Turner, J. Rodney
The Handbook of Project-Based Management, 2nd ed.
Improving the Processes for Achieving Strategic Objectives
McGraw-Hill Company, London, 1999: 93-123
ISBN 0-07-709161-2

5 Managing scope

5.1 Introduction

In this part, I describe methods, tools and techniques for managing the five project management functions: scope; organization; quality; cost; and time. I start with scope. The next four chapters deal with the other four functions. I shall then describe the management of the risk inherent in them all.

Scope management can be defined as the function of *ensuring that enough, but only enough, work is undertaken to deliver the project's purpose successfully*. There are three key elements to this definition:

- an adequate, or sufficient, amount of work is done
- unnecessary work is not done
- the work which is done delivers the stated business purpose.

There are four essential steps to scope management:

1. Developing the concept through the project's objectives and product breakdown structure.
2. Defining the scope of work through the work breakdown structure.
3. Authorizing and executing the work, and monitoring and controlling progress.
4. Commissioning the facility to produce the product and obtain the benefit.

It is through the process of managing the scope that the owner's requirements are converted first into the definition of a facility to produce the expected benefit and then into a statement of the work required to construct and commission that facility, and that the work identified is brought to a successful conclusion. This is the *raison d'être* of project management, and so scope management is the principal project management function. The other four are enabling functions or constraints.

In this chapter, I describe the methods, tools and techniques used to manage scope. I shall start by revisiting the principles of good project management introduced in Section 4.5, and show how these are achieved

by the use of product and work breakdown structure. In the next three sections, I shall explain how the products and work of the project are defined at the three fundamental levels of breakdown: how to define the facility required to achieve the owner's purpose and the broad areas of work required to construct that facility; how to break the facility into intermediate products, or milestones, in each of the areas of work; and how to specify the work, as activities or tasks, required to produce the intermediate products. I close the chapter by illustrating the concepts with several case studies.

5.2 The principles of scope management

Four of the principles introduced in Section 4.5 relate to scope management:

- manage through a breakdown structure
- focus on results
- balance objectives and levels of ambition
- keep it simple.

All four of these principles can be met by the use of a breakdown structure. The second will be achieved if the primary breakdown is via a *product breakdown structure* (PBS). The third is achieved by ensuring that results are delivered in all the areas of the project, and by balancing the work through the work breakdown structure (WBS). The fourth is achieved if we use single page reporting at all levels of the structures. In this section I consider the principles of product and work breakdown.

Breakdown

Breakdown is a technique by which *the project is divided and subdivided for management and control purposes*. Rather than breaking the work of the project into a low level of detail in a single step, it is devolved through increasing levels of detail. Focusing on results means we start with a PBS. The PBS is developed by breaking the facility into intermediate or sub-products. The work required to produce each subproduct and the work required to assemble and commission the facility from the subproducts is then identified. I previously described three fundamental levels of breakdown: integrative, strategic and detail levels. However, a WBS can be developed to many more levels and I have seen seven used on large engineering projects. Table 5.1 shows a typical structure, with several levels of deliverables, associated work elements, and possible relative durations for a project lasting about a year. This structure shows the project as part of a much larger programme of work, required to deliver the company's 5- or 10-year objectives.

Table 5.1 · Typical products and work breakdown structures

Deliverable/product	*Work element*	*Duration*
Corporate development objectives	Programme	5–10 years
Specified change	Project	9–18 months
Individual project objective	Areas of work	6–18 months
Milestone	Work package	1–3 months
Component	Activity	1–3 weeks
	Task	days
	Step	hours

There is no universal agreement on the terms to be used for the work elements and their deliverables. There is one supplier of project management software which uses the sequence project-phase-activity-task in one of its products and project-phase-task-activity in another.

Advantages of using a breakdown structure

There are several reasons for using breakdown:

- it provides better control of work definition
- it allows work to be delegated in coherent packages
- it allows work to be defined at an appropriate level for estimating and control for the current stage
- it allows containment of risk.

BETTER CONTROL

The use of a breakdown structure satisfies the first three principles of good management listed in Section 4.5. One of the pitfalls in planning is to develop the work definition at a single, detailed level. Developing the work definition in a structured way ensures better results. Further, by defining work through its deliverables ensures that, as the project progresses, only work which is necessary to produce the facility is done, not work which was envisaged some months previously, but is no longer required. Hence, the plan also becomes more stable. The work required can change in changing circumstances, but only certain results build towards the required end objective. This is clearly the case in research and development projects, where the process of doing the project defines the work to be done. However, it can also be true of engineering, construction, information technology and organizational development projects. For example, the construction of an aeroplane and a submarine involve similar activities:

– the fabrication of metal into a cylindrical pressure vessel
– internal outfitting to support life in a hostile environment
– the fitting of propulsion equipment.

On a detail level the work appears the same. However, one set of intermediate products leads to an Airbus, and another set to a submarine. The high levels of the structure can also be used to balance areas of work on a project. By developing the definition at a detail level only there is a risk that we give undue emphasis to one area only. This may be technical work over cultural work (Section 3.3), or it may be our own area of expertise at the expense of another. On Heysham 2 Nuclear Power Station, the computer systems required to operate the plant were not given sufficient emphasis in the plan, swamped by the amount of engineering work, and would have delayed the commissioning of the station several months, if it were not for another technical problem. A small amount of work could have kept a multi-billion pound investment lying idle.[1]

COHERENT DELEGATION

The parcelling of work in a breakdown structure is natural, because it is aimed at achieving a product. Responsibility can be assigned to individual parties for each product. In fact, they can be left to identify the actual work required, and in this way experts retain their integrity, while being set measurable targets. Sometimes this can be the only way to control progress on a research project, as the work itself is unknown, only the measurable, intermediate results can be measured. If work is defined at a detail level and amalgamated into packages, then they may not actually be natural packages of work, and the project manager can appear to be telling people more technically skilled than themselves how to do the work.

LEVELS OF ESTIMATING AND CONTROL

The lowest level of work breakdown appropriate for estimating and control depends on several factors:

– the size, type and duration of the project
– the purpose for which the estimates will be used
– the current stage in the project management life cycle
– the requirement for effective control.

I find on projects of a year's duration that activities of two weeks' duration are the lowest appropriate level for planning and control. There is a law of diminishing returns which makes it inefficient to plan and estimate at lower levels, except in areas of high risk.

Lowest level of work breakdown: If the activity level is the lowest level of estimating and control, it is also the lowest level for central planning. However, team leaders may assign work to people at the task level, and individuals may plan their own time at the item level. The lowest level does depend on the size of the project. On the four-week overhaul of ammonia plants, the lowest level of planning was activities of two to four hours. On the other hand, I worked briefly on a project of seven years' duration, on which people were planning steps of four hours' duration six months in advance. The plans were meaningless.

Lowest level of estimating: Because of inherent uncertainties, there is only a certain level of accuracy you can expect. It is pointless to plan in greater detail. The people on the seven-year project thought that planning at lower levels improved the overall accuracy. Unfortunately, that is not the case. Probability theory tells us that the percentage error of the part as a ratio of the percentage error of the whole is inversely proportional to the square root of the size:

$$\frac{\pm e\%}{\pm E\%} = \sqrt{\frac{S}{s}}$$

We might expect to finish a year-long project, $S = 52$ weeks, to within a month, $E = \pm 10$ per cent. Therefore on an activity of two weeks' duration, we need to be accurate to within one week, $e = \pm 50$ per cent. On a task of two days' duration, we need to be accurate to within two days, $e = \pm 100$ per cent. The accuracy on steps is even more meaningless.

