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12 Project implementation and control

12.1 Introduction

The middle stage of the life cycle is execution and control. During this stage, most of the work to deliver the objectives (build the facility) is undertaken, and thus most of the expenditure made. The stage is started by completion of detailed design. At the previous stage sufficient design (a systems design) has been done to prove the concept and obtain financing. The detail design shows how the work of the project will be implemented, and from this a cost estimate corresponding to the fourth line of Table 8.4 developed. A corresponding project plan is also produced. This plan and design may require three or four times as much effort as the systems design developed at the previous stage, but it is only done after the project has been proved and the finance raised. Once sufficient design has been done, work can begin. If fast-build or fast-track is possible, this may be before detail design is complete. Resources are selected, and they plan the detail work on a rolling-wave basis. Work is authorized by the project manager, and allocated to teams or individuals. As work is done, progress is measured to ensure the desired results are achieved; that is the required facility is delivered within the constraints of quality, cost and time, and that this will achieve the required benefit. If there is a shortfall, appropriate recovery action is taken. This may mean doing nothing because the variances are small, replanning the work to recover the original plan, or revising the plan to accept the current situation. In extremis, it may mean terminating the project, if the original objectives are unobtainable.

In this chapter, I shall describe the management of execution and control. I start by explaining the selection of resources, implementation planning, and the allocation of work. I then describe the requirements for effective control, how to monitor progress and analyse variances to forecast completion of all

five project objectives, and how to take action to respond to deviations from the plan. I end the chapter by describing an integrated control cycle. I said in the last chapter that this control cycle applies to the management of feasibility and design and appraisal. It is described here because it is the major emphasis of this stage. I do not describe the detail design process, as it is merely a refinement of what was covered in Chapter 11.

12.2 Resourcing a project

One of the recurrent questions of project management is: 'Do you assign work to people or people to work?'

In one approach – assigning work to people – you form a project team, they decide how best to achieve the project's objectives, and assign the work to the people in the team. The risk is you will find the skills of the people in the team are inappropriate for the work you have to do. In the other approach – assigning people to work – you define the scope of work and then form a project team of appropriate skills. The risk is that the project manager will not be a technical expert, and so will be dictating to experts how they should undertake the task.

To overcome this dilemma, you develop the definition of scope and organization in parallel down the breakdown (Figure 1.13). During proposal and initiation, you define the areas of work, and the functional areas of the organization involved (Sections 11.3, 5.3 and 6.3). During design and appraisal, you work with functional managers, to develop the milestone plan and responsibility chart at the strategic level (Sections 11.5, 5.4 and 6.4). From the responsibility chart, you determine the skill types required and form a team. The team determine how they think the work should be done, and so define the scope at the tactical level. The project manager and work-package manager agree and authorize the work and assign it to the team. Hence, the people to do the work are selected from a resource pool, which is identified by planning the work at the strategic level in the project hierarchy.

The process of resourcing a project includes the following steps:

1. *Identify what is to be achieved*: through the milestone plan.
2. *Identify the skills and skill types required to do the work*: through the responsibility chart. The skills required include technical, craft, professional and functional skills, or managerial knowledge.
3. *Identify the people available*: through discussion with the resource providers. It is important to obtain people with the correct skill. There is a danger, especially with a fixed project team, of selecting somebody to do work because they are available, not because they have the right skills, or that the resource provider may try to provide their least

competent people, and retain their best individuals within their own sphere. You should take account of people's true availability. A person may only be available to a project part time, and be retained for the remainder of their time on their normal duties. In Section 9.3, we saw that someone working nominally full time on a project may do on average only three and a half days work per week throughout a year.

4. *Assess the competence of the people available*: to identify any shortfall in skills. Even after selecting people of the correct skills, it is unlikely there will be a complete match to requirements.
5. *Identify any training required*: to overcome the deficiency in skill levels. Training may be in the form of open or bespoke courses, or on-the-job coaching.
6. *Negotiate with the resource providers*: Throughout this process, you must negotiate with the line managers of the people who will do the work, so that they willingly release their people. If the resource providers will not cooperate, the manager can bring pressure to bear via the sponsor. However, even then they may not cooperate, and block their people working on the project, so it is best to win the resource providers' support. This can be done by gaining their commitment to the project's goals, and by helping them understand how the project is of benefit to them.
7. *Ensure that appropriate facilities and equipment are available*: Facilities may include office space, meeting rooms, security arrangements and transport. Equipment may include computers and other office equipment, computer software, (including word processing, spreadsheets, and project management information systems), telephone, modems and facsimile.

12.3 Implementation planning

Having identified the people to do the work, the team can then define the details of the work to be done and assign work to themselves for execution. The detail work should be planned on a rolling-wave basis, as it is only when you are about to start the work that you have all the information required to plan activities in detail. In this way, you can also allow people to plan their own work. However, I suggested in Section 5.6 that you can create a preliminary activity definition through work-package scope statements for early estimating. In this section, I consider the process of implementation planning, including:

- planning and scheduling the activities to be done
- authorizing the work
- representing the activity schedule
- representing the time schedule.

Planning and scheduling activities

There are five steps in planning and scheduling activities:

1. *Define activities required to reach a milestone*: When selecting activities, the team should choose ones which are controllable, that is they should:
   - *produce a measurable result*: It must be possible to determine when an activity is finished. It is no good dividing a work package into five activities each equal to 20 per cent of the work. In those circumstances the last activity often takes 80 per cent of the effort
   - *have average duration roughly equal to the frequency of review*: See Section 5.2.
2. *Ratify the people involved*: The people to do the work have been chosen as described above. However, once the activities have been defined it may be necessary to review the team to ensure it contains all the necessary skills, and no redundant skills.
3. *Define roles and responsibilities*: The involvement of each of the team members in the activities is then identified. A responsibility chart can be a useful tool for this.
4. *Estimate work content and durations*: The work content and durations are estimated applying the processes used at the work-package level.
5. *Schedule the activities within the work package*: Finally the activities are scheduled within the work package to deliver the milestone on time. This can be done manually, or by building the activities into a nested network, as illustrated in Figure 12.1.

If you adopt rolling-wave planning, estimates of work content and duration at the activity level will be made at a later stage of the project than those at the work-package level, after sanction has been obtained. Some people are uncomfortable with this, fearing that the activity estimates will turn out to be different from – usually higher than – the work-package estimates. What should happen, of course, is that the range of possible out-turns for the total project after activity estimating, should fall within the range after work-package estimating. Table 8.4 shows that the range of accuracy for the project after estimating at the work-package level may be of the order of +10 per cent, and after estimating at the activity level may be +5 per cent. Figures 12.2 (a) and (b) show acceptable activity estimates, and Figures 12.2 (c) and (d) unacceptable activity estimates. Figure 12.2 (d) is unacceptable because overestimating can lead to viable projects being cancelled, or capital being tied up and unavailable to fund other worthwhile projects. If the estimates consistently fall outside the allowable range of those prepared at the work-package level, the estimating data used for the latter needs improving. It is therefore important to feed the results back to the estimators so that they can improve their data.

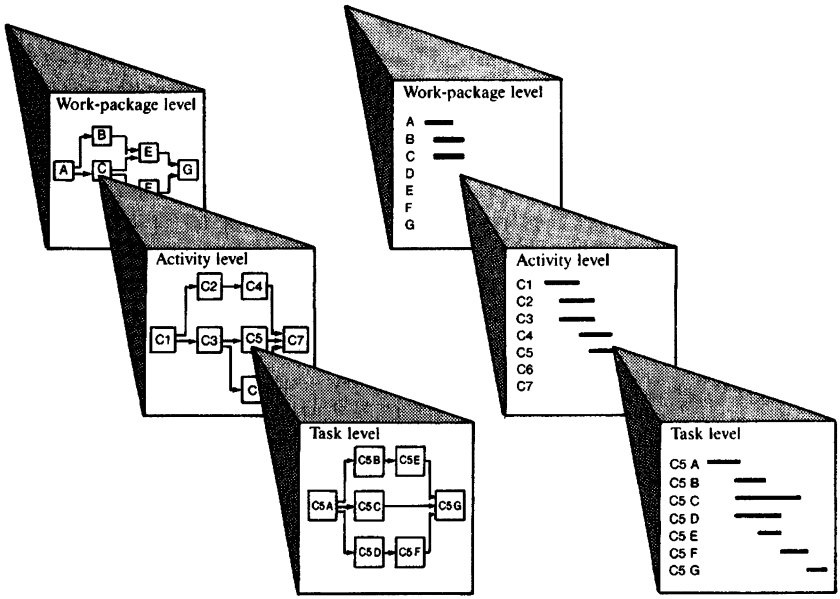

Figure 12.1 Nested networks and bar charts

If it is not possible to schedule the activities to deliver the milestone on time (subject to Figure 12.2), the delay to the plan must be subjected to change control. The change can be to declare a variance between the current schedule and the baseline, or if the delay is severe to update the baseline.

