plan need not be a very elaborate or detailed one: the Preliminary Estimate with a statement of resource needs is probably sufficient. This may take half a day on a small project, or a week or more on a larger one.
- The plan should allow for the very significant time that the validator may need from the planning and estimating team. The validator should state what he or she will need from whom and when.
- The plan will also require amendment as a result of the validation work. This will itself absorb time and effort during the planning stage.

5.4 *Step 4: Estimating and Validating Teams (Project Manager)*

This work element includes the following:



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- Staffing of the estimating (and validation) teams
- Written job briefs for each team
- Orientation for each team

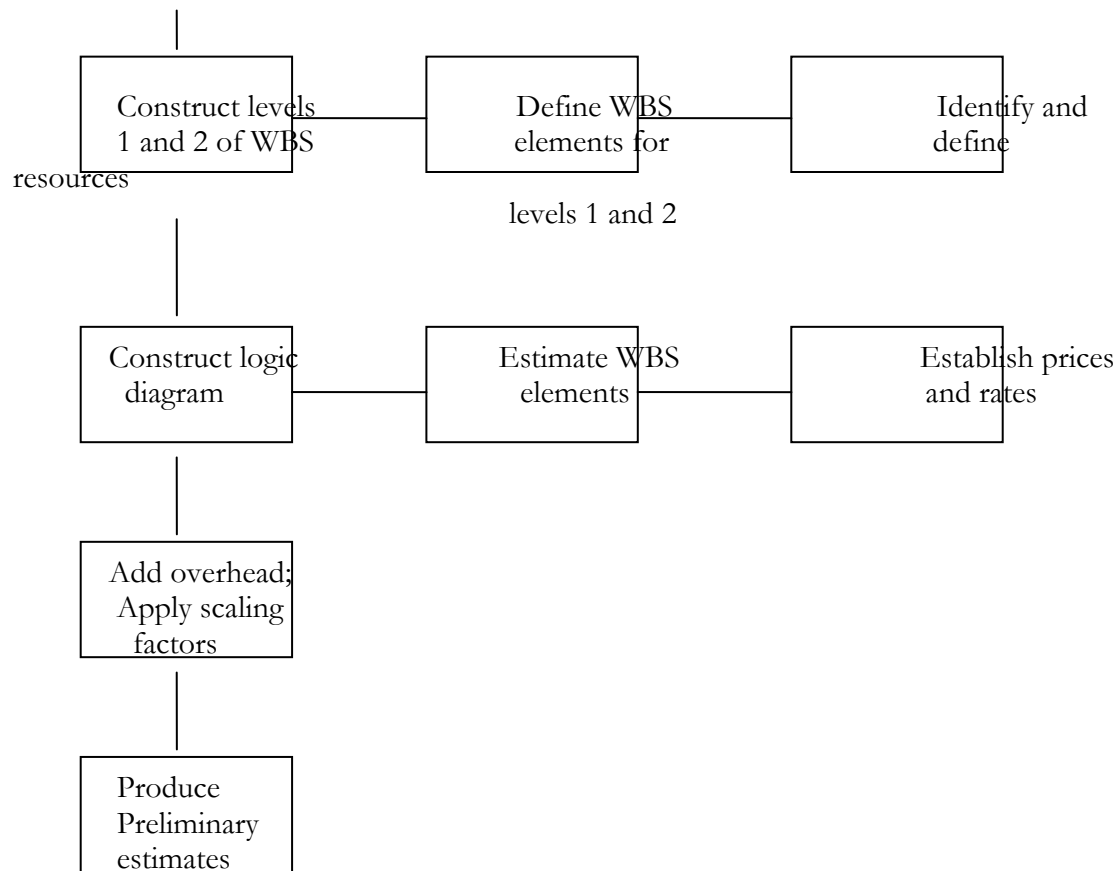
5.4.1 Guidance

Note the following:

- Allow adequate time for orientation, which means meeting and discussing with members of the project team, and reading all of the available material. Allow one day as a minimum; on large projects, you may need up to 2 weeks.
- Revise the plan according to the real availability of the planning team.

5.5 Step 5: Preliminary Estimate (Project Manager)

This requires an early estimate for the project, using the material so far available. The approximate sequence is shown in the following diagram.



The outputs are as follows:

- WBS broken down to at least 2 levels.
- Each work element defined and estimated (Work Specification Form).
- A list of the resources which will be needed.
- A high-level network for the project.
- A preliminary schedule of milestone dates.
- A rough schedule of resource requirements, especially staff.
- Estimates for the support costs and overheads of the project.
- Assumptions on the scaling factors which will be important, and preliminary values for them.
- A summary of the estimate.
- Confirmation or revision of the Plan for the Plan.
- Confirmation of which subprojects need to be further broken down.

5.5.1 Guidance

Note the following:

- The purpose of this is to ensure an early estimate, a first milestone chart with rough schedule, and a view of where the costs and difficulties are likely to arise in the target project. The preliminary estimate also provides a consistent framework and point of comparison for the later stages of estimating.
- It is possible, of course, that such a preliminary estimate already exists from the Identifying the project phase, when it will have been needed during the preparation of the Business Case. It is still necessary to revisit, for the following reasons:
 - Understanding will be changing fast, so estimates will soon become out of date.
 - The project team will probably be different, and it is their estimates which matter.
 - More expertise should now have been drawn onto the project.
- The basic set of project information on which to estimate should by now have been collected and established--see "Step 8: Project Baseline Library (Project Manager or Project Office)" in topic 5.8.
- Breakdown should be level 2--see the guidelines in the MITP Work Breakdown Structure Guide.
- The methods of estimating each WBS element must be high-level. They may include the following:
 - Comparison with known projects.
 - Consensus of experts.
 - Where the type of project is well-known, and industry or company statistics are available, comparison with that past experience.
 - Work Distribution Models.
- Estimates are probably in terms of gross work-months or work-years and calendar months.
- Calculation of overheads will probably be simple: 10% for technical support on the technical parts of the project; 15% for project management of uncomplicated projects.
- At this stage, confidence in the estimate is likely to be low. So allowance for contingencies will be high.
- The experience of the estimator must be high, and their involvement should have been secured in Plan for the Plan--including, again, orientation. Such people may have full schedules.
- The Preliminary Estimate must be documented, though not in such details will later appear in the plan to be baselined. See "The Project Plan Report" in topic 4.3 for the expected information for draft sections of the Consolidated Project Plan.

5.6 *Step 6: Subproject Interim Estimates (Subproject Managers)*

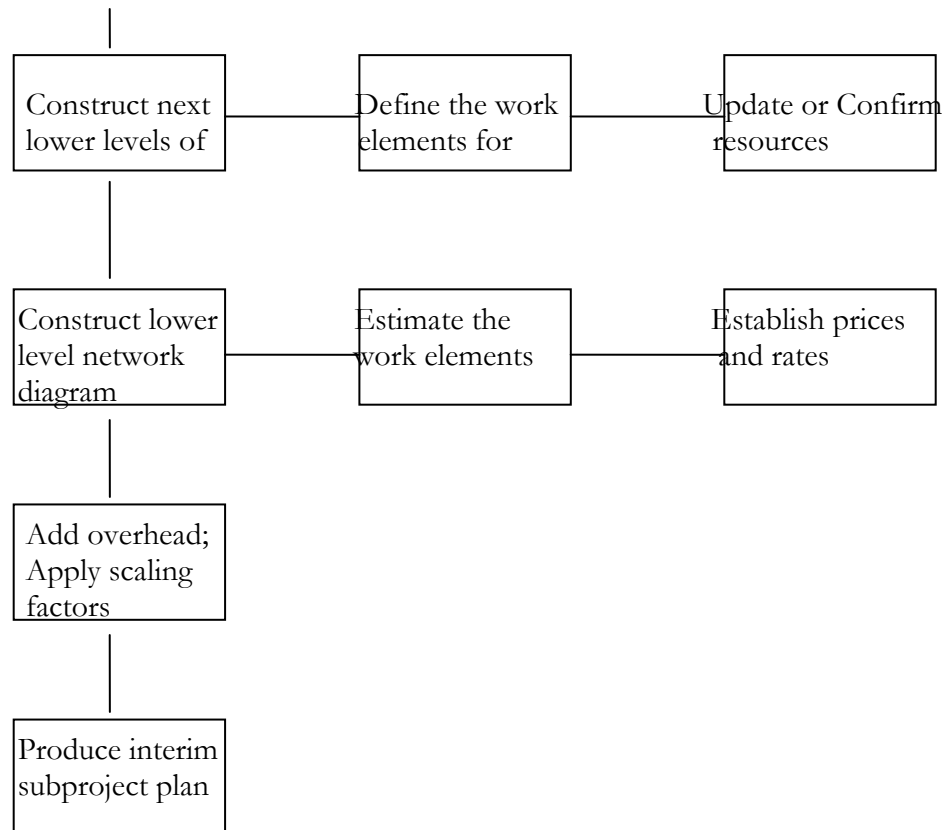
This requires that, where deemed necessary after the preliminary estimate, an interim and more detailed plan and estimate is prepared using the Task-By-Task Method, for each subproject. This, therefore, consists of several parallel activities, one per subproject being estimated. The joint requirements governing the breakdown level will be as follows:

- Time left for planning and estimating.
- How far ahead the subproject is.
- Whether this is a Proposal or Delivery project.



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- Size of the project.
- Whether the subproject is one of significant risk.



Outputs, for each subproject, are the interim subproject plan:

- The project WBS broken down to at least 3 levels following the recommendations in the Work Breakdown Structure technique.
- Each work element defined and estimated.
- An updated list of the resources which will be needed.
- Definitions of those resources.
- A high-level network for the subproject.
- A schedule of the milestone dates of the subproject.
- Estimates for the project's support costs and overheads.
- A summary of the estimate.

In conjunction with step 7 in the next topic, this will probably have to be repeated in order to achieve a satisfactory plan and estimate. This repetition will probably necessitate breakdown to a more detailed level within selected areas of various subprojects, in order to clarify and evaluate areas of risk or uncertainty in the pursuit of a better plan and estimate.

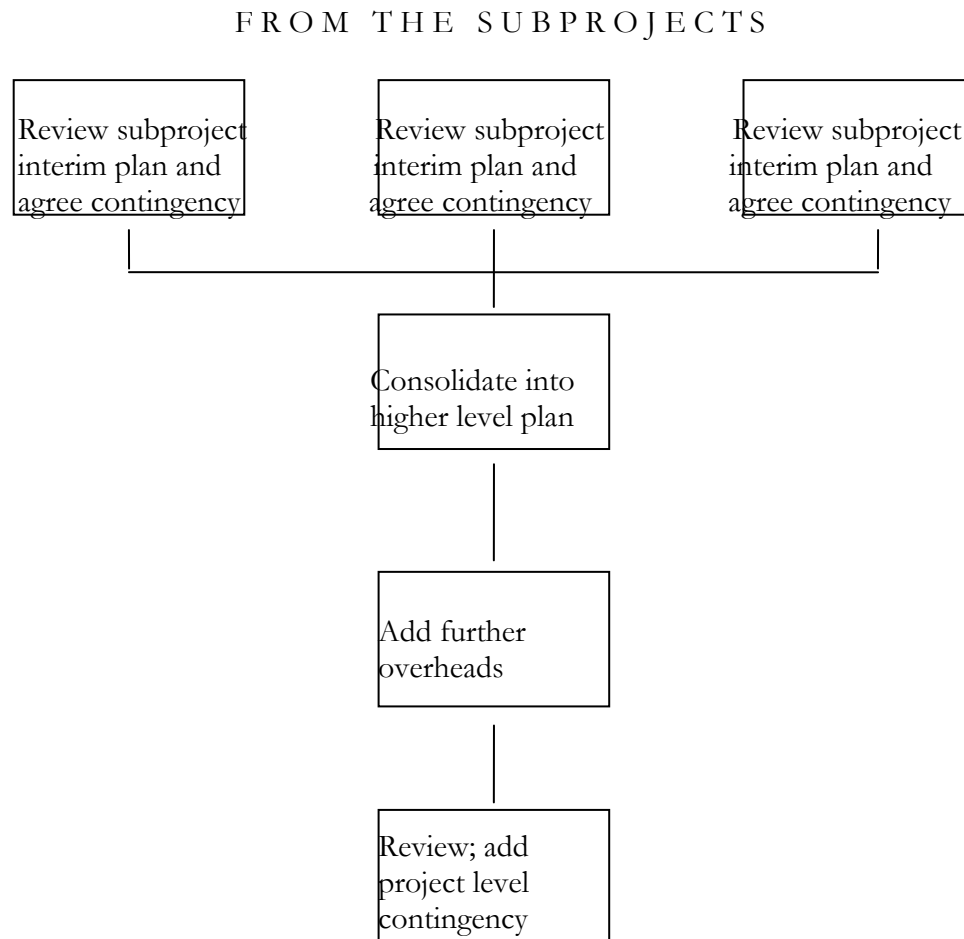
5.6.1 Guidance

Note the following:

- This begins the more detailed subproject planning and estimating, and the people participating should be the future Subproject Managers.
- An early step should be to confirm that the subproject objectives, clarified during the Project Definition, are still correct.
- Breakdown will probably be to one or in some cases two lower levels of the WBS. See the guidance in the Work Breakdown Structure Guide.
- The planner/estimator owns this part of the WBS at present, and must ensure that:
 - All deliverables and work products from the subproject have been identified and appear in the WBS.
 - All dependencies on other projects (approvals or specific deliverables) have been identified and that the other subproject manager is planning for this dependency.
- Conversely, he or she is responsible to others for taking account of their requirements. All such dependencies must be recorded.
- For each subproject an interim estimate is needed. The above diagram is, of course, similar to that for the Preliminary Estimate. We are repeating at a lower level a process already performed at a higher one.
- Unless someone is adept with PC planning tools, there should be reluctance to dash to the keyboard and generate the plan at the PC. If working in a group, a white board with sticky notes is probably one of the most effective ways to begin. On one's own, a first draft of the network on A3-size paper speeds the process.
- If the WBS is well structured it should be possible, though seldom easy, to develop a hierarchy of networks. Otherwise it may be that you need to change the WBS.
- Ensure that the required resources are cataloged and documented. Staff, for instance, should be noted on the Staff Specification Form where their availability and overheads should be stated.
- Remember to allow for costs and ensure that they are associated with a work element in the WBS. If necessary, create one specially. Again, see the Work Breakdown Structure Guide.
- The estimating methods to be used are more detailed. See "The Project Plan and Estimate" in topic 5.0 for further guidance.
- Estimate in work-days or work-hours, not higher.
- Plan how the estimates are going to be checked.
- After overheads and scaling factors, decide on the level of contingency the estimate currently needs. Also, allow for those parts which have not yet estimated.

5.7 Step 7: Consolidated Interim Estimate (Project Manager)

This requires that the estimates for each subproject are assembled, reconciled and consolidated to produce a first, more detailed estimate for the project.



The outputs are as follows:

- Updated Plan Database
- Revised milestone schedule
- Work, cost and resource schedules
- The first draft of the full project plan, including the Estimate Summary, within its classification of the estimate.

In conjunction with step 6 in the previous topic, this will probably have to be repeated in order to achieve a satisfactory plan and estimate.

5.7.1 Guidance

Note the following:

- The Project Manager must review the subproject plans for consistency, because the project plan depends on them.

- The policy on contingency allowances must be clear. Each Subproject Manager should agree them with the Project Manager, and hold it as a reserve to be called on as necessary. The Project Manager may hold a further such reserve, but not as a duplication.