Planning in greater detail also requires more effort in estimating. The formula above implies that to double the accuracy of the estimate requires four times as much planning effort, and this has been measured in the petrochemical industry.[2] Therefore, at early stages of the project, you want very course estimates, obtained by planning at high levels of work breakdown, with lower levels developed only as the project is shown to be viable at the high levels. You also reach a point at about $E = \pm 5$ per cent accuracy, at which it costs more to estimate than the value of the data you are getting. This sets a limit on the lowest worthwhile level of work breakdown for estimating purposes. I return to this concept in Chapter 8.

Lowest level of control: Similar arguments apply to the level at which the project is controlled. Controlling at a lower level can mean more time is spent in control than doing work; controlling at a higher level means slippages can get out of hand before they are recognized. The appropriate size of activity for control is the same as the frequency of control meetings.

If meetings are once a fortnight, activities should, on average, be a fortnight long. Then, at each review an activity is either not started, finished, or half finished – three simple states. If activities are very much shorter, it will be difficult to determine what is critical for completion. If they are very much longer, the percentage completion will be reported as the elapsed time divided by the original duration while that is less than one, and 99 per cent while it is greater until the activity is actually finished.

CONTAINMENT OF RISK

I qualified remarks above by saying it did not apply in areas of high risk. In fact there is no need to take the WBS down to a consistent level. The lowest level of WBS may vary according to the level of risk: in areas of low risk you may stop as high as the work-package level; in areas of high risk you may continue to a very low level of WBS. The lowest level of WBS may depend on:

– the uncertainty introduced by the risk
– the need to contain the risk.

Figure 5.1 illustrates a project in which all risk is thought to be in work-package A, activity A3 within that, and task A3A within that. At the task level, the uncertainty introduced by the risk, ±100 per cent, is less than the estimating error, ±150 per cent, and since the task is only of two days' duration, the maximum impact it can have on the project's duration is two days.

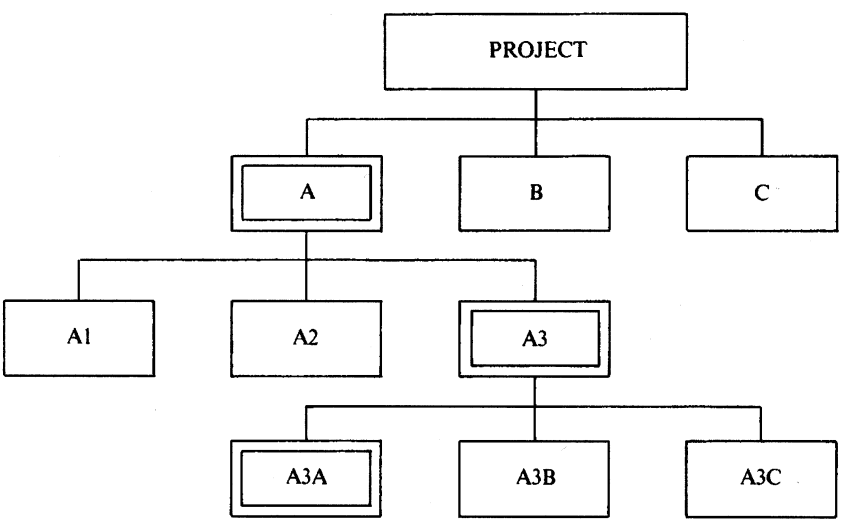


Figure 5.1 Containment of risk in the work breakdown structure

5.3 Project definition

Project definition initiates the project and therefore relates the work of the project to the owner's business objectives. To achieve this, it is necessary to identify the owner's requirements, including the facility expected to satisfy them, and then to identify the broad areas of work required to construct the facility. The following three should be defined:

- the purpose
- the scope
- the outputs.

THE PURPOSE

This is a statement of the business need to be achieved by the project. It may be a problem to be solved, an opportunity to be exploited, a benefit to be obtained, or the elimination of an inefficiency, but will derive from the strategic objectives of the parent organization (Chapter 2). The statement of the purpose should be clear and precise, and should contain both quantitative and qualitative measures. Once the project is underway, it will become the 'mission' of all those involved in the project, both as project team members and as resource providers. It can be a powerful motivating force if it is seen to be worth while and beneficial to the business, and can help to build cooperation. Of course it can be a powerful demotivator if it is seen to conflict with individuals' self-interest (Example 3.1).

THE SCOPE

This is an initial, high-level description of the way in which the purpose will be satisfied. If the purpose is viewed as a problem to be solved, the scope will identify possible solutions, and the one selected for further work; the fourth, fifth and sixth steps in Figure 1.6. The statement of scope includes three things:

- the work within the remit of the project, required to solve the problem and achieve the benefits
- the work which falls outside the remit of the project
- interfaces with other projects in the programme.

The inclusions will later be made redundant by the initial stages of work breakdown. However, it is important to include them in the statement of project definition. They are a key step in the problem-solving process, which indicates the thought processes of the people drawing up the definition. The exclusions can arise either because the work is not required to achieve the benefits (although it would be nice to have) or because it is

being handled elsewhere. The owner does not have a limitless pot of gold, and so a boundary must be set on the work to be done. Sometimes the potential benefit must be reduced to match the available funds. Also, when a project is taking place as part of a larger programme, it may share work with other projects. It can then be more efficient to have one project handle all the joint work. This is especially true when projects create a need for redeployment or redundancy. One project may then delegate the work to the other. For whatever reason, the exclusions must be clearly stated, so that they are understood by people joining the project later, and so that interfaces with other projects are identified and managed (Chapter 14). These exclusions will include the definition of interfaces with other projects in the programme.

THE OUTPUTS

These are quantitative and qualitative measures by which completion of the project will be judged. In effect they identify the facility to be produced by the project. If the facility is an engineering construction (factory, dam or chemical plant, say), then the outputs may be something like:

> when the facility has been constructed, the supporting establishment is in place, the facility has been commissioned, and is operating to a certain percentage of capacity.

A similar statement can apply to a computer system, management development programme or organizational change. You will notice that the statement implies that the facility has been shown to be able to achieve some of the benefits. People are usually quite happy with this for a factory, less so for a computer system or organizational change process. In the latter cases, the project is over once the system is commissioned, and the project team have no responsibility for ensuring that it works properly! In Section 4.2, I said that it is not always possible to set the project's benefits as the objectives, as they may not be achieved until some time after the end of the project, and the facility has been commissioned. However, it is important that the outputs are likely to deliver the benefits, and the project team address the question of how they are to be attained. Further the outputs should:

- address all the work within the scope of the project
- not address work outside the scope of the project
- begin to set parameters for managing quality, cost and time.

You will see now why it is important to record the scope of the project.

Initiating work breakdown

The statement of the outputs completes the project definition. It is now possible to define *areas of work*, which begins the process of work breakdown. Each area of work delivers one of the project's objectives, linking the integrative level (level 1), to the strategic level (level 2). The areas of work may form subprojects, as in Table 5.1. In Chapter 11, I describe the Project Definition Report. The statement of purpose, scope and objectives appears in an earlier section, and sets the scene for the project. The areas of work appear in the section on work breakdown. Again it is important that the areas of work cover all the objectives, but no more.

Standard documentation

Some companies use standard forms for defining purpose, scope, objectives and areas of work. They can serve a useful purpose in enforcing discipline in project proposal. However, I prefer a standard document, produced on a word processor. That gives greater flexibility, and can be built into the Project Definition Report later. Whichever is chosen, the document should be no more than two or three pages long.