Authorizing work

The newly created activity schedule is entered into the master plan, and then at appropriate intervals, current work is allocated to individuals to do. Both of these steps must be authorized.

AUTHORIZING INCLUSION IN THE MASTER PLAN

Although the project manager may delegate the creation of the activity plan to the team, he or she must negotiate an agreed estimate with the team, and authorize its inclusion in the master plan because:

- any variances in the estimates as a result of the lower level planning must be agreed
- experts will sometimes plan for a Rolls-Royce solution rather than an adequate solution within the quality constraints, and so the project manager must have an opportunity to ratify the plan
- the experts may sometimes allow themselves excessive contingency.

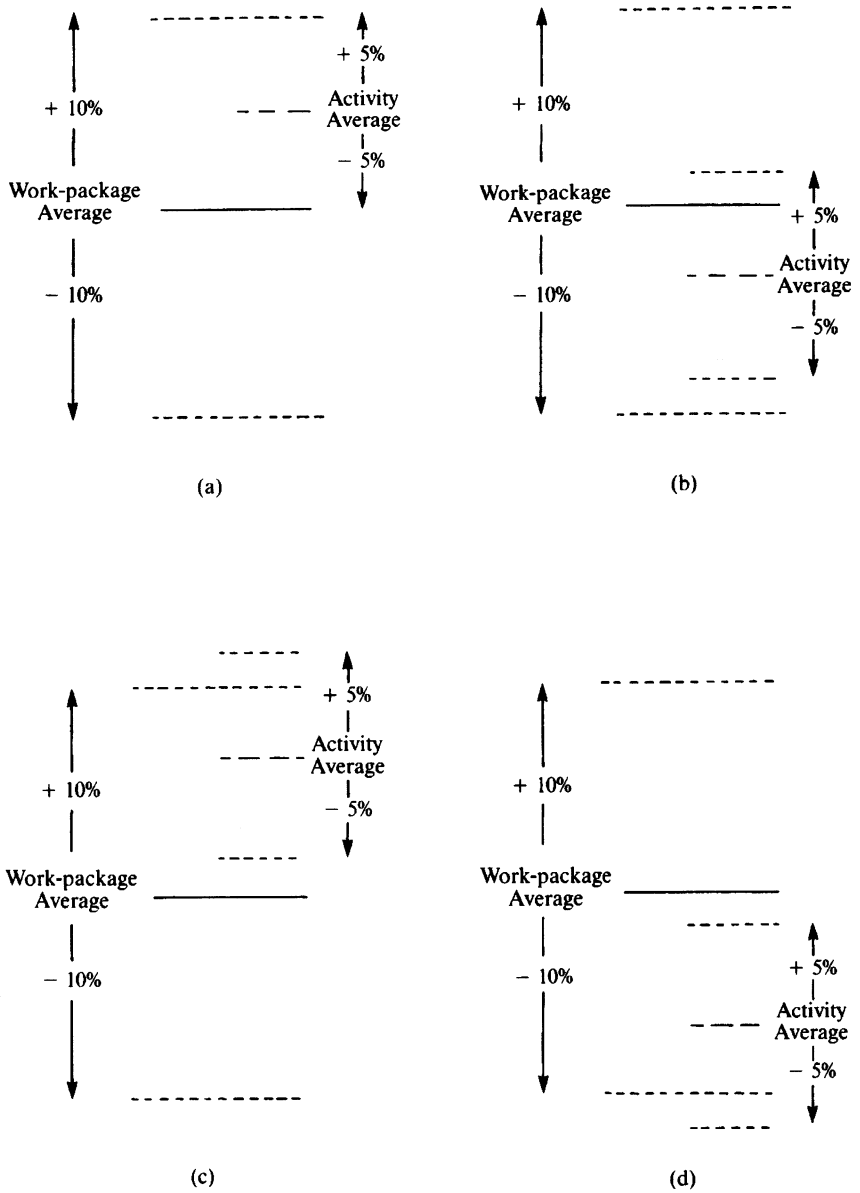

Figure 12.2 Comparison of total project estimates following estimating at the work-package level and activity level

AUTHORIZING ALLOCATION OF WORK

Including the activity schedule in the master plan does not automatically give the project team the authority to do the work at the planned time. The project manager must authorize all work before it is done, often through the issuing of *work-to lists* (see Section 12.4). The project manager may need to re-schedule the work for a variety of reasons:

- it may be dependent on other delayed work
- other resources may need to work in the same space at the same time
- the work may be rearranged as part of a larger recovery plan
- there may be financial or resource constraints.

Representing the activity schedule

There are several ways of representing the activity schedule:

RESPONSIBILITY CHARTS

The responsibility chart provides a complete picture of the schedule of activities which make up a work package. Figure 12.3 shows the activity schedule for milestone P1 in the CRMO Rationalization Project.

ESTIMATING SHEETS

The responsibility chart is an effective tool for representing the people involved, but weak for estimating work content. An estimating sheet, Figure 12.4, can be used for the latter. This is often usefully developed in a spreadsheet, and it:

- lists the activities
- lists the people involved
- breaks the activities into repeated events
- sums the work content of the events to the activities
- spreads the work content between resources
- sums for the work package as a whole
- calculates the duration and cost of the work package.

An estimating sheet only shows the resources represented by an X or C on the responsibility chart. It can be augmented to show start and finish dates for activities. However, it is a tool for calculating the work content and schedule, not for communicating them. A responsibility chart or bar chart is better for that purpose.

NESTED NETWORKS

You can draw a network of the activities which make up a work package. Figure 12.1 (a) illustrates nested networks. If you are using computer tools, the nested network can be included as hammocked networks in the master network, or kept as a separate sub-network linked to the master network.

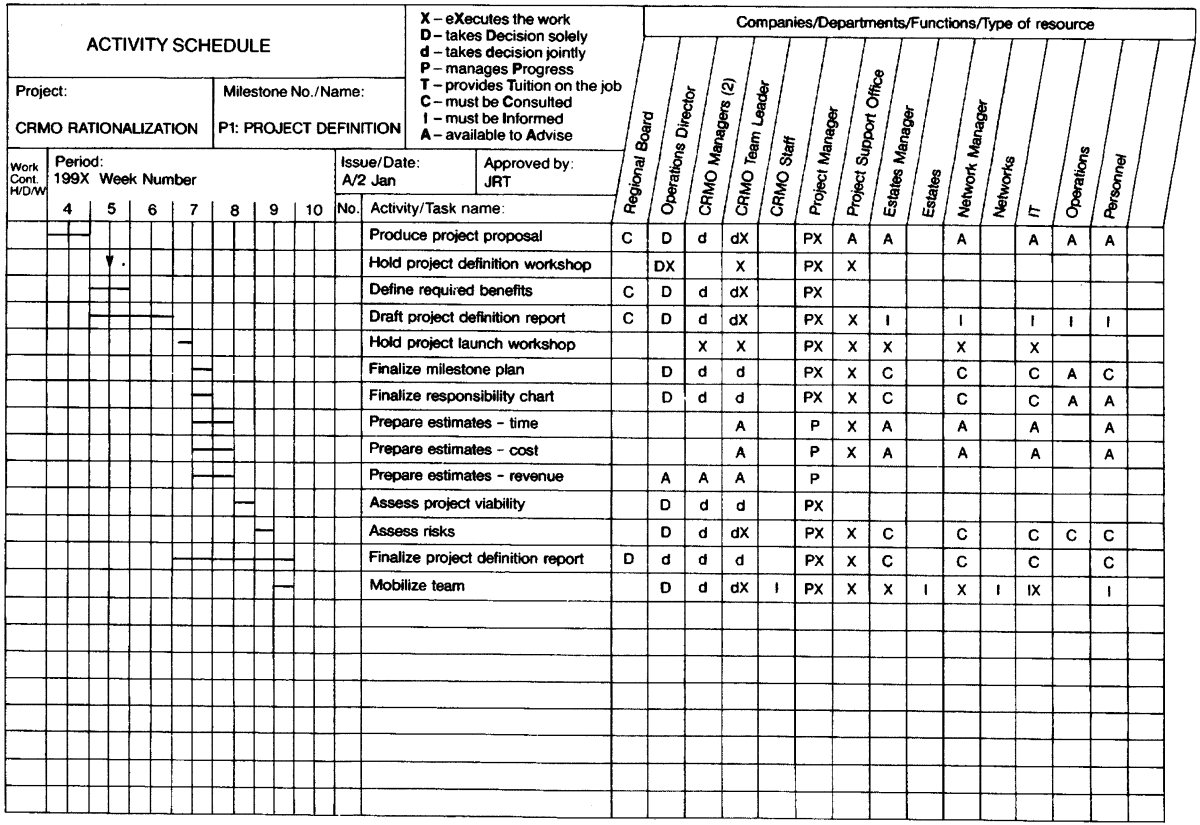

Figure 12.3 Activity Schedule for milestone P1 in the CRMO Rationalization Project