5.8 Step 8: Project Baseline Library (Project Manager or Project Office)

The project baseline library consists of the agreed documents which define what the project must do, of the internal and external suppliers' statements of how when and what they will do, and a catalogue of them. In other words, they are the documents which, if they change, may necessitate change to the Project Plan, such as:

- Invitation to Tender
- (Draft) client contract
- Documents imposing standards
- Requirements specification
- Solution design document
- Development process
- (Draft) supplier contracts
- Supplier quotations.
- (Draft) documents of understanding
- Schedules of agreed milestones and dates

The characteristic of them all is that they will be agreed, explicitly or implicitly, by the Project Manager with an external party and so form part of the ultimate commitment. Another is that they are very likely to change during the planning and estimating.

5.8.1 Guidance

Note the following:

- It is important that these documents are assembled and catalogued as early as possible, for they provide the base for estimating. They are needed for practically all the work to Plan for the Plan, for the Preliminary Estimate, and for the more detailed estimating which continues from the Preliminary Estimate to the Baseline Project Plan.
- The project office, if there is one, should control these documents.

5.9 Step 9: Planning Database (Project Manager or Project Office)

This is developed and updated throughout planning and estimating. It consists of all internal files from which a project plan can be drawn. It is the working set of files owned and directly controlled by the Project Manager and Subproject Managers. These include:

- Work Breakdown Structure
- Work Specifications and Estimates (Work Specification Form)
- Resource specifications (such as Staff Specification Form)
- Network diagrams at each level
- Cost structure for the project

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- Overhead definitions
- The list of assumptions
- Source documents not belonging to the Project Baseline Library which provide, say, productivity data The Validation Report

In a simple project these may be on paper, held by the project manager. In more complex projects they may consist of paper plus the following:

- Data contained in estimating tools
- Project plans contained in project scheduling tools
- Text files on PC or mainframe
- Spreadsheets
- The risk assessment

5.9.1 Guidance

Note the following:

- Particularly on large projects, as more data is stored on individual PCs, keeping a record of what constitutes the Planning Database becomes increasingly important.

5.10 Step 10: Validation Report (Validator)

In a full scrutiny this consists of the following activities:

- Planning the validation
- Performing
- Analyzing and drawing conclusions
- Producing the report
- Review and acceptance of the report

5.10.1 Guidance

Note the following:

- The question will always arise as to how far the validator should work independently from the planning and estimating team, holding back recommendations for the report, as opposed to working in concert with the team and suggesting changes as validation progresses.
- In any case, the validation plan must allow time for the project manager and Subproject Managers to implement the accepted recommendations of the validator. This means planning effective completion before the final adjustments prior to filing the plan in the baseline library.

5.11 Step 11: Baseline Subproject Plans (Subproject Managers)

This is a repetition of step 6 to create the plans which are to be base lined. The accepted recommendations of the validator must have been incorporated.



Completion is marked by the base lining of the subproject plans, with the Consolidated Plan.

5.12 Step 12: Baseline Consolidated Project Plan (Project Manager)

This is a repetition of step 7 to create the plans which are to be base lined. The accepted recommendations of the validator must have been incorporated.

It includes securing the agreement of the Project Sponsor to the Consolidated Project Plan, which is then base lined with the Subproject Plans.



6 Presenting The Estimate

This topic discusses the importance of how to present the estimate to the client.

It is essential not only to prepare and validate the estimate, but it is also critically important to communicate the content of the estimate and to explain properly the following:

- Important components
- Assumptions
- Dependencies

If these are properly understood by the client, you will be more successful in obtaining agreement and "buy-in" to the total estimating package. This can result in more support for the estimate and less external pressure to reduce or modify the estimated effort and price without adjusting some of the other key components of the estimate.

The following topics provide some guidelines for you to use, as appropriate to your particular project.

Subtopics

- 6.1 Prepare Estimate Presentation
- 6.2 Explain Estimate
- 6.3 Identify Critical Components Of Estimate
- 6.4 Highlight Critical Dependencies
- 6.5 Review Estimate Assumptions
- 6.6 Obtain Agreement

6.1 *Prepare Estimate Presentation*

During the course of completing the estimate, it should be presented to all individuals with a vested interest in the project.

If you call a review meeting at which to do this, then the attendees should include the following:

- Members of the client management and client project team
- Developers
- Technical architects
- Project Managers
- Other managers

The purpose of the review is to explain the critical components of the estimate and to obtain agreement to the content of the estimate and commitment to support all the terms and conditions associated with the estimate.

The presentation should include the following:

- An overview of the proposed solution
- Scope of the work to be performed
- Associated estimates
- Deliverables
- Resources required (including people)
- Duration and schedule of major deliverables
- Assumptions used
- Identified risk elements and associated containment plans
- Contingency plans included in estimate
- Critical dependencies included in estimate

6.2 *Explain Estimate*

Information about the estimate should be communicated to all people on whom the success of the project is dependent. This should cover all key components of the estimate.

Note: It is crucial that all those involved understand the key conditions upon which the estimate is based.

6.3 *Identify Critical Components Of Estimate*

Some components of the estimate will be more critical than others. This may be due to the following:

- Skill required
- Resource constraints
- Multiple locations
- Multiple subcontractors
- Single source subcontractors

- Critical schedule date
- External dependencies
- Acceptance criteria
- Project completion criteria, and so on

These should be highlighted when presenting your estimate so that others are aware of them and how they are expected to support the project and to help contain the inherent risks.

6.4 Highlight Critical Dependencies

Frequently there are things that could affect the execution of the project plan and the ability of the project team to perform according to the estimate. Some of these may not always be under the control of the project, and are external dependencies that are critical to completing the project as estimated.

Examples of such critical dependencies could be gaining approval or acceptance of a project deliverable within a specific time period, or the availability of required equipment, resources or other items for the project. These external dependencies must be documented and presented so that others are aware of them and that, if they are not met, the estimate will change.

6.5 Review Estimate Assumptions

It is important to highlight the assumptions that have been made in preparing the estimate so that the final estimate is completely understood. If any of the assumptions prove to be incorrect then the estimate will be incorrect. Therefore the assumptions must be documented and explained in detail to ensure that all key members of the project validate, understand and accept them.

6.6 Obtain Agreement

Agreement that the estimate is reasonable and acceptable must be obtained from the attendees. They must agree to the following:

- What is in the project scope
- What is out of the project scope
- Project estimate

If you cannot reach agreement then at least one of the following must be changed:

- Project scope
- Resources planned (including alternate or multiple sourcing)
- Timeframe or schedule

Note: The estimate must not be changed without a corresponding change to one of the above items.



7 Further Guidance

This topic provides further details concerning some aspects of the Planning and Estimating technique.

Subtopics

- 7.1 Classification of MTP Estimates
- 7.2 Scaling the Estimate
- 7.3 Project Management and Support Overheads
- 7.4 Days in a Year and Hours in Week
- 7.5 Estimating Durations
- 7.6 Some Types of Resource and Sources of Cost
- 7.7 Estimating by Matrix
- 7.8 A Summary of Project Network Techniques
- 7.9 Work Distribution Models and Their Applicability
- 7.10 Some Rules of Thumb

7.1 Classification of MITP Estimates

The purpose of classifying the estimates is to ensure that the project manager or estimator:

- Has a common basis for understanding and agreeing with the Project Sponsor the quality of estimate required when the Terms of Reference for the plan are discussed
- Informs the Project Sponsor of the quality of the estimate in the completed Project Plan.

For the whole project or for the subproject, *including contingency allowance*:

Class	Name	Accuracy \pm %	Example of Possible Use
A1	Control	2 - 10	Day-to-day control.
B	Budgetary	10 - 25	For early inclusion in budgets, but before the firm price.
C	Feasibility	25 - 75	Solution selection.
-	Ballpark	300 ?	Decision to investigate

The required confidence level for A, B, C is 80% For example, at the stage of setting budgets you should have an estimate of class B; that is, confidence level of 80% that the actual will fall within the \pm 10-25% range of your estimate. This should be stated in the Estimate Summary.