Case study

The concepts can be illustrated by a case study. This is based on a real example, but is adapted to illustrate the points. A project brief is given in Example 5.1, followed by a statement of purpose, scope, outputs and areas of work. These would be Sections 1, 2 and part of 3 of the contents of a Project Definition Report (Chapter 11), and are written as such. The model is developed as new concepts are introduced.

The definition of the project contains a statement of the expected time scale: five months to the commissioning of the first offices and nine months to completion of the project. At this stage these are targets. People familiar with the technology should be able to say whether they are realistic, but the precise time scale would only be determined as the project plan is developed to lower levels. However, I am a great believer in being *goal directed*, aiming to achieve this target and scheduling the work appropriately, rather than allowing rather theoretical mathematics in the form of a network to impose a longer duration. Often tight time scales can be achieved with management effort. Similarly, there is already enough information for experts to begin to develop initial estimates of capital cost and revenue for the project.

TRIMAGI COMMUNICATIONS BV - PROJECT DEFINITION REPORT

Rationalization of the Customer Repair and Maintenance Offices

1 Background

With its expansion in Europe, TriMagi Communications intends to rationalize its Customer Repair and Maintenance Offices, CRMOs, in the Benelux countries, starting in its home base in Holland.

There are currently 18 CRMOs in the region. Each office is dedicated to an area within the region. An area office receives all calls from customers within the area reporting faults. The fault is diagnosed either electronically from within the office, or by sending an engineer to the customer's premises. Once diagnosed the fault is logged with the field staff within the office, and repaired in rotation. Each area office must cope with its own peaks and troughs in demand. This means that the incoming telephone lines may be engaged when a customer first calls, and it can take up to two days to diagnose the fault.

To improve customer services the company plans to rationalize the CRMO organization within the region, with three objectives:

- never have engaged call receipt lines within office hours
- achieve an average time of two hours from call receipt to arrival of the engineer at the customer's premises
- create a more flexible structure able to cope with future growth both in the region and throughout Europe, and the move to 'Enquiry Desks', dealing with all customer contacts.

This improvement can be achieved by changing the CRMO structure using new technology recently developed by the company's R&D department. In the new structure, there will be three call receipt offices, two diagnostic offices and four field offices servicing the entire region. It would be possible to have just one office for each of call receipt and diagnosis, but that would expose the service to technical failure.

Incoming calls would be switched to a free line in one of the call receipt offices. It will be logged automatically, and passed on to a diagnostic office. The diagnostic office will try to diagnose the fault electronically, which should be possible in 90 per cent of cases. The diagnostic offices are also able to discover faults before the customer notices them. The diagnostic offices will pass the faults to the field offices to repair the faults, and diagnose the remaining 10 per cent. The field offices will be nominally assigned to an area within the region, but will share cases to balance their workload.

2 Project definition

PURPOSE: The purpose of the project is to rationalize the CRMO organization:

(a) to improve customer service so that:
  - all customers calling the receipt offices obtain a free line

- all calls are answered within 10 seconds
- the average time from call receipt to arrival of an engineer on site is two hours.

(b) to improve productivity and flexibility so that:
- the costs are justified through productivity improvements
- the call receipt offices can be made part of a unified 'enquiry desk'
- but there are no redundancies so that all productivity improvements are achieved through natural wastage, redeployment or growth.

SCOPE: The work of the project includes:

(a) changing from the existing structure of 18 area offices to three call receipt offices, two diagnostic offices and four field offices
(b) investigating which of two new CRMO networking technologies is appropriate for the new structure, and to implement that chosen
(c) refurbishing the nine new offices to current standards
(d) training and redeploying staff to meet the needs of the operation of the new CRMOs
(e) installing hardware to connect the CRMOs to the new Customer Information System, and to implement a statistical package to analyse fault data.

The work of the project excludes the retrenchment of any staff who are surplus to requirements within the CRMO structure; they will be passed to central personnel for redeployment on other expansion projects; with the implementation of the new Customer Information System, the call receipt offices may within the next two years be incorporated into unified 'enquiry desks' dealing with all customer contacts. However, it will not be the project team's responsibility to achieve that integration.

OUTPUTS: The outputs of the CRMO Rationalization Project are:

(a) when the CRMO facilities have been installed in nine offices (three call receipt offices, two diagnostic offices and four field offices), within nine months
(b) when appropriate networking technology has been selected and implemented, together with statistical MIS to achieve the required customer service levels
(c) when appropriate operating systems have been designed and implemented, together with procedures to achieve the required customer service levels and productivity improvements
(d) when staff have been trained and redeployed to fill new positions, and vacate old positions
(e) with the objective that the first offices should be operational within five months and the work complete within nine.

3 Work structure

AREAS OF WORK: To achieve the project's objectives, the following areas of work

are required:

A *Accommodation*: Refurbish new offices, install hardware and furniture. (There is only one floor area available in the region large enough to take the first call receipt and fault diagnosis offices. The remaining eight offices must be housed in existing CRMO space.)
T *Technology*: Decide on networking technology to be used, implement statistical MIS, implement networking technology in new offices.
O *Organization*: Communicate all changes to the staff involved, define the operation of the new CRMOs, train and redeploy staff to fill new positions.
T *Project*: Plan the project, organize the resources, obtain financial approval.

MILESTONE PLAN: The Milestone Plan for the project follows:

.....

.....

Example 5.1 Project definition for the case study project

5.4 Planning at a strategic level: milestone plans

Having defined the project, we are in a position to develop the work breakdown structure to the second level, the strategic level. In this section, I shall describe the requirements for planning at this level, and then introduce a tool, the *milestone plan*,[3] which satisfies these requirements.

Requirements for planning at the strategic level

At the second level of breakdown, the manager sets the strategy for his or her project. The plan at this level:

- shows how the intermediate products, or deliverables, build towards the final outputs
- sets a stable framework, fixed goal-posts, for the team, and thereby provides a common vision
- controls devolution of the management of the scope to other parties.

I described above how similar activities are involved in the manufacture of an Airbus or submarine, yet one set of intermediate products delivers an aircraft, another a submarine. It is at the second level of the work breakdown that we set the strategy, showing how the intermediate products build towards the facility to be delivered by this project. Because only one set of intermediate products delivers the required final objective of this project, the plan at this level can be made stable. This can be a powerful motivating tool, giving the project team a common vision.

To build a common vision, the plan should be represented on one page. It then presents a clear picture of the strategy for the project. It is through this single page, the milestone plan, that the project manager communicates the overall strategy of the project upwards to the project sponsor and champion, and downwards to the project team. This was the fifth principle of good project management introduced in Section 4.5. It is also at this level that focusing on the deliverables can help delegate work to subproject teams. A team accepts responsibility for the delivery on an intermediate product, and plans its own work to deliver that milestone independently of other project members. They know that they must achieve their milestone by a certain date to enable the project to proceed, but they are able to work without interference. We have seen how this can allow professional people to retain their integrity when working for a project manager from a different discipline.

Milestone planning

It is common, when developing the plan at the second level to define the packages of work first, and then define the deliverable which results from each work package. However, for the reasons above, I suggest that you define the deliverables, or milestones first, in the form of a milestone plan.[3] The packages of work which result in each milestone are derived later. The milestone plan is a strategic plan, or framework, for a project, defined in terms of intermediate products, or results, to be achieved. It shows the logical sequence of the conditions or states a project must pass through to achieve the final objectives, describing what is to be achieved at each state, not how the state is to be achieved.

Figure 5.2 illustrates the milestone plan, with the circles representing the milestones, the lines joining them representing the logical dependency between them. Hence, the milestone plan represents a logical network for the project.