ESTIMATING SHEET — TRIMAGI COMMUNICATIONS BV — 02-Jan-9X

PROJECT:	CRMO Rationalization	CODE:	C1	ISSUE:	A
WORK AREA:	Project	CODE:	C1P	AUTHOR:	LJN
WORK PACKAGE:	Project Definition	CODE:	C1P1	APPRVD:	JRT
ACTIVITY:	.....	CODE:	.....	DATE:	02-Jan-9X

ACTIVITY/TASK		WORK CONTENT			RESOURCES				9 People	
		No of steps	Effort/ step	Total effort	Prjct Mgr	Prjct Offc	CRMO TL	CRMO Mgrs	Ops Direct	Other Mgrs
Number	Description		(days)	(days)	1	1	1	2	1	3
1	Produce project proposal	1	4	4	1	2	1			
2	Hold Project Definition Workshop	1	4	4	1	1	1		1	
3	Define required benefits	1	2	2	1		1			
4	Draft Project Definition Report	1	8	8	2	6				
5	Hold project launch workshop, 1.5 day duration	1	12	12	1.5	1.5	1.5	3		4.5
6	Finalize milestone plan	1	2	2	1	1				
7	Finalize project responsibility chart	1	2	2	1	1				
8	Prepare estimates - time	20	0.1	2		2				
9	Prepare estimates - cost	20	0.1	2		2				
10	Prepare estimates - revenue	1	1	1		1				
11	Assess project viability	1	1	1	1					
12	Assess risks	1	3	3	1	1	1			
13	Finalize Project Definition Report	1	5	5	2	3				
14	Mobilize team	1	3	3	0.5	0.5	0.5			1.5
	SUB-TOTAL:			51	13	22	6	3	1	6
TOTAL EFFORT:	56 DAYS									
TOTAL COST:	£K 22.22		ALLOWANCE %		10	10	10	10	10	10	10
DURATION:	30 DAYS									
TARGET START:	01-Feb-9X		TOTAL EFFORT:		56	14	24	7	3	1	7
TARGET FINISH:	15-Mar-9X									
			UNIT RATE:	£K/day	0.5	0.3	0.3	0.5	0.8	0.5
			COST:	£K	7.15	7.26	1.98	1.65	0.88	3.30

Figure 12.4 Estimating Sheet representing the activity schedule for milestone P1: *Project Definition* of the CRMO Rationalization Project

NESTED BAR CHARTS

Similarly you can draw a bar chart of the activities which make up a work package. Figure 12.1 (b) illustrates nested bar charts. Responsibility charts at several levels contain nested bar charts. As discussed in Chapter 9, the bar chart is a good communication tool, and as such may be augmented by:

- base line start and finish
- current planned actual start and finish
- estimated work content
- work done to date.

All the above tools conform to the principle of single-page reporting. All the activities which make up a work package are shown together, and alone, on a single page. This can be repeated at lower levels of work breakdown if required.

Representing the time schedule

The activity schedules represent the time schedule at the lowest level of breakdown. The schedule will be represented in many different ways depending on the level of planning and for whom it is being prepared. It is worth while at this point to summarize the different representations (Table 12.1).

12.4 Allocating work

When work is about to be done, it is allocated to the team, often via *work-to lists*. A work-to list is a list of activities to which a person or resource is assigned to work. The activities may be listed by:

1. *Work package*: The person or resource is given the activity schedules for all work packages on which they are working (as a responsibility chart or estimating sheet).

Table 12.1 Representing the time schedule

Level of breakdown	*Representation of programme*
Integrative level	Project definition report
Strategic level	Milestone plan Project responsibility chart Master network Master bar chart
Detail level	Responsibility chart as activity schedule Work-package estimating sheets Nested network Nested bar chart

2. *Time period*: They are given a listing of the activities to which they are assigned for a given period of time from across all work packages on which they are working. The period is typically the current control period and one or two control periods into the future. That will be six weeks if reviews are held fortnightly. The work-to list contains:
   – all activities started but not finished
   – all activities due to start in the period.

The work-to list may be in the form of a responsibility chart, (Figure 12.3) or output from a computer system (Figure 12.5). It is now quite common for this to be sent from the master plan to the individual's work station electronically, and will subsequently become their time sheet. The work-to list may contain the following information:

– activity number and name
– baselined dates and duration
– current estimate/actual dates and duration
– estimated work content
– work to date
– bar chart of baselined dates
– bar chart of current estimate/actual dates.

Some people also include float, but I do not agree with this. The team do not need to know the float, and they will invariably consume it. My strongly held views here cause some controversy. Some people say that I do not trust the team, but I am afraid I believe in Parkinson's law: work done expands to fill the time available. I also know that most people are working to tight deadlines on much of their work, and they will put off anything with large float (I do). For this reason, I also do not think people should be given work with a very large float, you should wait until much of the float has disappeared. It is inconsiderate to give busy people non-urgent work, and work which may actually need to change as other work is done. However, I do agree that the team should be told whether work is critical or not. If they need to consume the float, they should negotiate that with the project manager, not assume that the float is there for them to consume by right because it is shown on the work-to list.

At the end of the control period the work-to list will become a *turn-around document*, (Section 12.6), through which the project team report progress. The processes of drawing up the activity schedules, including them in the master plan and issuing work-to lists are shown in the procedure for monitoring and control (Figure 6.9).

The equivalent list for gathering materials on a project is called a *kit-marshalling list*. This lists all the materials required for an activity and the

WORK-TO LIST AND TURN-AROUND DOCUMENT — TRIMAGI COMMUNICATIONS BV — 15-Feb-9X

PROJECT: CRMO RATIONALIZATION — REPORT AUTHOR: — PAGE: 1
WORK PACKAGE: PROJECT DEFINITION — APPROVED: — PRINT DATE: 15-Feb-9X — REPORT DATE:

ACTIVITY NUMBER	DESCRIPTION	ORG DUR (D)	REM DUR (D)	BASE START	BASE FINISH	SCHED START	SCHED FINISH	ACTUAL START	ACTUAL FINISH	WRK EST (D)	WRK DNE (D)	WRK REM (D)	COMMENTS
P1A	Project Proposal	5.0		01Feb9X	05Feb9X			01Feb9X	05Feb9X	4.0	5.0		
P1B	Definition W'Shop	1.0		10Feb9X	11Feb9X			11Feb9X	11Feb9X	4.0	4.0		
P1C	Define Benefits	5.0		08Feb9X	12Feb9X			08Feb9X	12Feb9X	2.0	2.0		
P1D	Draft Defn Report	10.0	5.0	08Feb9X	19Feb9X		19Feb9X	08Feb9X		8.0	3.0		
P1E	Launch W'Shop	1.5	1.5	23Feb9X	24Feb9X	25Feb9X	26Feb9X			12.0			Workshop Delayed
P1F	Milestone Plan	2.5	2.5	24Feb9X	26Feb9X	01Mar9X	02Mar9X			2.0			
P1G	Respbl'ty Chart	2.5	2.5	24Feb9X	26Feb9X	01Mar9X	02Mar9X			2.0			
P1H	Estimate Time	5.0	5.0	24Feb9X	02Mar9X	01Mar9X	05Mar9X			2.0			
P1I	Estimate Costs	5.0	5.0	24Feb9X	02Mar9X	01Mar9X	05Mar9X			2.0			
P1J	Estimate Revenue	5.0	5.0	24Feb9X	02Mar9X	01Mar9X	05Mar9X			1.0			
P1K	Assess Viability	2.5	2.5	03Mar9X	05Mar9X	03Mar9X	05Mar9X			1.0			
P1L	Assess Risks	2.5	2.5	08Mar9X	10Mar9X	08Mar9X	10Mar9X			3.0			
P1M	Final Defn Report	15.0	15.0	22Feb9X	12Mar9X	22Feb9X	12Mar9X			5.0			
P1N	Mobilize Team	2.5	2.5	10Mar9X	12Mar9X	10Mar9X	12Mar9X			3.0			

Figure 12.5 Computer-generated work-to list

date they are required by. If the materials are held in a store, then the list may be issued in the reporting period before that activity, so that the materials can be collected together (marshalled) to a central point, ready for use. If they need to be procured, clearly the list must be issued earlier still. The planning system needs to record the lead time. A computer system can be very useful for this.