7.2 Scaling the Estimate

In many cases you can get a first estimate for tasks, or for a group of tasks, from standard or guideline figures. Do not accept this guideline unthinkingly.

Every estimate must be scaled to account for the factors unique to the situation, such as lack of experience, much international travel and communication, or highly skilled people. Some factors will decrease the estimate, many will raise it.

It is too big a job to scale every single task estimate independently. Scaling should be applied to groups of tasks (that is, to activities) and may even be applied to a subproject as a whole.

Note: Scaling is not the same as contingency. Scaling is applied to take account of non-standard circumstances and, in doing the scaling, those circumstances need to have been identified. In contrast, contingency is applied to take account of unknown circumstances--that something will happen although it is not known at the time of estimating exactly what it will be.

The following are the factors which may affect any estimate, making it larger or smaller. When the estimate is done, the following list should be checked to see whether any of the factors could influence the achievement of the estimate. Don't be foolhardy; remember "Murphy's law"
-- if a factor can have an effect, it will!

The extent of the effect is a different question, and the answer has to be down to judgment. A positive influence could improve the estimate by 5% or maybe in an

exceptional case by 10%; a negative influence can easily worsen your situation by 25%, or more.

Many of these factors will also appear in the Risk Management Plan. If an influence is particularly ominous, the estimate should be scaled accordingly, but it should also be treated as a risk and be built into the risk management plan.

Scaling the estimate is not a science, and should not be applied to the smallest units (tasks) but worked at a higher level (activities or subprojects). If scaling seems to be lifting the estimates by extraordinary amounts an expert needs to be consulted. It may be the estimate for a very high risk project, or it may simply be too pessimistic. If the latter is the case, the risks are not simply fixed by raising the estimates, but rather through the need to develop a risk plan for management signoff.

There follows a list of scaling factors. This is not comprehensive list--there are many others.

7.2.1 Organizational Factors

The project organizational scaling factors are as follows:

- Clarity of the decision making
- Honesty of the negotiations
- The amount of support for the project and what it is aiming to do from the organization, its structure and its culture
- Relationships with suppliers and levels of trust.

7.2.2 People and Skills

The People and Skills scaling factors are as follows:

- Project staff have skills to do the job
- Suitable experience
- Stable environment--little turnover of project staff
- Staff are familiar with this kind of work

For further information, see the Organization and People Management Guide.

7.2.3 Management and Project Management

The Management and Project Management scaling factors are as follows:

- Good project management practices in place and being used
- Good managers (can lead and manage)
- Project Manager has experience of this kind of project
- Project organization--responsibilities are clear
- Management has a history of success on similar ventures

For further information, see the Organization and People Management Guide.



7.2.4 Size, Scale and Nature

The size, scale and nature scaling factors are as follows:

- Sheer size; it is very big
- Complexity
- Organizationally widespread; pervasive effect on company
- Geography--project staff in multiple locations
- Bigger than anything they have ever done
- Novelty

7.2.5 Technical

The technical scaling factors are as follows:

- New hardware or software
- New combination of products
- Demanding performance criteria
- Working at the leading edge
- Are all the teams competent
- New development techniques in use
- Requirements fully understood, documented and signed off
- Solution fully understood

7.2.6 Contract and Business

The contract and business scaling factors are as follows:

- Is the project highly visible?
- Is it must-do or must-get-right-first-time?
- Any contract concerns or issues?
- Are there major political factors?

7.2.7 Experience and track record

The experience and track record scaling factors are as follows:

- Have the key people successfully managed similar projects in similar contexts?
- Is this project totally different from any project the organization has previously managed?
- Are the project staff familiar with this kind of project and the work disciplines it will require?

7.3 *Project Management and Support Overheads*

This topic looks at the following overheads:

- Project Management
- Support people and other resources

7.3.1 Project Management

Project management should have its own work element(s) in the WBS. How much effort should be allowed?

Early estimating, at the Preliminary estimate level, should assume an uplift of about 10-15% on the sum of all other effort.

As more detailed estimating progresses, however, specific end products and activities from the Project management effort will be identified. These will need to be expanded



under the PM work element, and estimates for them separately made. An obvious example is the implementation plan; another, setting up the Project Office.

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Many factors will exacerbate the management load; few will lighten it. Typical sources of increased management effort include the following:

- Multiple subprojects
It would be wise to estimate PM time separately for each--and this means a PM work element allocated to each.
- More than 5 people reporting to a manager
- Geography--more than one location
- Two or more participating organizations
- Multiple clients (for example, in a community project, or Electronic Data Interchange (EDI))
- External suppliers
- Contract negotiations
- Two or more countries involved
- Time-zone differences
- High visibility of the project (hence active management interest)

Note that a supplier will require management effort (and sometimes a great deal) even though all of the direct work seems to have been delegated from the prime supplier by a contract.

One rule of thumb suggests adding one manager for every 20 people the subcontractor has in the subproject. Frequently this will not be sufficient; strained relations will increase it dramatically.

7.3.2 Support People and Other Resources

Record the people and other resources which are not aligned with subprojects. Examples include the following:

- Project office staff
- Technical Support
- Technical office/design co-ordination/architect
- Clerical support

Each of the subprojects should be responsible for stating how much of these resources, and of what type, they need.

7.4 *Days in a Year and Hours in Week*

This topic looks at the work days in a year and a week, allowing for public holidays, illness, and so on.

7.4.1 Days in a Year

The table below shows the days lost to a project throughout a year owing to weekends, public holidays, and so on.

Item	Days lost to the project	Days remaining
------	-----------------------------	-------------------



Weekends	104	261
Public Holidays	8	253
Personal Vacation	say 30	223
Education	20	203

From the table we can see there are roughly 200 days a year available for work. How different will the staff be on your project?

Now consider what happens to those remaining 200 days.

7.4.2 Hours per Week

The total working week includes both project work and overheads. The "project week" includes both project task work and other project activity. Hence the number of hours an individual can spend on project tasks is significantly fewer than the total number of hours worked in the week.

What are these factors which reduce the time available for task performance? They need to be included in the assumptions. Some examples are given in the list below. A few of these may have to appear as identified tasks in the estimate; for example, training:

- Orientation and learning curve
- Training and education for project
- Sickness (including dentist, blood donation, and so on)
- Company/department meetings and administration.
- Project meetings and reviews, including the following:
 - Time in the meetings
 - Time preparing for meetings
 - Follow-up from meetings
 - Delay in holding meeting ("Can't get them all together till next Thursday").
- Informal project meetings
- Guidance to/from colleagues
- Rework
- Interference from normal business work
- Project administration
- Travel

7.4.3 So What is Left?

The amount of time and effort that these withdraw from available task time will vary from organization to organization, and from project to project. There is no standard figure but there are a few guidelines, and the numbers seem surprisingly low:

- In a well-managed, highly motivated and team oriented environment, where the staff are working on totally familiar tasks in a comfortable and familiar environment, the task hours per week might achieve 70%.
- A useful rule of thumb is 50-60%.
- If any estimate assumes 65% or more, challenge it. It may be right, but it should be provable.
- There are many cases of projects (seen retrospectively as successful) in which this figure lay in the range 40%-45%.

These figures are never unambiguous. Estimates are frequently made on an elapsed time basis, which will hide certain project overheads. Do the "standard" percentages represent records, collected over a long period of time, that include average sickness and vacation? This will not be known until analyzed and documented.



7.4.4 Gross versus Net

Many estimates are quoted as "gross"; many as "net." What do these terms mean?

Gross Includes all the above. So a gross work-year is one person for one year, holidays, sickness, education and all. It is not one person working for 365 days or even 253 days, 24 hours or even 7 hours per day. It leaves you that 60%-70%.

Net This is the time that the person has available on a normal day in the office. It is the time left that will actually be allocated to scheduled tasks, such as orientation, code writing, installation, and so on.