We return to networks in Chapter 9 where two types are described; *Precedence* and *Activity-on-Arrow Networks*. In precedence networks, work is represented by the nodes of the network. These are joined by arrows representing the logical dependency of the work. In an activity-on-arrow network work is represented by the arrows. The nodes are events in time, and the logic is represented by the way the arrows join at the nodes. The milestone plan is a precedence network. The circles in Figure 5.2 represent packages of work, defined by the results they deliver. The arrows show how one work package follows another, and are known as *end-to-end dependencies*: the end of one package (milestone), is dependent on the end of the previous one. They say nothing about the start of the work: one package can start before the previous one has finished. This allows greater flexibility in scheduling the work.

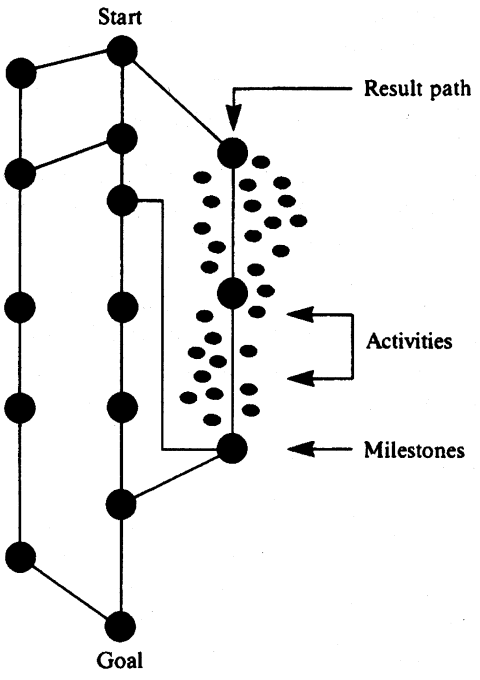


Figure 5.2 The milestone plan

Result paths or areas of work

In Figure 5.2, the milestones are grouped into vertical columns representing the areas of work. These vertical columns have been called result paths. One of the principles of project management (Section 4.5), was to balance the changes and level of ambition. I suggested that the WBS should be used to ensure that equal emphasis is given to work in different areas. The result paths give visual representation to this. By inspecting the result paths, you can ask yourself one of two questions, as illustrated in Example 5.2:

- Have all the areas of work been covered, or has something been left out? In particular, have the cultural changes been addressed?
- Is equal emphasis given to all areas of work?

I did some work with a research establishment where they were installing a larger computer to store the empirical data from a particularly large experiment they were conducting. I helped them plan the project to make the change. The plan had three result paths:

- hardware and software
- the database
- the establishment.

Down the first path there were a large number of milestones:

- hardware and software selected
- hardware installed
- operating system loaded
- database software loaded
- system tested.

There were a similar number of milestones in the third path:

- computer room ready to receive machine
- furniture obtained
- operating procedures written
- operators recruited
- operators trained.

There were only two milestones in the central path:

- data transferred
- system commissioned.

Without prompting from me, the two people working with me on the development plan said, 'Hold on! The purpose of this project is not to obtain new hardware and software, and not to create a new establishment. It is because the data has got too large for the old machine. We ought to be giving greater emphasis to the database.' They therefore inserted two more milestones in the centre column. One dealt with data cleanse, removing incorrect, incomplete or redundant data. The other dealt with restructuring the database to meet future, rather than historical, requirements. Some people say that these two milestones may have made the rest redundant!

Example 5.2 Balancing objectives through the result paths

Selecting milestones

A good milestone plan:

- is understandable to everyone
- is controllable, both quantitatively and qualitatively
- focuses on necessary decisions
- is logical, with decisions and work packages in the right order
- gives an overview at the right level.

UNDERSTANDABLE

The milestone plan is a tool to build cooperation and commitment to a common vision. It must therefore be understood by all those involved in the

project. This requires the milestone descriptions to be written in English, not in technical jargon, only understandable to a few.

CONTROLLABLE

The plan is also a tool for control, and so the descriptions must be precise, so that you can determine when they have been achieved. Technical milestones can be given a quantitative measure, e.g. 'when the new machine tool is operating at design capacity'. Other milestones must be given a qualitative description, with some measure of quality written in. For example, it is not adequate to say: 'when a report is written'. Two lines on the back of an envelope satisfy that. The report must:

- meet certain requirements
- satisfy a steering committee
- allow a decision to be made.

DECISIONS

Milestones represent states en route to the final objective. Often the interesting state is not the production of a design or report. That is not the purpose of the work. It is the taking of a decision, based on the design or report, to allow more work to proceed. That is the required deliverable, and is controllable. The responsibility chart (Chapter 6), defines who is to take the decision.

LOGICAL

The milestone plan is a logical plan. It contains a network, which shows the strategy for building through the intermediate products to achieve the final objective.

SINGLE-PAGE OVERVIEW

The objective is to produce a plan on a single page, which clearly communicates the project strategy. This is only achieved if the number of milestones and areas of work are limited. I find the ideal number of milestones is somewhere between one and two dozen. With fewer the plan does not give a useful structure, and with more it becomes confusing. Similarly, I recommend three or four result paths. Setting limits on the number of milestones determines the size of the work packages, rather than allowing the size of work packages to determine the number of milestones. On small projects this will be the only level of planning. On large projects it will be the first of several.

Standard form for the milestone plan

In Figure 5.2, the milestone plan is drawn down the page, whereas it is common to draw a network across the page. The reason is simple. I suggest

a form for the milestone plan[3] (Figure 5.3), with three columns:

- the central one is for drawing the network
- the right-hand one is for writing the description of the milestones (which in themselves describe the packages of work)
- the left-hand column is for the milestone dates, once the work has been scheduled (Chapter 9).

The right-hand column gives adequate room to write a full description of the milestone, whereas if you draw the network across the page, you have to write small to fit the description of the work package into the box or on to the arrow. It may seem heretical to draw the network down the page, but it does allow the network and a full description of the work to be portrayed on a single page. It also represents the milestone plan as a process flow diagram for the project, emphasizing the process nature. Figure 5.4 is a milestone plan for the CRMO Rationalization Project, showing the use of the form.

MILESTONE PLAN		Company:
Planned date:		Project description:
		Milestone:

Figure 5.3 Blank milestone plan form

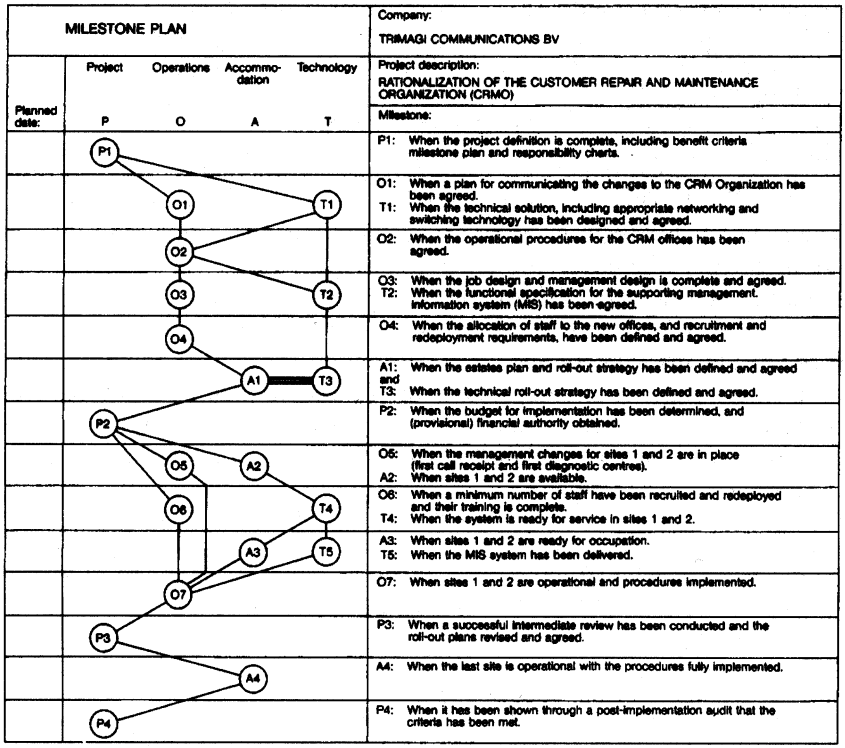


Figure 5.4 Milestone plan for the CRMO Rationalization Project

Developing the milestone plan

Ideally, the milestone plan should be developed in a launch workshop (Chapter 11) with selected key managers and project personnel present. Developing the plan in a group session builds greater commitment than the project manager developing it on their own and trying to impose it on the team. However, to be effective the workshop should not have more than about six people present. The process I recommend for developing the plan has six steps:

1. Start by agreeing the final milestone, the end of the project. The Project Definition Report should help this.
2. Generate ideas for milestones. Brainstorm them on to flip charts.
3. Review the milestones. Some will be part of another milestone. Some will be activities, but will generate ideas for new milestones. As you rationalize the list record your decisions, especially where you have decided that a milestone is part of a larger one.

4. Experiment with result paths. Draw them on a flip chart or white board. Write the milestones on 'Post-It' notes and stick them on the paths, in the order they occur down the path. Experiment with different paths, and review them as suggested above. Note this may change the definition of the areas of work.
5. Draw the logical dependencies, starting with the final objective and working back. This may cause you to review the definition of milestones, add new milestones, merge milestones, or change the definition of the result paths.
6. Make a final drawing of the plan.

Work breakdown structure

The milestone plan, as shown in Figure 5.4 is a communication tool to communicate the project strategy to the parties involved. It represents both the work and its logical relationship. However, we should not lose sight of the fact that we are developing level 2 of the WBS. Figure 5.5 shows the WBS tree, to that level for the CRMO Rationalization Project. It is this representation of the work, coupled with the logic in the milestone plan, which may be used to derive the more formal precedence network (Figure 5.6) when scheduling the project.

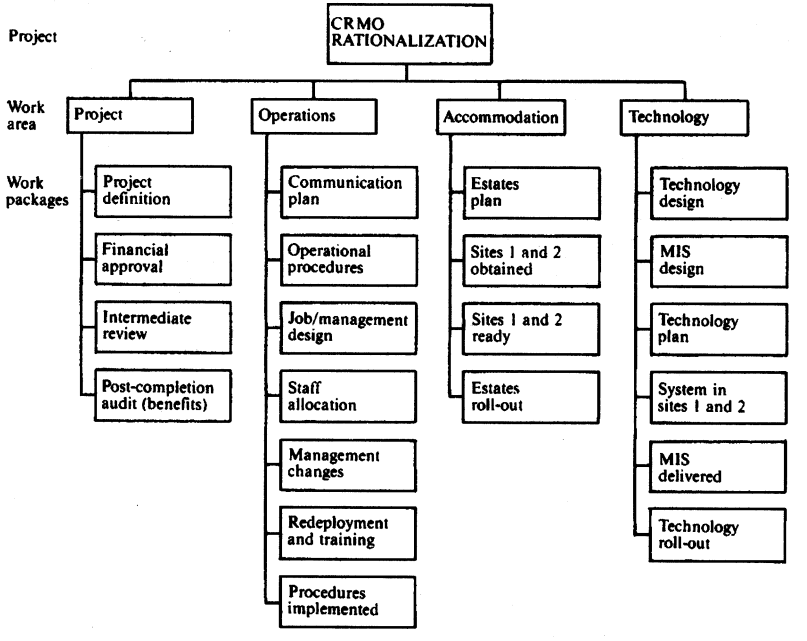
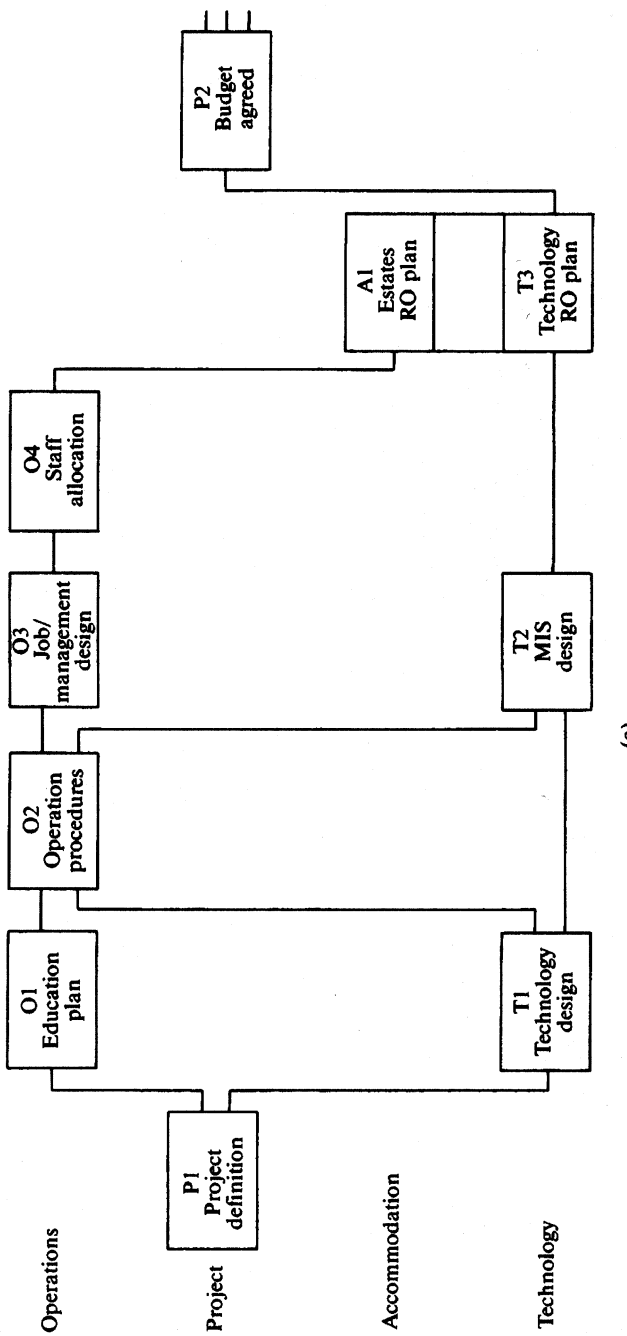


Figure 5.5 Work breakdown structure for the CRMO Rationalization Project


P2
Budget
agreed
A1
Estates
RO plan
T3
Technology
RO plan
O4
Staff
allocation
O3
Job/
management
design
T2
MIS
design
O2
Operation
procedures
O1
Education
plan
T1
Technology
design
P1
Project
definition
Operations
Project
Accommodation
Technology

(a)