12.5 Requirements for effective control

Everything covered up to now has brought us to the point where we are doing work. However, as the work is done we must ensure that we achieve the planned results, and that we deliver the facility to the specification we designed, and within the cost and time at which it was thought to be worth while. Furthermore, as the facility is commissioned, we must ensure it delivers the expected benefits which were used to justify the money spent. We can be sure that this will not occur in a haphazard fashion. The structured process by which we check progress and take action to overcome any deviations from plan is control. There are four essential steps to the control process (Figure 7.2):

1. Plan future work and estimate performance.
2. Monitor and report results.
3. Compare results to the plan and forecast future results.
4. Plan and take effective action to recover the original plan, or to minimize the variance.

The book so far has dealt with the first step. In the remainder of this chapter, we shall deal with the other three steps in turn. Let us start with an explanation of the requirements for effective control. For control to be effective, each step in this four-step process must be effective.

Effective plans

I have discussed the requirements of effective planning throughout the book. In particular, the plans must be comprehensive, and frozen into a baseline to provide a fixed measure for control. If the plans are updated frequently, without the application of strict change control, there will be no measure for control. The project will always be on time, because the plans have just been updated. Team members may develop new activity schedules, but the project manager must authorise them before they are included in the master plan. Work is done against current work-to lists, issued regularly.

Effective reporting

Effective reporting mechanisms (Section 12.6) should satisfy the following requirements:

REPORTS SHOULD BE MADE AGAINST THE PLAN

To ensure that people are interpreting the reports in the same way, they should be made against the plan. In Example 4.4, I described a case in which the project manager and team members were working to different plans. The team members were making verbal reports and reporting satisfactory progress. The project manager could not understand why they were not achieving his milestones. Below, turn-around documents are described as a tool for reporting against the plan.

THERE SHOULD BE DEFINED CRITERIA FOR CONTROL

Likewise it is important to have defined criteria. If people are asked to make ad-hoc reports, they tend to report the good news and hide the bad news. If asked to report against set questions, they will usually answer honestly. If they report dishonestly, it will become obvious at the second or third reporting period. Defined criteria are given in the next section.

THE CONTROL TOOLS SHOULD BE SIMPLE AND FRIENDLY

Team members should spend as little time as possible filling in reports. If submitting reports takes an excessive amount of time, people rightly complain that they are being distracted from productive work (Example 12.1). Simple, friendly tools means single-page reporting nested in the WBS, and reports against the plan, with defined criteria, requiring simple numeric or yes/no answers. Reports are often filed against work-to lists. These are the *turn-around documents* mentioned above. The work-to list contains space for the report, and is returned at the end of the reporting period. The turn-around document may even have expected answers entered.

I used to work on ammonia plant overhauls, each a four-week project. Every day, supervisors came to a one-hour control meeting in the morning, a two-hour meeting in the afternoon, and spent one hour after work completing daily returns. They complained that they should spend more time on the patch motivating their men.

Example 12.1 Simple, friendly tools

REPORTS SHOULD BE MADE AT DEFINED INTERVALS

Just as it is necessary to report against defined criteria, it is also necessary to report at defined intervals. You should not ask people to report only when there is something to discuss. People hate to volunteer failure, so they will not ask for help until it is too late to recover. If people know that they must report both good news and bad at defined intervals, then they

will report more freely. The frequency of the reporting period depends on:

- the length of the project
- the stage in the project
- the risk and consequence of failure
- the level of reporting.

At the start of a year-long project, you may report fortnightly at the activity level and six weekly at the milestone level. In areas of high risk you may report more often. Towards the end of the project you may report weekly, or even daily.

REPORTS SHOULD BE DISCUSSED AT FORMAL MEETINGS

To be effective the reports must be made and discussed at formal meetings. Passing the time of day at the coffee machine is part of effective team building, but not of effective control. Formal meetings have an agenda, and a chairman to maintain control. To keep the meetings short and effective, the discussion should also focus on identifying problems, and responsibility for solving them, but the meeting should not attempt to solve the problem.

THE REPORTS SHOULD STIMULATE CREATIVE DISCUSSIONS

To link into the next steps of control the reports must generate creative discussion, so the team can identify where variances are occurring, and possible ways of taking effective timely action.

Effective reviews

Having gathered the data, the team must determine whether the project is behaving as predicted, and if not calculate the size and impact of the variances. The two quantitative measures of progress are cost and time, and so receive significant attention. The team uses the reports to forecast time and cost at completion, and calculates any differences (variances) between these figures and the baseline. It may simply be that work is taking longer and costing more than predicted. Or delays or additional effort may be caused by variances in quality, people failing to fulfil their responsibility, externally imposed delays, or changes in scope. Therefore the variances in time and cost can point to a need to control one or more of the five project management functions. The defined criteria, formal meetings and creative discussions are key to this process.

Effective action

To close the control loop, the team must take effective action to overcome any variances. This may mean revising the plan to reflect the variances, but hopefully it means at least taking timely effective action to stop them getting

worse, and preferably reducing or eliminating them. Effective action requires:

- being able to calculate the impact of any changes in the plan on the project's outcome
- having the resolve to take action.

REPLANNING

This is often called *what-if* analysis. The team calculates the impact of action it may take. The most effective management information is obtained by doing this through plans nested in the WBS (single-page reporting). The impact of a change in one activity on related activities can be analysed at the activity level, and on other work packages at the milestone level. However, in complex situations the what-if analysis may be done with computer systems. To be able to perform this what-if analysis it is vital that the project's plans have been kept up to date.

THE RESOLVE TO TAKE ACTION

This is dependent on managers using their sources of authority, and being able to motivate and persuade their teams. To motivate and persuade the teams, the managers must build their commitment to the common mission, and help them understand how the project will be of benefit to them. Teams are discussed further in Chapter 17. Recovery planning and taking action are discussed in Section 12.7.

12.6 Gathering data and calculating progress

Gathering data

The first step in the control process is to gather data on progress. The criteria for control should be to measure satisfactory progress against the five functions of the project. The data required to control them are given in Table 12.2. These are usually collected at the activity level, but may be collected at the work-package or task levels. When collected at a lower level they can be summarized to report at a higher level. The use of these data in the control process is described in the next section.

I said above that data is most effectively gathered against defined criteria using turn-around documents. These are work-to lists issued at the start of the reporting period and then used at the end of the period to gather data. Many modern computer systems use an individual's time sheet as a work-to list and turn-around document. Turn-around documents provide reports against the plan, defined criteria, and simple, friendly tools. They can also be used as the focus for formal meetings. I find it effective to photocopy the turn-around document on to a transparency, and project it on to a white

Table 12.2 Criteria for control, and required data

Criteria for control	*Quantitative data*	*Qualitative data*
Time and Cost	Revised start/finish Actual start/finish Effort to date Effort remaining Other costs to date Other costs remaining	
Quality		Problems encountered
Organization		Responsibility chart kept
Scope		Changes Special problems

board. The team can fill in the document on the board in a group meeting. This process encourages creative discussions to identify any problems, but also enable the meeting to be kept short. Figure 12.6 is a manual turn-around document encompassing the activity schedule from Figure 12.3. Figure 12.7 contains a computer-generated turn-around document. Figure 12.8 is a turn-around document at the milestone level.

Calculating progress

The data gathered are used to calculate progress on all of the five project management functions: time; cost; quality; project organization; scope. In particular, with the first two we try to forecast the final out-turn, the time and cost to completion, as this gives better control than reporting the actual time and cost to date. This concept is part of the forward-looking control of which project managers speak.