7.5 *Estimating Durations*

Given that a subproject or project has been estimated as X gross work-months, how do you estimate its duration? How many people will it need? It is clear that it cannot be achieved in an elapsed minute; but 15 years may not satisfy the Project Sponsor.

One simple way for estimating duration at this level, before the project has been broken down into smaller lumps which can be independently scheduled, is the "square root rule," much used in the application development community. The square root rule is shown in the following diagram.

$$Duration = \sqrt[3]{X}$$

$$No. of staff = \sqrt[3]{X}$$

In effect, this proposes the minimum time for the project, below which it is unwise to go as the additional communications between more staff over an unnaturally shortened project will increase the project effort beyond X.

Note: X is in gross work-months, not work-weeks or work-years. Note also its limitations; it is for people-intensive projects, where their work is interdependent.

However, some factors in the more detailed tasks will work hard to extend durations. For example:

- Lead times
- Time for decisions
- People unavailable when needed
- Actions delayed until the next monthly review is imminent
- Delay in another person's work, on which you depend

7.6 *Some Types of Resource and Sources of Cost*

Just some of the resources that you will need to allow for are the following:

- Manpower and skills
- Overtime
- Rewards
- Training courses
- Subcontractors
- Hardware (deliverable or internal)
- Software (operating system or project management tools)
- Machine time
- Equipment
- Office space
- Supplies
- Travel and accommodation
- Software
- Publications



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- Bureau services
- Cross-charges
- Filing space
- Communication lines
- Fax
- Transport
- Assignment costs
- Time

7.7 *Estimating by Matrix*

The content of a work element should become discernible when that work element is defined on the Work Specification Form. How that content is to be estimated depends on the internal structure of that work element, for it may be:

- One significant piece of work, not easily broken down further--usually at the lowest levels of WBS.
- A set of activities which are not homogeneous, which can be broken down further (if required at this stage of planning and estimating) but which must be estimated by different methods because of that lack of homogeneity.
- A set of homogeneous activities, which can be broken down further when required but which can be estimated in a similar way, because the activities are similar, differing only in a limited number of ways.

The third category is susceptible to matrix methods of estimation. The main requirements are as follows:

- A classification scheme can be devised, based on a limited number of "dimensions" each of which directly affects the work content of an item.
For example, complexity; distance; duration; number of students.
- Each of these dimensions can be split into a small number of ranges of values, whose boundaries are clearly defined.
For example, Simple, average, complex; less than 20 miles, 20-75 miles, more than 75 miles; less than 0.5 seconds, 0.5-2 seconds, more than 2 seconds; fewer than 5 students, 5-15 students, more than 15 students.
- Each of the individual items can be assigned to one of the ranges, for each dimension--and so to a "cell" in a matrix.
For example, complex and 20-75 miles and more than 2 seconds and fewer than 5 students.
- To each such cell one can assign a typical quantity of resources.

The task of estimating this work element using matrix methods then breaks down to the following steps:

1. Identify the dimensions to be used.
Sometimes there may be one; often two; more, occasionally.
2. Define the range boundaries.
This will usually be on the basis of past experience. Sometimes a natural structure is evident.
3. Estimate the resources to produce a representative item for each cell.
This normally requires historical data, but experienced opinion can substitute.
At this point a standard resource matrix is defined.
4. Classify each item within the work element: assign to a cell.
5. Total the number of items in each cell.
At this point a matrix or tally sheet for the work element exists. It shows the frequency distribution of the items across the matrix.
6. Multiply the two matrices to produce a third matrix, which shows the total resource required for each cell.
7. Total all elements in this third matrix.

The following diagram illustrates the above.

		COMPLEXITY								
		Simple			Avg			Complex		
					S	A	C	S	A	C
S										
I	Small	1	4	9	10	0	0	10	0	0
Z	Medium	3	7	12	5	20	7	15	140	84
E	Large	5	10	16	2	3	3	10	30	48

x =

Standard Resource
Matrix

Frequency
Matrix

TOTAL = 337

This method can be used when the number of programs in a code and test phase is known and the design is sufficiently complete to be able to classify each program. Other examples could include the following:

- Interviews during a data collection phase
- Stores during a Point-of-Sale roll-out project
- Development of courses in a new curriculum
- Production of a large document with many chapters, including text, graphics, and so on.

This method needs a number of factors:

- The process for each item is reproducible
- The process for each item is reproduced
- Measurements can be taken of actuals
- A feedback process from updating each resource cell.

7.8 A Summary of Project Network Techniques

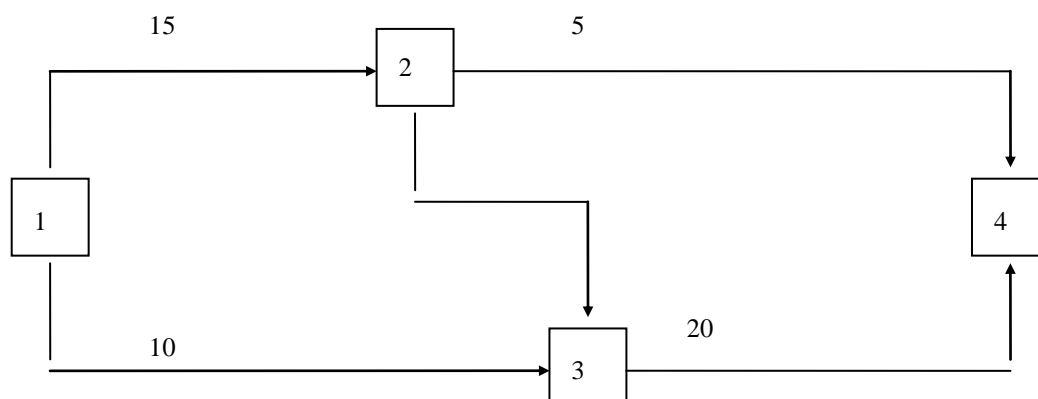
Work Breakdown Structures, covered as a separate technique within MITP, do not assist scheduling of any but the simplest of projects, primarily because the inter-dependencies of work elements are not fully represented. Project Network Techniques (PNTs), developed since World War II, help to fill the gap. This topic introduces them, but does not provide detail, which can be found in many standard works on project management, and in the several books devoted to PNTs.

Note: Alternative and not identical terms are Critical Path Method, Critical Path Analysis, and Project Evaluation and Review Technique (PERT).

A project network is, at its simplest, a diagram which shows all work elements (within PNT they are generally called "activities"), and their interdependencies. The two main forms of representation in common use are described below.

7.8.1 Activity on Arrow (AOA)

Activity on Arrow networks are also known as "arrow" or "IJ" networks. The activity (work element) is represented as an arrow, and the interdependencies are the points where the arrows meet. The following diagram provides an example of such a network.



Within this network there are 4 "events" which are known as 1, 2, 3 and 4. There are also 4 work activities which would be known as 1-2, 1-3, 2-4 and 3-4, where the first number is the "tail event" number and the second, the "head event" number. Further, there is a "dummy" activity, whose work content is zero. The diagram portrays the following:

- Event 1 is the start of the project.
- Activity 1-2, of duration 15 units, can start immediately.
- Activity 1-3, of duration 10 units, can also start immediately.
- Activity 2-4, duration 5 units, cannot begin until event 2 has happened which, in this case, means that activity 1-2 must have completed.
- The dashed and crooked line from event 2 to 3 is called a "dummy" and exists solely to indicate a dependency. It has no work content and, in this case, its duration is zero. (It need not be zero; it could be positive number, indicating a delay.)
- Activity 3-4, duration 20 units, cannot begin until event 3 has happened; that is, that activity 1-3 has completed but also activity 1-2 (because of the dummy, 2-3)
- Event 4 is the end of project, and it occurs when both 2-4 and 3-4 have completed.

The duration of the project can be calculated by working out the earliest event dates, early activity start dates and finish dates in a forward pass through the network.