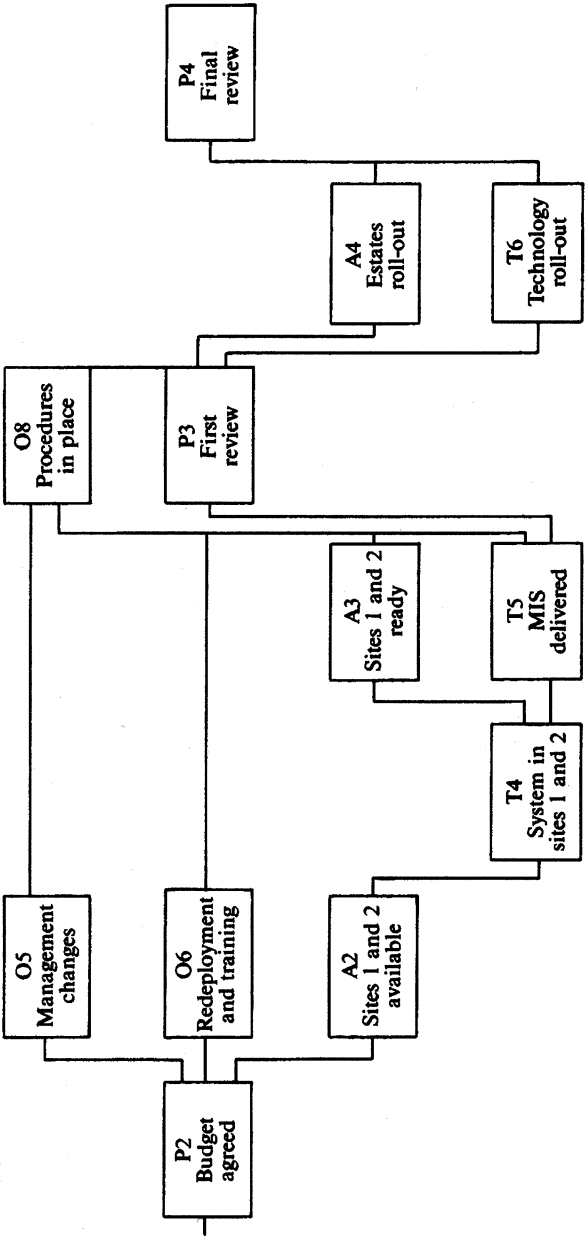


Figure 5.6 Precedence network for the CRMO Rationalization Project

5.5 Planning at lower levels

The plan at level 2, the milestone plan, is part of the WBS and will therefore be supported by plans at lower levels. These will include:

- activity plans
- work-package scope statements
- subsidiary milestone plans.

Activity plans

These detail the work packages which lead to the milestones. They describe the work at the next level of work breakdown, level 3. Following the principle of single-page reporting, the number of activities making up a work package should be limited to 15. I usually find 6 to 10 is about right. This again determines the size of activities. Figure 5.7 is an activity plan for milestone P1 in the CRMO Rationalization Project.

There are some project management methodologies which recommend that a full definition of all the activities required by the project be derived before any work is done. Those people who misuse networking systems, creating the activity definition without the supporting WBS, are forced into this. However, most modern approaches to project management recommend what is called a *rolling-wave* approach to activity planning.[4] Fully detailed activity plans are only derived and maintained for those work-packages which are current, or about to start. The detailing of later work packages is left until necessary, so that as much current information as possible is used to derive the activities. Some computer-based networking packages will support this approach by allowing the nesting of networks. There are several reasons for this approach:

1. You wait until you know you are likely to do the work before expending effort on detail planning. I spoke above of increasing the accuracy of the estimates during subsequent stages of the life cycle by spending increasing time on planning and design. To prepare estimates at project initiation stage you should estimate at the work-package level, and not prepare the activity definition. Some people find this uncomfortable, but I have worked in organizations which have prepared quite detailed designs and estimates for projects, only to find the project uneconomic.
2. You prepare detail activity plans when you have maximum information. If you prepare a detail plan for a year-long project at the start, the only thing you can guarantee is that you will be wrong. You will have left out things which should be included, and included things which should be left out. It is better to prepare the detail activity definition when you have gathered information about the best way to achieve the milestone. This is

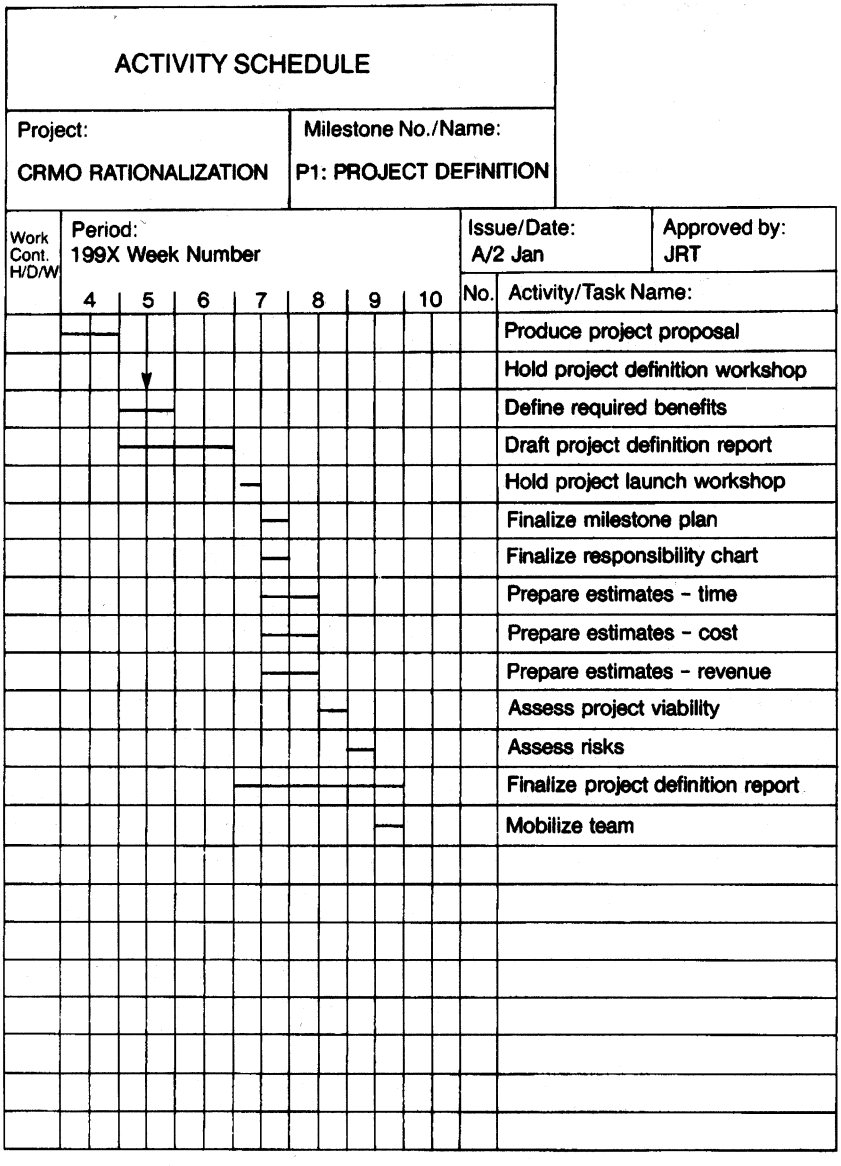


Figure 5.7 Activity plan for milestone P1 in the CRMO Rationalization Project

especially true on development projects, where work in the early stages will determine work in the latter stages. You will know what the later milestones are, if you are to reach your final objective, but you will not know how they are to be achieved. Furthermore, there is no point in trying to guess, because it serves no purpose, and wastes time.

3. You can delegate the definition of activities to reach a milestone to the teams who will be undertaking the work, as described before.