Forecasting time to completion

Time is the simplest function to monitor and that is perhaps why it receives the greatest attention. If critical milestones have been delayed, or if the critical path has been delayed (and no other path has become 'more critical'), then it is likely that the project has been delayed by that amount. If the team has maintained an up-to-date network for the project, that can be used to forecast the completion date for the project in exactly the same way it was used to predict the end date initially. The record of effort to date versus effort remaining can also be used to control time, in one of three ways:

- by revising estimates of duration
- by indicating the cause of delays
- through an earned value calculation.

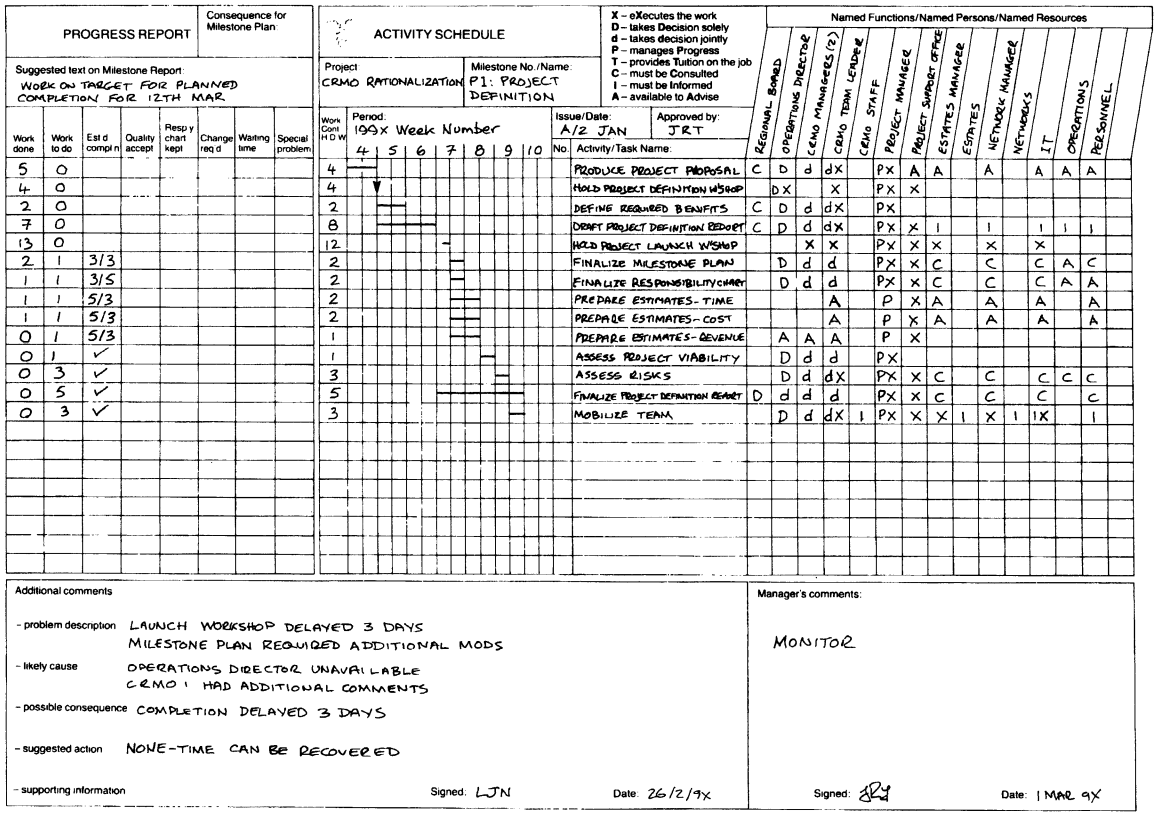

Figure 12.6 Manual turn-around document encompassing the activity schedule

WORK-TO LIST AND TURN-AROUND DOCUMENT — TRIMAGI COMMUNICATIONS BV — 15-Feb-9X

PROJECT: CRIMO RATIONALIZATION — REPORT AUTHOR: LJN — PAGE: 1
WORK PACKAGE: PROJECT DEFINITION — APPROVED: JRT — PRINT DATE: 15-Feb-9X
REPORT DATE: 26/2/9X

ACTIVITY NUMBER	DESCRIPTION	ORG DUR (D)	REM DUR (D)	BASE START	BASE FINISH	SCHED START	SCHED FINISH	ACTUAL START	ACTUAL FINISH	WRK EST (D)	WRK DNE (D)	WRK REM (D)	COMMENTS
P1A	Project Proposal	5.0		01Feb9X	05Feb9X			01Feb9X	05Feb9X	4.0	5.0		
P1B	Definition W'Shop	1.0		10Feb9X	11Feb9X			11Feb9X	11Feb9X	4.0	4.0		
P1C	Define Benefits	5.0		08Feb9X	12Feb9X			08Feb9X	12Feb9X	2.0	2.0		
P1D	Draft Defn Report	10.0	5.0	08Feb9X	19Feb9X		19Feb9X	08Feb9X	24/2/9X	8.0	7.0	—	
P1E	Launch W'Shop	1.5	1.5	23Feb9X	24Feb9X	25Feb9X	26Feb9X	25/2/9X	26/2/9X	12.0	13	—	Workshop Delayed
P1F	Milestone Plan	2.5	2.5	24Feb9X	26Feb9X	01Mar9X	02Mar9X		3/3/9X(E)	2.0	2	1	Extra Person
P1G	Respbl'ty Chart	2.5	2.5	24Feb9X	26Feb9X	01Mar9X	02Mar9X		5/3/9X(E)	2.0	1	1	
P1H	Estimate Time	5.0	5.0	24Feb9X	02Mar9X	01Mar9X	05Mar9X		5/3/9X(E)	2.0	1	1	
P1I	Estimate Costs	5.0	5.0	24Feb9X	02Mar9X	01Mar9X	05Mar9X		5/3/9X(E)	2.0	1	1	
P1J	Estimate Revenue	5.0	5.0	24Feb9X	02Mar9X	01Mar9X	05Mar9X		5/3/9X(E)	1.0			
P1K	Assess Viability	2.5	2.5	03Mar9X	05Mar9X	03Mar9X	05Mar9X			1.0			
P1L	Assess Risks	2.5	2.5	08Mar9X	10Mar9X	08Mar9X	10Mar9X			3.0			
P1M	Final Defn Report	15.0	15.0	22Feb9X	12Mar9X	22Feb9X	12Mar9X			5.0			
P1N	Mobilize Team	2.5	2.5	10Mar9X	12Mar9X	10Mar9X	12Mar9X			3.0			Completion Expected on Time

Figure 12.7 Computer-generated turn-around document

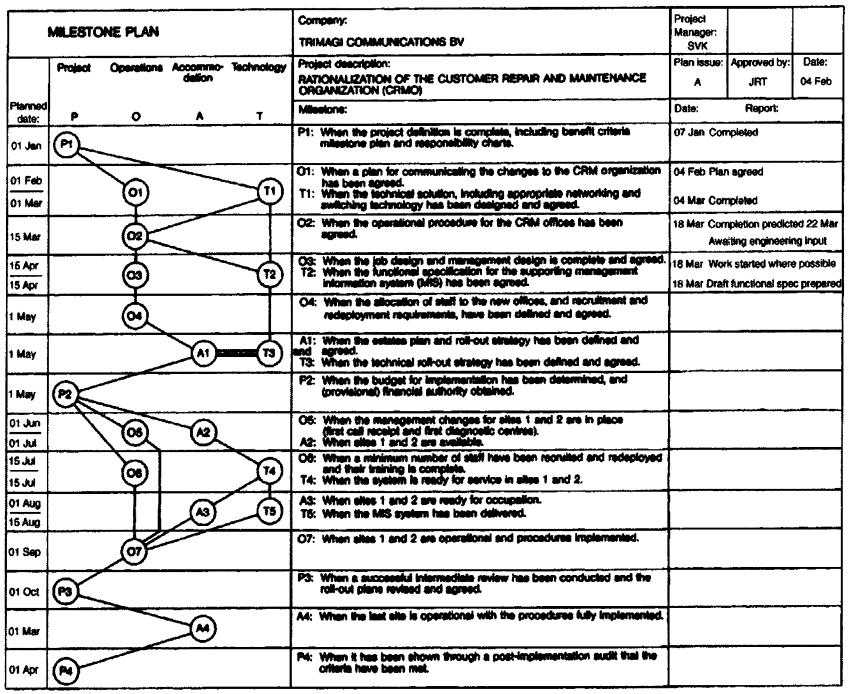

Figure 12.8 Turn-around document at the milestone level

REVISING ESTIMATES OF DURATION

If there is a consistent estimating error, this will be indicated by a trend. The estimates of duration can be revised accordingly.