In this case, the project duration is 35 units. In a backward pass, one can calculate the latest versions of the same dates. From these--and indeed from the diagram--it is easy to see that activities 1-3 and 2-4 do not require all the time available to them, and allow some flexibility in choice of start and finish dates. They have "float"; 1-3 has 5 units of float; 2-4 has 15. So each of these activities could extend by up these amounts, and the end date of the project would not change.

On the other hand, activities 1-2 and 3-4, with the dummy 2-3, allow no flexibility. They have zero float; they are on the "critical path" Any lengthening of these critical activities will directly affect the project end date, at event 4.

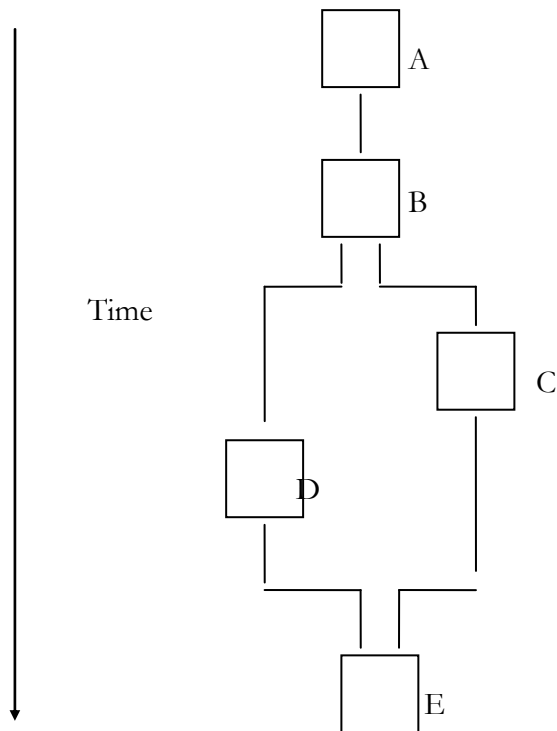


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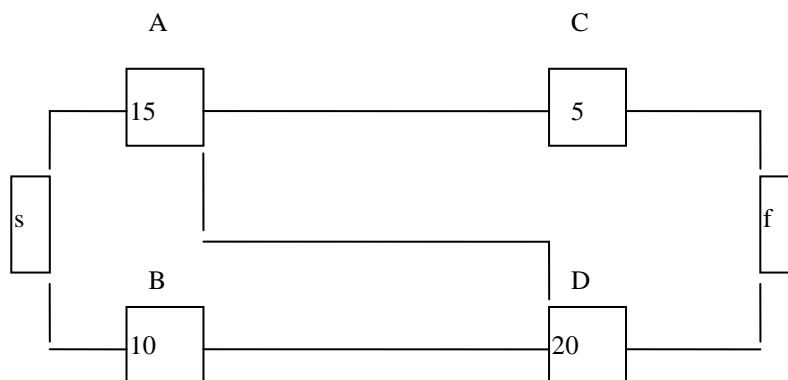
Note: For events "slack" is the equivalent term to float for activities. Thus events 1, 2, 3 and 4 all have zero slack.

One feature of the above arrow network is that the dependencies are evidently from the finish of one activity to the start of the next. A second is that the method clearly distinguishes between events and activities. These lead to its use in an interesting variant, the milestone network, where the events become predominant, and they are joined by arrows which are not the activities, but dependencies linking the finish of one activity to the finish of another.

7.8.2 Activity on Node



Activity on node (AON)



This diagram represents the same project network as that for AOA. The activities are the boxes, however, and the arrows are the dependencies. The events are now buried in the activities, one at the beginning of each activity, and one at the end. The calculations would be identical, and give the same result.

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Note that the dummy is no longer needed. Note also that a duration, positive or negative, could be placed on any arrow to indicate a "lag" or delay, or a "lead," respectively.

There are several variants of the AON network:

Method of Potentials

Precedence Network

Invention credited to IBM, this "multiple dependency" network allows many sorts of link between activities.

- Start-to-Start
- Start-to-Finish
- Finish-to-Start
- Finish-to-Finish

These simply say where the arrow comes out of one activity and where it goes into the next, both in the diagram, and in logic. The third of these is still the one of most use.

Single dependency

Only Finish-to-Start dependencies are used so it is, in effect, a special case of the precedence network.

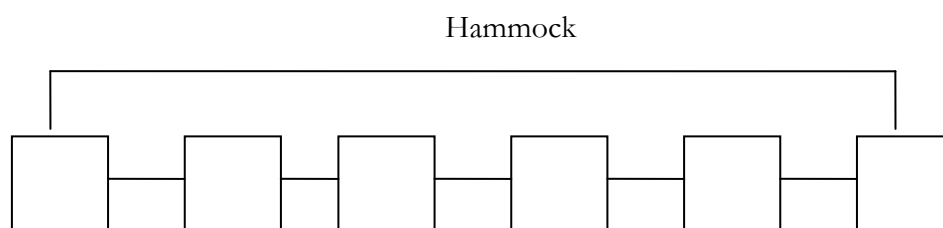
Method of Potentials

Only Start-to-Start dependencies are used, but each such dependency will show the duration of its preceding activity. Leads and lags must therefore be represented in a slightly different way.

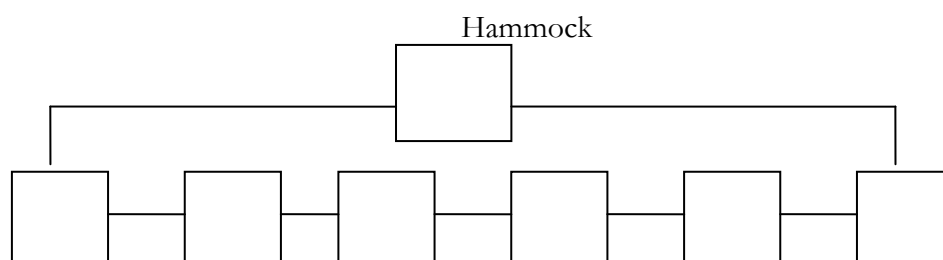
Hammock Activities

In allocating costs within a project it is often impossible to identify a single activity which should logically contain them, as the cost may be spread across several; for example, occupancy costs. In such cases a "hammock" can be used.

For AOA (arrow, IJ):



For AON (precedence):





Summary Project Network Techniques are essential tools in the scheduling of complex projects. From a calculated network a Gantt chart can be derived, though the Project Manager's judgment will be needed to decide on the scheduling of those activities which have nonzero float.

Most PC-based project management tools support PNT, in precedence form, or in arrow form; occasionally, in both. Modern tools also have facilities for scheduling such networks when the additional complexity of resources other than duration are introduced.

Publications The British Standards Institute has produced two detailed publications on PNT: BS4335 (1987) and BS6046 (in 4 volumes).

7.9 *Work Distribution Models and Their Applicability*

Where an organization repeatedly conducts similar projects, a common process should be definable. Such a process would typically be divided into successive "phases."

Provided that the process is commonly followed, and that data is collected from each of the projects, a base of historical data can be accumulated which allows a "Work Distribution Model" (WDM) to be developed, as shown in the example below.

THE WORK DISTRIBUTION MODEL

Phase	Percentage of total resource
1	2
2	8
3	15
4	25
5	30
6	15
7	5
-----	-----
Total	100
-----	-----

Provided that the project to be estimated is of the same type as those providing the historical base, and that the same processes will be followed by a similar development team, a total estimate for the project can be derived if one of its phases can be estimated, or has been completed.

For instance, if Phase 3 is estimated at 300 work-days, using a different method, then the total resource estimate for the project will be 2000 work-days; and for Phase 4, 600 work-days. This is a method frequently used for Application Development projects.

In all cases the source for the Work Distribution Model data should come from the specialist organization which will undertake the project.

Note: It is most unlikely that the same percentages will apply to other resources consumed; duration (because of parallelism and variations in project team size); cost (because of different team compositions and cost rates).