Work-package scope statements

Although the detail activity planning is done on a rolling-wave basis, it is necessary to prepare some definition of the scope of each work package at an earlier stage. There are several reasons for this:

1. It is necessary to prepare some form of estimate of work content and duration for early, high-level estimating and scheduling. This should be based on some substance, even if it is only an approximate statement of the most likely outcome.
2. Work packages may include activities with a long lead time. These must be recognized and started in time.
3. While preparing the milestone plan you may not include one milestone, assuming it is part of another. This must be recorded.

These requirements can be satisfied by preparing work-package scope statements. These will be akin to the definition of scope and areas of work for the project as a whole, but on a smaller scale. The milestone name, remember, defines the purpose and objectives of the work package. The work-package scope statement can also include a measure of completion for configuration management purposes (Chapter 7). Example 5.4 contains a sample work-package scope statement for milestone P1 in the CRMO Rationalization Project.

TRIMAGI COMMUNICATIONS BV
WORK-PACKAGE SCOPE STATEMENTS

MILESTONE:	P1 – when the project plans have been prepared and resources assigned to the project.
SCOPE:	The work package requires the preparation of high-level plans and estimates, to enable resource budgets to be prepared and their availability agreed.
POSSIBLE WORK:	Identify key managers Hold launch workshop

	Finalize milestone plan and project responsibility chart Estimate resource requirements and durations Schedule resource requirements Discuss requirements with managers Plan and agree their availability.
Measure of completion	Project plans approved by the steering committee Resource managers sign agreements to resource availability.

Example 5.4 Work-package scope statement

Subsidiary milestone plan

Sometimes there is a milestone which requires a particularly large amount of work. You may want to define intermediate milestones as control points through that work, but there may be no natural milestone to use on the level of the milestones plan. It is not sufficient to define milestones such as:

SM1: when the work is 25 per cent complete

because that will not be measurable. In these circumstances it may be worth while to derive a subsidiary milestone plan for that package of work. In effect the work package is treated as a mini-project. Figure 5.8 is the

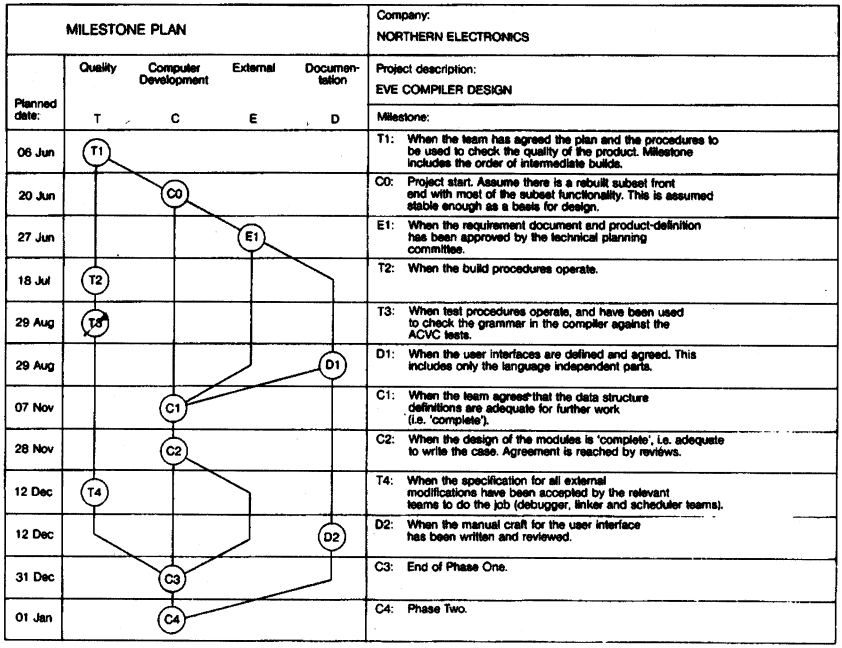


Figure 5.8 Milestone plan for developing a compiler language

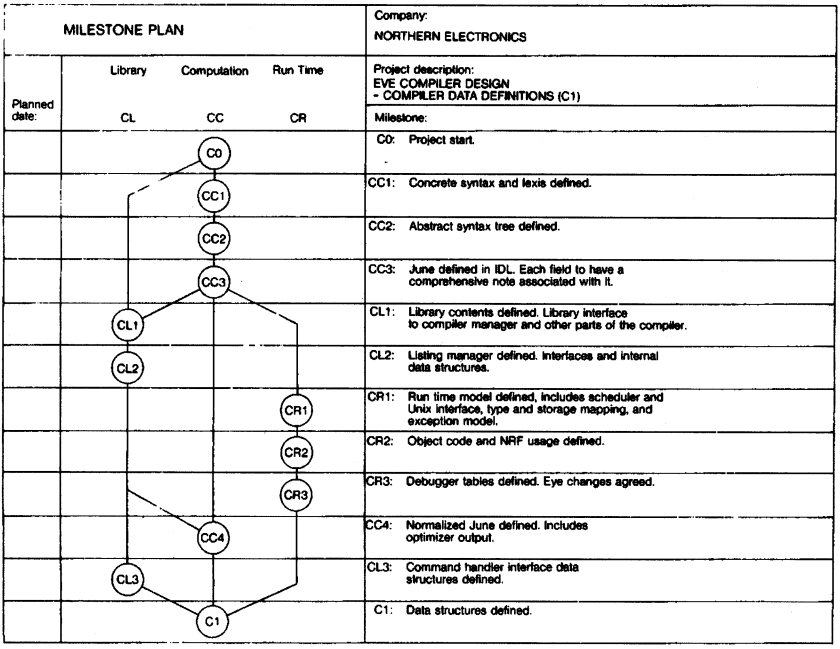


Figure 5.9 Subsidiary milestone plan for milestone C1

milestone plan for developing a compiler for a computer language. Milestone C1 is of the type described, requiring five months of work to achieve it. However, there are no natural milestones on the level of this plan to define control points through the work. The team therefore derived a subsidiary plan (Figure 5.9) for that milestone alone.

5.6 Applications

I close this chapter by describing two applications of milestone planning:

- milestone planning at different stages of the life cycle
- milestone planning of subprojects on large, multi-disciplinary projects.

Different stages of the project management life cycle

Milestone plans can be prepared for work at all stages of the project management life cycle. For instance, you can prepare plans for:

- the feasibility study in proposal and initiation
- the design study in design and appraisal

– project implementation in implementation and control
– commissioning in finalization and closure.

The management emphasis changes throughout each of these stages:

1. At the early stages, the emphasis is on encouraging creativity. The milestone descriptions should enable this by allowing maximum flexibility in the way the milestones are achieved, and the results delivered, while still providing a framework for control.
2. At the later stages, the emphasis will be on completing the work. Money is being spent, and so the benefits must be obtained as quickly as possible. Therefore the milestone names will be more prescriptive, providing more rigid control.

Large, multi-disciplinary projects

I have worked on several large multi-disciplinary projects which, for management purposes, we divided into several subprojects almost independent of each other, and each the responsibility of a separate discipline. The project team derived a milestone plan for each subproject, and each discipline was then able to work virtually independently of the others, corresponding only at key milestones. I have applied this approach to construction projects, development projects and IT projects.

NORTH SEA OIL FIELD DEVELOPMENT

This development consisted of two phases each of £3.0 billion. In the first phase, the project used ARTEMIS and planned at a fairly low level of detail. Management reports were 150 pages of computer output, and the management team had no visible control. In the second phase, it was recommended that they adopt a work breakdown structure. The development was divided into several contracts, and each contract into several stages, such as:

– feasibility
– design
– procurement
– construction
– link-up
– commissioning.