INDICATING THE CAUSE OF DELAYS

Table 12.3 shows four possible outcomes of duration and effort. Both may be on (or under) budget, in which case all is well. The project may be on time, but effort over budget, in which case there may be minor estimating errors, but the team is coping, perhaps by working unplanned overtime. Estimating errors will be indicated as above. The project may be late, but no additional effort has been expended. Then the cause of the delay must have been due to external factors, perhaps other people failing to fulfil their responsibilities, or late delivery of some materials, or perhaps the project team have been occupied on work of higher priority (to them). The qualitative control data (Table 12.2) may help to indicate the cause. If both time and effort are over budget, then the cause may be serious estimating errors, rework due to poor quality or rework due to change.

Table 12.3 Determining the cause of delays by comparing of effort and completion dates

Effort	*Duration*	
	On time	*Late*
As predicted	No problem	External delays Responsibilities not fulfilled
Over budget	Minor estimating errors Minor changes	Estimating errors Major changes Major quality problems

A trend will indicate the first as described above, and so you will need to monitor effort and duration over several reports. The qualitative control data (Table 12.2) will indicate the second or third cause. You can see from Table 12.3 how the complete set of control data can help initiate discussion over the likely causes of delays and help in their elimination.

EARNED VALUE CALCULATION

The volume variance, calculated as part of the cost control process, will indicate whether the project is on average ahead or behind schedule.

Forecasting cost to completion

The simplistic approach to controlling costs is to compare costs to date to the baseline cost to date. However, I showed in Section 8.7 that this comparison is of little value. If actual cost is less than baseline cost we do not know if the work is underspent, late or even late and overspent. I therefore introduced the concept of *earned value*, or *baseline cost of work complete* (BCWC). This is what was planned to have been spent on the work complete, and so is a measure of the amount of work done for the money spent. With the earned value we can calculate two variances:

$$\text{Cost variance} = \text{Actual cost} - \text{Earned value}$$
$$\text{Volume variance} = \text{Earned value} - \text{Baselined cost}$$

These figures can be calculated for the reporting period, or as cumulative figures over all reporting periods to date. The cost variance indicates whether the project is over- or underspent. The volume variance indicates whether it is (on average) early or late. With the variances calculated as shown, a positive cost variance will be unfavourable; the project is overspent, and is therefore likely to turn out over budget. However, a positive volume variance is favourable, the project is (on average) ahead of schedule, and is likely to be completed early. (I say 'on average', because it is possible for a large non-critical item to be early, and a small critical item

late, and the project will appear to be ahead of schedule according to the volume variance, but behind according to the network.) The actual cost, earned value and forecast of cost to completion can be calculated from the data gathered as follows:

ACTUAL COST

The actual cost in the period is the sum of the man-hour costs and other costs in the period:

$$\text{Actual cost} = \text{Effort} \times (\text{Man-hour rate}) + \text{Other costs}$$

Obviously if there is more than one resource then the sum over all resources must be used. There is an additional complication when the costs are assumed to be incurred (Section 8.7). It is too late for control purposes when the invoices are paid. In Chapter 8 I described typical assumptions. I would only reinforce here that what is important for control purposes is that actual cost, baselined cost and earned value all incorporate the same assumptions.

EARNED VALUE

This calculation is more complex. For work finished the earned value is clearly the baselined cost of that element of work. For work in progress, some estimate of the percentage completion must be made. This can be done in four ways:

- by summing the percentage completion of work elements at low levels of work breakdown, for instance by adding over the activities in a work package
- by making a visual inspection
- by assuming (at a low level of work breakdown) all work in progress is on average 50 per cent complete
- by using the effort accrued and effort remaining to calculate percentage complete.

Visual inspections are subjective. People usually overestimate percentage completion when using a visual inspection. Indeed, I was told once that in the civil construction industry it is common for a contractor's quantity surveyors to deliberately overestimate percentage completion, to improve the contractor's cash flow. Most of the profit is made by investing money obtained for work which is not yet done. Effort accrued and remaining can be used to calculate percentage complete as follows:

$$\text{Percentage complete} = \frac{(\text{Effort to date})}{(\text{Effort to date} + \text{effort remaining})}$$

The sum of effort to date and remaining are used on the lower line, rather than the original estimate, because that provides a better estimate of percentage complete. You only need consider the case where effort to date is already greater than the original estimate. However, the estimate of effort remaining can be subjective, and may be sometimes obtained by subtracting effort to date from the original estimate (until such time as the former is the greater). Percentage completion can also be calculated by replacing effort by duration in the above formula. The two are the same for a single resource activity. For an activity with internal lead times, or several resources working at different times, effort is needed to give a more accurate answer. When calculating percentage completion at work-package or project level by summing over activities at a lower level, it does not matter too much what assumptions are made at the lower level, because errors cancel out as you sum to higher levels; (as long as there is not a consistent error, such as from deliberate overestimating, which will reinforce at higher levels). Hence, in most cases the 50 per cent assumption for activities in progress is as accurate as you need. Figures 12.9 and 12.10 are a computer-generated cost report for the CRMO Rationalization Project, showing the costs for each work package and the aggregate for the project overall. Figure 12.9 shows the percentage completion of the work packages calculated on the duration, and Figure 12.10 calculated making the 50 per cent assumption.

FORECAST COST TO COMPLETION

This is calculated using the cost variance. The forecast cost to complete of activities is estimated in one of the ways just described. At the project or work-package level it is possible to make one of three simplifying assumptions:

1. All remaining activities will be done at baseline cost:

   Cost at completion = Original estimate + Cost variance to date

2. Over-expenditure will continue at the current rate:

   Cost at completion = Original estimate * (1+% Cost variance to date)
   % Cost variance = Cost variance/Earned value

3. Some activities in the future will be overspent but it will be possible to make savings in other areas. Using the WBS, a second estimate can be maintained alongside the baselined cost, the current best estimate, and this can be used to forecast the cost to completion.

Figures 12.9 and 12.10 also show the forecast cost to completion. The forecasts are made using the current best estimate.