7.10 Some Rules of Thumb

All Rules of Thumb must be used with the greatest caution. Some are so ancient that one cannot be sure of their source (Homer?) or applicability (dairy farming?). However, some are undoubtedly practical and useful for coarse estimating, or for testing the estimates of others.

Ensure that, before using them, you check their validity in your environment. Here is a selection, in no particular order:

- Allow 10-20 % for project management.
- Allow up to 10% for change in an AD project.
- Add 2% to a project for time recording and data collection.
- Reqs + extl design : code + unit test : sys test + implement = 30 : 40 : 30. This dates from the 1970s or earlier, but is still occasionally used. There are many others which conflict. For example, Requirements : Design : Build = 20 : 30 : 50. 4GLs and CASE tools will change. The individual development group will always be different.
- 1 week-3 months for orientation.
- Variation in productivity, expert : novice = 4 : 0.5. In a very short project this could mean that the novice is of no use.
Another suggests a 100 : 1 ratio for good : bad.
- In AD, requirements = 35% of (requirements + design)
- In AD allow 5% of total project effort for systems support.
- A new development tool will add 10% to the phase.
- Documentation rate: 1-3 pages per day. However, for highly reviewed documentation, such as critical proposals, allow 10 hours per page in total.
- Before feasibility study the guess may be a factor of 4 wrong, in either direction; after feasibility, a factor of 2; after requirements specification, a factor 0.6, and so on.
- Function Points per work-month can vary from 2 to 50.

Note: This list should inspire caution more than confidence.



A Appendix A. Estimating Checklist

This appendix contains a checklist to help in the planning and estimating of a project.

Subtopics

- A.1 Type of Estimate Required
- A.2 Environment and Background
- A.3 Basis For The Estimate
- A.4 Work Areas
- A.5 Estimating Skills
- A.6 Estimating Process
- A.7 Details Of The Estimate
- A.8 Schedule and Plan
- A.9 Contract
- A.10 General

A.1 Type of Estimate Required

- What is the purpose of the estimate?
The estimate may be required for many reasons including the following:
 - Feasibility (rough approximation)
 - Guidance to client
 - Supplier estimate for proposal project
 - Supplier estimate for implementation project
 - Budgetary & Planning figure for business case
 - CSA estimate to allocate an amount of resource
 - Third party submission to supplier as part of a contract
- Is the level of the estimate appropriate for the requirement?
- What is the extent of the estimate?
 - Estimate only
 - Plans
 - Schedules
 - Full management system

A.2 Environment and Background

- Is the situation one where the estimate is likely to be achieved?
- Does the estimate allow for the nature of the business relationship that exists between the client and supplier?
- Is work by third parties included in the estimate?
- Has full account been taken of possible risks and issues associated with third parties, suppliers or subcontractors?
- Does the business dependent upon this situation justify the figures quoted?
- Is the supplier protected in the event of failure or significant delays in the project?

A.3 Basis For The Estimate

- Is the basis for the estimate comprehensive enough?
Note that the estimate should be based on documentation which at least covers the following:
 - Statement of requirement
 - Solution description and approach to the project
 - System definition
 - Functional specifications of the components of the project, both IT-related and not IT-related.
 - Preliminary project definition
 - The project scope and bounds
 - Terms of reference for the estimate
 - What is to be estimated and what is not
 - Estimating assumptions
 - Business case (for the project as well as for involvement of IBM)
- Is the estimate based on sound written documentation?
- Is the documentation used as the estimate base agreed by the client, supplier and all third parties?



- Is the base documentation complete to the level expected for the estimate?

A.4 Work Areas

- Are all work areas included in the estimate?
- Is the work-breakdown structure sufficiently detailed?
- Are all the deliverables identified and specified?
- Are the completion and acceptance criteria clearly defined?
- Are skills and responsibilities clearly identified?

A.5 Estimating Skills

- Was the estimate prepared by people with appropriate estimating skills?
- Was the estimate prepared by people with experience in the industry or application area?
- Was sufficient time spent in preparing and generating the estimate?

A.6 Estimating Process

- Who prepared the estimate?
- Was the MITP Planning and Estimating Guide used?
- Is there an estimate report?
- Is the format of the estimate report in line with that recommended in the MITP Project Control Book?
- Has the methodology used been documented?
- Were similar estimates/projects used to assist with the estimate?
- Were the estimates checked during the generation process?
- Is there a documented estimate validation?

A.7 Details Of The Estimate

- Has the project been broken down into subprojects and an estimate produced for each?
- Have all tasks for each subproject been identified and documented?
- Were standard figures used to establish effort estimates for tasks?
- Are the rates used appropriate in the circumstances?
- Was appropriate scaling applied?
- Does each subproject list:
 - Deliverables?
 - Assumptions?
 - People, skills and availabilities?
- Has adequate contingency been allowed?
- Has allowance been made for effort over and above the project task work, such as:
 - Project management?
 - Set up and running of a project office?
 - Specialist support for guidance, technical review etc.?
 - Assurance reviews?



- Progress reviews?
- Decision-making delays?

A.8 Schedule and Plan

- A schedule and set of plans may be required for an estimate:
- Have all factors and dependencies been allowed for in generating the schedule?
- Has sufficient time been allowed for critical items?
- Has time been allowed for:
 - Project definition and start-up?
 - Establishing relationships with the client, the Project Sponsor and with all external parties?
 - Milestone or phase-end reviews and decisions?
- Do plans cover:
 - Human resources--which skills are needed, and when?
 - Management system--how the project will be managed?
 - Reviews--how the project will be reviewed by management?
 - Assurance--how project and technical assurance will be discharged?
 - Testing--how the developing systems (business and IT) will be tested?
 - Training--how project members and users will be educated and trained?
 - Documentation--how project deliverables will be handled?
 - Agreement--how approvals will be gained?
 - Implementation--how the project and its deliverables will be handed over to the line business, and used as part of the day-to-day business activity?

A.9 Contract

Is the estimate satisfactory for the level of contractual commitment implied?

A.10 General

- Is the presentation of the estimate satisfactory?
- Have queries or concerns about the estimate been answered satisfactorily?
- Is the estimate a sound piece of professional work?
- Is it fit for the intended purpose?

B Appendix B. What the Estimator Must Consider

All estimates are wrong; some are acceptable. Factors which the estimator must consider to increase the chances that the estimate will be reasonably close include the following:

Accuracy, confidence level

The greater the precision required of the estimate, the greater the requirement for more time to prepare or for more experienced estimators to be involved. The estimator should be prepared to state the confidence level in the estimate; he should record it in the estimate report.

Activity and resource scheduling

The estimating process is interlaced with activity and resource scheduling, since it provides the basic numerical data. A significant amount of rework effort may be required as plans and schedules change.

Assumptions

All estimates include them, whether they are about productivity rates, on the outcome of decisions yet to be made, to cover gaps in the target system specification, or on aspects of the project not yet defined. All must be recorded.

Change or stability

The likelihood of change to the target system depends on many factors, including the degree of user involvement so far, the means of change control and, of course, the duration of the project. Any change will require effort to define, review and agree its fate, as well as the technical effort to implement it.

Checking

While $(2 + 2)$ work-years = 4 work-years, estimates have been known to say otherwise. There is no simpler way of increasing the error in an estimate than leaving it unchecked.

Communications

The effort needed to ensure effective communications within the project team and with users will depend on the number of different parties and departments involved and their geographical separation. Where different parties use different systems of communication these must be bridged--which requires effort.

Constraints and dependencies

No project is independent of external activities or natural or imposed constraints. This project may require the output from other projects, and there may be management-imposed limits or deadlines.

Contingencies

Allowance must be made for each contingency that may occur, in proportion to the likelihood and impact of that contingency. Often these are lumped together under a single percentage figure added to the project effort as the last stage in the estimate. However, specific allowances at task level may also be required.

Deliverables or end products



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In a full and detailed estimate a complete list of the individual deliverables should be attempted, rather than, for example, phrases such as "procedures and other documentation."