Figure 5.10 illustrates this work breakdown. A milestone plan was prepared for each contract stage. Figure 5.11 is an example of a typical plan. The management team monitored progress against the milestone plans. The project teams supported these with lower level plans.

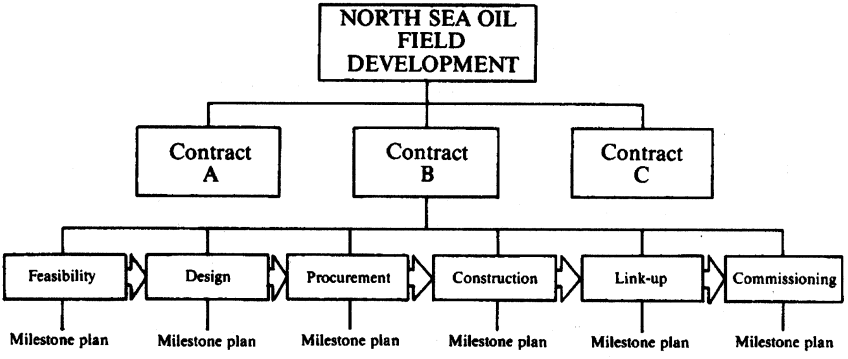


Figure 5.10 Work breakdown structure for the development of a North Sea oil field

REGIONAL HEALTH AUTHORITY, REGIONAL DISTRIBUTION

The Health Authority was changing from distributing supplies through each of the 15 districts, to regionally coordinated distribution. The project was divided into 22 subprojects, each with its own milestone plan, and each the responsibility of a separate discipline. There were a few, easily monitored links between each plan. The projects were:

- construction of the regional warehouse
- creation of the warehouse establishment
- implementation of computer systems
- recruitment, redeployment and training
- switching from district buying to regional buying
- switching from district revenue to regional revenue
- district implementation (15 districts)
- commissioning the warehouse.

Each discipline met once a fortnight to monitor progress against their plan. The team leaders then met every six weeks to monitor progress of the project overall, by comparing progress on each plan.

COMPUTERIZATION OF THE NORWEGIAN SECURITIES SERVICE

This project consisted of four subprojects:

- design and implementation of the computer system
- creation of a company to operate it
- registration of dealers and holders of stock
- legal basis.

An overall milestone plan was developed for the project as a whole.

MILESTONE PLAN		Company: NORTHERN ENERGY AND CHEMICAL INDUSTRIES PLC		Project manager:	Contractor:	Contract no:
Planned date:	Engineering E / Vendor selection V / Procurement P	Project description: NORTH SEA OIL FIELD DEVELOPMENT – STANDARD PROCUREMENT CHAIN		Plan issue:	Approved by:	Date:
		Lead text:	Definition:	Project procedures:		Contractor's procedure:
	E1	Preliminary requirement raised	Transmittal of short package description with ref. to req. no. and pck. no. from engineering discipline to procurement.			
	P1	Preliminary enquiry issued	Preliminary enquiry comprising short package description issued to approved vendors (by telex).			
	V1	Bidders list approved	List of all approved bidders for package.	PS-CB30 PS-CA13		
	E2	Requirements for enquiry approved	Transmittal of provisional package with all necessary documentation attached.	PS-CA13		
	P2	Enquiry issued	A complete invitation to tender issued to approved bidders.	PS-CB31		
	V2	Bid closure date	Deadline for bidders to submit tenders as stated in the ITT covering letter.	PS-CB32		
	E3	Preliminary bid evaluation	Preliminary evaluation of bids by Engineering and Procurement. Joint recommendation compiled by Procurement.	PS-CB32		
	P3	Bidders' short-list approved	Bidders short-listed from evaluation.	PS-CB32 PS-CA13		
	V3	Bid evaluation	Evaluation of bids by Engineering and Procurement. More information may be obtained from vendors. Joint recommendations compiled by Procurement.	PS-CB32		
	E4	Recommended vendor approved	Vendor selected and approved.	PS-CB32 PS-CA13		
	P4	Purchase order requirements approved	Issue of revised requisition for purchase.	PS-CA13		
	V4	Purchase order issued to vendor	Issue of signed purchase order to selected vendor.	PS-CB33 PS-CA13		
	E5	Purchase order acknowledgement approved	Acknowledgement of purchase order received from selected vendor and approved.	PS-CB33		
	P5	'Dear John' letters issued	Unsuccessful bidders informed of decision.			
	P6					
	P7					

Figure 5.11 Sample milestone plan for the development of a North Sea oil field

Subsidiary milestone plans were also prepared for the first two subprojects. This project involved one million people, and yet was managed to a successful conclusion using manual planning methods only by taking this structured approach. At one point the Norwegian government tried to delay passing the enabling legislation by twelve months. Using the top-level plan, the project team was able to demonstrate to the minister that that would delay the project by twelve months, and effectively kill it. The argument won the day and the bill was passed.

CUSTOMER SERVICE SYSTEM IN A REGIONAL SUPPLY COMPANY OF A LARGE PUBLIC UTILITY

Implementation of the CSS required several projects:

- implementation of hardware and software
- transfer of data
- networking of buildings
- estates refurbishment
- writing operating procedures
- training
- commissioning.

Again, an overall milestone plan was developed, supported by milestone plans for each subproject.

You may notice that the last three of these projects involve a mixture of:

- construction or building work
- IT
- organizational change
- recruitment, redevelopment and training.

They each also had a duration of about 15 to 24 months, and each was finished on time and to cost.

5.7 Summary

1. The purpose of scope management is to ensure:
   - adequate work is done
   - unnecessary work is not done
   - to achieve the project's purpose.
2. Work breakdown is a process by which the work of the project is subdivided for management and control purposes.
3. The project is defined at the strategic level, through:
   - the *purpose*: the problem to be solved, or the opportunity to be exploited, or the benefit to be obtained

   - the *scope*: the solutions to the problem, and covering the inclusions (work within the remit of the project) and the exclusions (work outside the remit, because it is deemed unnecessary, or because it is shared with other projects)
   - the *outputs*: the facility to be measured, quantitative and qualitative measures of when the project is complete.
4. At the strategic level, the milestone plan:
   - shows how the intermediate products, or deliverables, build towards the final objectives of the project
   - sets a stable framework, fixed goal-posts, for the project team, and thereby provides a common vision
   - controls devolution of the management of the scope.
5. A good milestone plan:
   - is understandable to everyone
   - is controllable
   - focuses on necessary decisions
   - is logical
   - gives an overview to build cooperation and commitment of all the parties involved.
6. The are six steps in milestone planning:
   - agree the final milestone
   - brainstorm milestones
   - review the list
   - experiment with result paths (areas of work)
   - draw the logical dependencies
   - make the final plan.
7. Plans at lower levels of work breakdown include:
   - subsidiary milestone plans
   - work-package scope statements
   - activity plans developed on a rolling-wave basis.

References

1. Morris, P.W.G. and Hough, G.H., *The Anatomy of Major Projects: The reality of project management*, Wiley, 1987
2. George, D.J. (ed.), *A Guide to Capital Cost Estimating*, Institution of Chemical Engineers, 1988.
3. Andersen, E.S., Grude, K.V., Haug, T. and Turner, J.R., *Goal Directed Project Management*, 2nd edn, Kogan Page, 1995.
4. CCTA, *PRINCE 2: Project Management for Business*, The Stationery Office, 1996.