PROJECT COST REPORT — TRIMAGI COMMUNICATIONS BV — 31-Aug-9X

PROJECT: CRMO RATIONALIZATION
WORK AREA: —
WORK PACKAGE: —

PAGE: 1
PRINT DATE: 31-Aug-9X
REPORT DATE: 31-Aug-9X

WORK PACKAGE NO	DESCRIPTION	ORG DUR (D)	REM DUR (D)	BASE COMPL (%)	PERCT COMPL (%)	BASELINE LABOUR (£,000)	BASELINE MAT'L (£,000)	CURRENT ESTIMATE TOTAL (£,000)	CURRENT ESTIMATE LABOUR (£,000)	CURRENT ESTIMATE MAT'L (£,000)	SCHEDULED COST TOTAL (£,000)	SCHEDULED COST LABOUR (£,000)	SCHEDULED COST MAT'L (£,000)	EARNED VALUE TOTAL (£,000)	EARNED VALUE LABOUR (£,000)	EARNED VALUE MAT'L (£,000)	ACTUAL COMMITMENT TOTAL (£,000)	ACTUAL COMMITMENT LABOUR (£,000)	ACTUAL COMMITMENT MAT'L (£,000)	ACTUAL COMMITMENT TOTAL (£,000)
P1	Project definition	30.0		100.0%	100.0%	11.2	6.4	17.6	11.2	6.4	17.6	11.2	6.4	17.6	11.2	6.4	17.6	11.0	6.3	17.3
T1	Technology design	40.0		100.0%	100.0%	12.8		12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.1	0.0	12.1
01	Communication plan	5.0		100.0%	100.0%	1.2	2.5	3.7	1.2	2.5	3.7	1.2	2.5	3.7	1.2	2.5	3.7	1.2	2.4	3.6
02	Operational proc.	15.0		100.0%	100.0%	9.6		9.6	9.6	0.0	9.6	9.6	0.0	9.6	9.6	0.0	9.6	9.8	0.0	9.8
03	Job/Management desc.	20.0		100.0%	100.0%	12.8		12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.5	0.0	12.5
T2	MIS function spec.	15.0		100.0%	100.0%	4.8		4.8	4.8	0.0	4.8	4.8	0.0	4.8	4.8	0.0	4.8	4.5	0.0	4.5
04	Staff allocation	15.0		100.0%	100.0%	3.6		3.6	3.6	0.0	3.6	3.6	0.0	3.6	3.6	0.0	3.6	3.7	0.0	3.7
A1	Estates plan	10.0		100.0%	100.0%	1.6		1.6	1.6	0.0	1.6	1.6	0.0	1.6	1.6	0.0	1.6	1.6	0.0	1.6
T3	Technical plan	10.0		100.0%	100.0%	0.8		0.8	0.8	0.0	0.8	0.8	0.0	0.8	0.8	0.0	0.8	0.8	0.0	0.8
P2	Financial approval	15.0		100.0%	100.0%	3.6	1.5	5.1	3.6	1.5	5.1	3.6	1.5	5.1	3.6	1.5	5.1	3.6	1.5	5.1
A2	Sites 1&2 available	15.0		100.0%	100.0%	8.4	6.6	15.0	8.4	6.6	15.0	8.4	6.6	15.0	8.4	6.6	15.0	7.5	6.9	14.4
05	Management changes	10.0		100.0%	100.0%	2.4		2.4	2.4	0.0	2.4	2.4	0.0	2.4	2.4	0.0	2.4	2.4	0.0	2.4
06	Redeployment/train	40.0	10.0	100.0%	75.0%	25.6	55.2	80.8	24.4	52.6	77.0	24.4	52.6	77.0	18.3	52.6	70.9	17.9	52.2	70.1
T4	System in sites 1&2	30.0	20.0	100.0%	33.3%	19.2	44.0	63.2	19.2	44.0	63.2	19.2	44.0	63.2	6.4	44.0	50.4	4.5	42.4	46.9
A3	Sites 1&2 ready	15.0	15.0	50.0%	0.0%	8.4	60.0	68.4	9.2	66.0	75.2	4.6	66.0	70.6	0.0	0.0	0.0			
T5	MIS delivered	15.0	9.0	50.0%	40.0%	4.8	38.0	42.8	4.8	38.0	42.8	2.4	38.0	40.4	1.9	38.0	39.9	1.6	40.2	41.8
07	Procedures implem.	10.0	10.0	0.0%	0.0%	4.0	10.8	14.8	4.0	10.8	14.8	0.0	0.0	0.0	0.0	0.0	0.0			
P3	Intermediate rev.	40.0	40.0	0.0%	0.0%	1.6		1.6	1.6	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0			
A4	Roll-out implem.	80.0	80.0	0.0%	0.0%	64.0	240.0	304.0	70.4	264.0	334.4	0.0	0.0	0.0	0.0	0.0	0.0			
P4	Benefits obtained	60.0	60.0	0.0%	0.0%	2.4		2.4	2.4	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0			
						202.8	465.0	667.8	208.8	492.4	701.2	123.4	217.6	341.0	99.4	151.6	251.0	94.7	151.9	246.6

Figure 12.9 Cost report using duration to calculate percentage completion

PROJECT COST REPORT — TRIMAGI COMMUNICATIONS BV — 31-Aug-9X

PROJECT: CRMO RATIONALIZATION
WORK AREA: —
WORK PACKAGE: —

PAGE: 1
PRINT DATE: 31-Aug-9X
REPORT DATE: 31-Aug-9X

WORK PACKAGE NO	DESCRIPTION	ORG DUR (D)	REM DUR (D)	BASE COMPL (%)	PERCT COMPL (%)	BASELINE LABOUR (£,000)	BASELINE MAT'L (£,000)	CURRENT ESTIMATE TOTAL (£,000)	CURRENT ESTIMATE LABOUR (£,000)	CURRENT ESTIMATE MAT'L (£,000)	SCHEDULED COST TOTAL (£,000)	SCHEDULED COST LABOUR (£,000)	SCHEDULED COST MAT'L (£,000)	EARNED VALUE TOTAL (£,000)	EARNED VALUE LABOUR (£,000)	EARNED VALUE MAT'L (£,000)	ACTUAL COMMITMENT TOTAL LABOUR (£,000)	ACTUAL COMMITMENT MAT'L (£,000)	ACTUAL COMMITMENT TOTAL (£,000)
P1	Project definition	30.0		100.0%	100.0%	11.2	6.4	17.6	11.2	6.4	17.6	11.2	6.4	17.6	11.2	6.4	17.6	11.0	6.3	17.3
T1	Technology design	40.0		100.0%	100.0%	12.8		12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.1	0.0	12.1
01	Communication plan	5.0		100.0%	100.0%	1.2	2.5	3.7	1.2	2.5	3.7	1.2	2.5	3.7	1.2	2.5	3.7	1.2	2.4	3.6
02	Operational proc.	15.0		100.0%	100.0%	9.6		9.6	9.6	0.0	9.6	9.6	0.0	9.6	9.6	0.0	9.6	9.8	0.0	9.8
03	Job/Management desc.	20.0		100.0%	100.0%	12.8		12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.8	0.0	12.8	12.5	0.0	12.5
T2	MIS function spec.	15.0		100.0%	100.0%	4.8		4.8	4.8	0.0	4.8	4.8	0.0	4.8	4.8	0.0	4.8	4.5	0.0	4.5
04	Staff allocation	15.0		100.0%	100.0%	3.6		3.6	3.6	0.0	3.6	3.6	0.0	3.6	3.6	0.0	3.6	3.7	0.0	3.7
A1	Estates plan	10.0		100.0%	100.0%	1.6		1.6	1.6	0.0	1.6	1.6	0.0	1.6	1.6	0.0	1.6	1.6	0.0	1.6
T3	Technical plan	10.0		100.0%	100.0%	0.8		0.8	0.8	0.0	0.8	0.8	0.0	0.8	0.8	0.0	0.8	0.8	0.0	0.8
P2	Financial approval	15.0		100.0%	100.0%	3.6	1.5	5.1	3.6	1.5	5.1	3.6	1.5	5.1	3.6	1.5	5.1	3.6	1.5	5.1
A2	Sites 1&2 available	15.0		100.0%	100.0%	8.4	6.6	15.0	8.4	6.6	15.0	8.4	6.6	15.0	8.4	6.6	15.0	7.5	6.9	14.4
05	Management changes	10.0		100.0%	100.0%	2.4		2.4	2.4	0.0	2.4	2.4	0.0	2.4	2.4	0.0	2.4	2.4	0.0	2.4
06	Redeployment/train	40.0	10.0	100.0%	75.0%	25.6	55.2	80.8	24.4	52.6	77.0	24.4	52.6	77.0	18.3	52.6	70.9	17.9	52.2	70.1
T4	System in sites 1&2	30.0	20.0	100.0%	33.3%	19.2	44.0	63.2	19.2	44.0	63.2	19.2	44.0	63.2	6.4	44.0	50.4	4.5	42.4	46.9
A3	Sites 1&2 ready	15.0	15.0	50.0%	0.0%	8.4	60.0	68.4	9.2	66.0	75.2	4.6	66.0	70.6	0.0	0.0	0.0			
T5	MIS delivered	15.0	9.0	50.0%	40.0%	4.8	38.0	42.8	4.8	38.0	42.8	2.4	38.0	40.4	2.4	38.0	40.4	1.6	40.2	41.8
07	Procedures implem.	10.0	10.0	0.0%	0.0%	4.0	10.8	14.8	4.0	10.8	14.8	0.0	0.0	0.0	0.0	0.0	0.0			
P3	Intermediate rev.	40.0	40.0	0.0%	0.0%	1.6		1.6	1.6	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0			
A4	Roll-out implem.	80.0	80.0	0.0%	0.0%	64.0	240.0	304.0	70.4	264.0	334.4	0.0	0.0	0.0	0.0	0.0	0.0			
P4	Benefits obtained	60.0	60.0	0.0%	0.0%	2.4		2.4	2.4	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0			
						202.8	465.0	667.8	208.8	492.4	701.2	123.4	217.6	341.0	97.0	151.6	248.6	94.7	151.9	246.6

Figure 12.10 Cost report assuming work packages in process are 50 per cent complete

S-CURVES

Introduced in Section 8.7, S-curves can be used to represent these concepts graphically (Figure 12.11). This figure also differentiates between the budget estimate and the baseline estimate. The baseline is the measure for control, the budget is the most you expect to spend, and the difference is the contingency. You will often here people referring to budget and baseline as the same thing.