Documentation

The documentation which specifies the project must be collected and understood by the estimator; and the estimator must include in the estimate the work needed to produce documentation deliverables.

Duration

The duration of the project will affect the size of the project team. If too short, the project team is unmanageable and the project frantic; too long, and the sense of urgency vanishes, while the requirement for changes during the project increases.

Effort

How much effort will the estimate itself take?

Estimating experience

One of the primary reasons for poor estimating is the inexperience of the estimator, which can lead to optimistic assumptions about productivity rates and, more importantly, necessary areas of work undetected.

Estimating method

The method to be used will depend on the quality of result required, the estimating data available, the experience of the estimators, and the quality of estimate needed.

External factors and influences

The economic environment, for instance, can affect the estimate. Financial constraints may delay or lengthen the project, changing the effort required. Money estimates particularly are vulnerable to economic circumstances, because of inflationary effects and also the real cost of borrowing.

Geography

Significant project time (and hence money) can disappear unproductively on travel and accommodation.

Lead times

The procurement process and scarcity of supply can impose significant delays in starting project activities. Lead times do not always stay the same but may lengthen during the course of a project.

Neglected

Sometimes in early estimates the following are neglected:
disaster recovery, fallback plans, end-of-phase reports, rework time following reviews, documentation, quality assurance, decision time, special stationery, help for the validator, kick-off meetings, the time to acquire people.

Novelty

If the project is outside the experience of this organisation and project team it will take more effort and longer to get it right. The time spent in review by technical experts will increase as may the number of technical problems, the effort to resolve them and the amount of time required in testing.

Orientation

Perhaps the most frequently forgotten task, this can quickly turn a promising project into one which has slipped a month in its first month. Everyone needs orientation, and it comes at the most critical time for a project--when a person starts. See also Turnover.

Organizational culture

If the organization is not well adapted to managing change, much project management time will need to be devoted to facilitating it. In such a case, decision making may be slower.

Overheads

These can amount to a high proportion of the total project effort. The need to operate the MITP control processes, to manage the project, to review the project and to provide quality assurance are necessary elements of project effort and may affect the elapsed time for many individual tasks.

Parties and partners

Increasing the number of parties to a project also increases the effort needed for liaison and monitoring and, perhaps, for the other parties to adopt and learn the processes and disciplines required in this project.

Phase of the project

Estimates are likely to be more uncertain at the start of a project when there are more unknowns. One can expect the accuracy of an estimate to be higher after program specifications are completed.

Planning horizon

Detailed breakdown into smallish tasks is generally difficult or impossible for subprojects which will not start until much later in the project. This usually demands that detailed estimates are committed only for early phases, and that later phases will be subject to later, separate contracts on the basis of the more detailed estimates which will then be possible.

Planning status

At the time of estimating, planning will be incomplete. The estimator will usually need to take part in it to ensure that the project is sufficiently defined to be estimated.

Productivity factors

Rates of production directly affect estimates and timescales, and need to be recorded. These may be lines of code per man-week, pages of documentation per man-day, man-days per installation, man-hours preparation per half-day of education, vouchers completed per day, keyed per day, and so on. The source of the assumed productivity rate, and its applicability to your project, need to be carefully examined.

Project definition

Ideally, the project should be defined before you begin to generate estimates. The detail in the project definition report provides the basis for structuring and estimating the smaller project of generating the estimate. In practice, the estimator will have to contribute to the process and make assumptions where gaps remain.

Project management

The quality and experience of the project management team directly affects its ability to bring the project home within estimate. Inexperience, or lack of project management disciplines in some of the parties to the project, should be allowed for in the estimate.

Project organization

The structure of the project organization directly affects project effort in reviewing with management and the elapsed time in reaching decisions relating to project work.

Project team

The size of the project team affects the amount of project management effort required, and the amount of time required for keeping the team informed.

Public relations

Particularly where the delivered solution will have a major impact on the user, where there may be strong resistance to change, or where the political environment requires sensitivity, more time, effort and money must be devoted to preparing the ground.



Purpose of the estimate

An estimate for preliminary sizing should not take as much time as that for an implementation contract. The estimator needs to consider the uses to which the estimate will be put before deciding how much time should be spent on it

Quality and completion criteria

These are essential. If undefined, the accuracy of the estimate is unknown and certainly outside the estimator's control. If they are not defined in measurable terms, time and a process must be allowed for resolving possible disputes.

Reviews

By project management, steering committees, technical consultants, quality assurance, peers and auditors. All take the time of reviewers and those whose work is being reviewed.

Revision

At the forefront of the estimator's mind must be the knowledge that at some point the estimate may need to be revised or reworked, and that someone has to do it. The amount of detail in the final estimate, and so the effort to produce it, must reflect this requirement for later understanding.

Risks

From the estimator's viewpoint these could be defined as those occurrences which, if they happen, make the estimate wrong or badly wrong. The estimator therefore needs to take account of risks, to estimate the risk plan for handling, and to recommend the level of residual allowance for contingencies.

Scaffolding or by-products

Not all that is produced by a project is destined for the end user as part of the solution. In most projects there will be internal deliverables, required to help in producing the end products or as an intermediate stage to the final and full solution. For example, bridgework in conversions, test drivers, discussion documents, prototype code which may be thrown away.

Scaling the estimate

This means adjusting the estimate to take account of known circumstances. If, for example, the standard estimate for a task is five days, it may be decided to scale it up by 20% to six days, because it will be performed by a slow worker. Contingency allows for possibilities, scaling for certainties.

Scarcity

If an essential resource or consumable is scarce, this may directly impact the estimate and project timescale. The price may also change. The estimator must allow for and record this.

Skills

Inexperience in the project team may mean extra education and introduce the "learning curve," both of which must be included in the project estimate. Where there is a lack of skills also outside the project team, the estimate must allow for the greater time to resolve problems. These may require more investigation or have to go to a separate organization for resolution.

Target system specification

When the specification is incomplete or sketchy, or is not yet agreed, more project effort is needed. First, much of the project team's time may be needed to complete and agree it at the required level of detail. Second, this completion activity will probably lead to the discovery of extra, work-generating demands, detail and difficulty in the project itself.



Technical complexity

The more the number of components or levels in a solution, the more the number of interfaces and paths. This may lead to a greater need to devote effort to defining protocols, and will certainly increase the testing. It may also increase RAS (Reliability, Availability, Serviceability) effort in the project.

Time available

The estimate itself takes time, which may be a day or several weeks. Like the project duration, the time available to produce the estimate may force the expansion of the estimating team. It may also result in an estimate of lower or too low quality. The estimator is responsible for ensuring that his or her professional opinion is heard, understood and taken into account.



Turnover

Is very seldom allowed for in estimates. Yet any project of six months or more will experience it. When this unplanned or planned event happens to a member of staff, the replacement (who may be a manager) must go through the orientation period too. This may now be longer than before, as the project has been busy creating history.

Units and dimensions

As soon as possible in the estimating process, the estimator needs to resolve the questions of what must be estimated--which parts of the project and which types of resource (money?)-- and the units that to be used for estimating, such as work-day or task-hour, K lines of code, an A4 page of documentation, a problem report. The units chosen should be stated and consistent across the estimate.

Unknowns

For all the definition work done, unknowns always remain. Assumptions must be carefully defined to plug the gaps. They must be stated in the estimate.

Validation

The independent validator needs to have access to the detail of the estimate, and to the estimator's time. Validation often results in recommendations for change to the estimate: rework time should be allowed for in the schedule for estimate generation.

Work breakdown

The normal technique for identifying all work is to break the project down into subprojects, to list all deliverables and scaffolding, and to break down into tasks all work needed to produce them. Deriving resource estimates at this fine level of detail means that a large number of separate estimates are created. When they are summed some cancellation of errors can be expected.

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Readers' Comments

MITP
Planning and Estimating Guide
Version C5.0

Publication No. MICG1PLN

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- 2 Satisfied
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