Controlling quality

The data gathered can show where deviations from the specification have occurred. These quality variances may have been identified as part of the quality control process, or may have been noticed by team members. The impact of quality problems on time and cost is indicated by Table 12.3.

Controlling organization

Similarly, the data gathered may indicate where the project organization is not performing as planned. This may specifically be caused by people not fulfilling their roles or responsibilities as agreed in the responsibility chart. Table 12.3 also shows how the control process can indicate the impact of these organizational delays on time and cost.

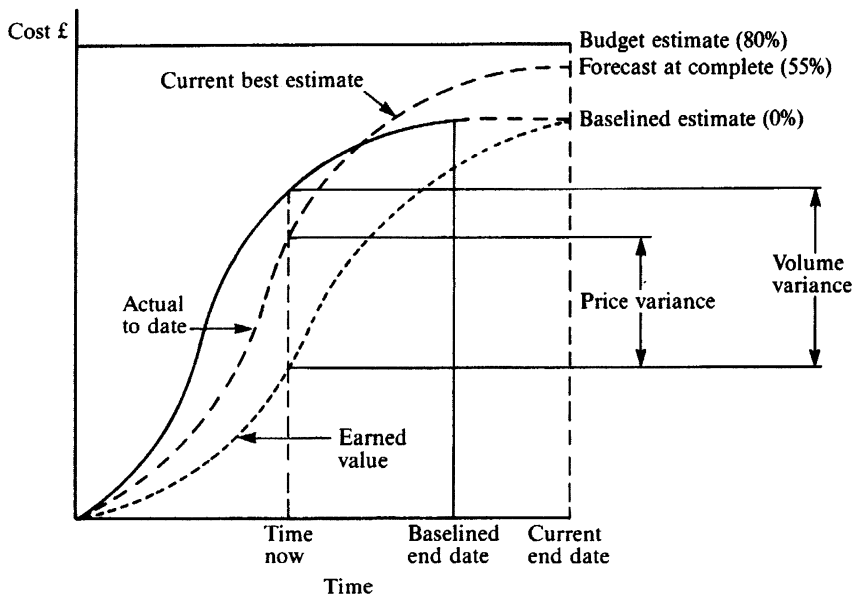

Figure 12.11 Use of S-curves

Controlling scope

Finally, the data gathered can indicate that changes in scope have occurred. These especially will have an impact on the time and cost of a project (Table 12.3). Changes in scope are usually inevitable. However, they should be rigidly controlled, and this requires a change control procedure. Change control is a six-step process:

1. Log the change.
2. Define the change.
3. Assess the impact of the change. Seemingly simple changes can have far-reaching consequences.
4. Calculate the cost of the change. This is not just the direct cost, but the cost of the impact.
5. Define the benefit of the change. This may be financial or non-financial. The latter includes safety.
6. Accept or reject the change based on marginal investment criteria. A return of 40 per cent per annum is possible for marginal criteria, compared to 20 per cent for the project as a whole.

If this procedure is applied rigorously, many changes do not get past step 3. Figure 12.12 is a form to aid this process.

12.7 Taking action[a]

Once we have identified that a project is deviating from the plan, we must take appropriate action. The earlier action is taken the better,[1] because it is then cheaper to recover the project or to abort it should it have proved non-viable. This relationship between project recovery and the life cycle was described earlier in the chapters on risk and quality. In this section I shall describe how to take appropriate action to recover a project.

Recovering a project

The response to the variances can be carefully managed, or unmanaged and reactive. The most effective approach depends on the circumstances. There are cases which demand an immediate response. However, in most cases there is time to reflect and recoup. A structured approach to problem solving (Figure 1.6) is the best means of recovery. Here, I describe a six-step version for planning recovery:

1. *Stop*: regardless of the size of the variance and its impact, everyone should pause. Unfortunately, the most common reaction is to seek an instant remedy. Some common solutions, such as adding more resources or sacking the project manager, may do more harm than good. While this

TRIMAGI COMMUNICATIONS
CHANGE CONTROL FORM

PROJECT: CRMO RATIONALIZATION.....
WORK PACKAGE: .....
ACTIVITY: .....
ORIGINATOR: .....

DESCRIPTION OF CHANGE

IMPACT OF CHANGE

COST OF CHANGE: £.....
VALUE OF CHANGE: £.....

	NAME	SIGNATURE	DATE
PROPOSED BY:	.....	.....	.....
CHECKED BY:	.....	.....	.....
APPROVED BY:	.....	.....	.....

Figure 12.12 Change control form

reaction is understandable, it is often wrong because of the emotional state of the team. Once I attended a recovery review where the chairman listened to the team, sympathized with them, made no undermining statement and gave them three days off to recover. The result was electric. The team came back remotivated to set things right. The project was back on the rails in very quick time and the product became a bestseller. Keep cool, calm and collected. Remember Dennis Healey's first law of holes: 'If you find yourself in a hole, stop digging.'

2. *Look, listen and learn*: it is important to undertake a thorough review with all team members and the client present. Effective recovery must be based on a clear understanding of the cause of the divergence, and possible ways of overcoming it. Seeking views on what went wrong, and what action the team proposes, is important in rebuilding commitment.
3. *Develop options and select a likely course*: by exploring every avenue and developing a range of solutions. Establish decision criteria so options can be evaluated against an agreed condition. If necessary return to the original financial evaluations, recost and retime each option, air them with the client and then select one which meets the decision criteria.
4. *Win support for the chosen option*: it is important that there is total support from all those involved. There is hard work ahead and uncommitted team members will falter at the first hurdle.
5. *Act*: once the agreed course of action has been accepted every effort must be made to implement it. Deviations from the agreed plan will only add to the confusion and make the situation worse.
6. *Continue to monitor*: the impact of any actions to ensure that they have the desired effect. If not, then the recovery process must be repeated.

Options for action

There are five basic options for taking action:

FIND AN ALTERNATIVE SOLUTION

This is by far the best solution. The plan is recast to recover the projects objectives in a way which has no impact on the quality, cost, time or scope. It may be that two activities were planned sequentially, because they share the same scarce resource. If the first is delayed for other reasons, it may be possible to do the second activity first, and hopefully when it is complete it will then be possible to do the other.

COMPROMISE COST

This means adding additional resource either as overtime or additional people, machines or material to recover the lost time. This is usually the instant reaction to project delays. However, remember the discussion in Section 9.3, describing how to calculate durations: doubling the number of people on a project usually does not double the rate of work. Brooks's law[2] states:

> Adding resource to a late software project makes it later still

The rationale is that the existing people must take time out to bring the new people up to speed.

COMPROMISE TIME

This means allowing the dates to slip. This may be preferable, depending on whether cost or time is the more important constraint on the project. This decision should have been made during the feasibility study, and communicated to the project team as part of the project strategy.

COMPROMISE SCOPE

This means reducing the amount of work done, which in turn means taking less on time to achieve some benefit. Notice I did not say compromising the quality. The latter is very risky once the initial specification has been set, and should therefore be discouraged.

ABORT THE PROJECT

This is a difficult decision. However, it must be taken if the future costs on the project are not justified by the expected benefits. Project teams are often puzzled that their recommendation to terminate a project is ignored; a decision which seems obvious is avoided, and good money is poured after bad, depriving other projects. It takes courage to abort a project. During their lives, projects absorb champions and supporters. Senior people may have become associated with its success and feel if the project fails it may damage their reputation. There is often a feeling that 'with a little more money and a bit of luck the project can be turned round'. The fact is that once an organization makes an emotional commitment to a project it finds it very hard to abandon. Another argument often put forward to support a failing project is that 'as we have already spent so much on it we should finish it'. Unfortunately, this argument is fallacious: future costs must be justified by the expected benefit, no matter how much has been spent so far. If the project's outcome is still important to the organization it may be more effective to abort a project, learn from it and start afresh.

12.8 The control cycle

Building the control processes above into a cycle of monitoring and control can be complex. During a control period you must:

- issue work-to lists
- gather the turn-around documents
- analyse the data
- hold a review meeting
- update the plan

all in time for incorporation into the new work-to lists. Timing these control activities within a control period is a delicate balance between conflicting

requirements. If the turn-around documents are gathered too late, changes to the plan cannot be incorporated until the next but one control cycle. If they are gathered too early, the reports will be based on predictions to the end of the control period. Futhermore, if attendance at review meetings is to be compulsory, they should not be scheduled for a Friday or a Monday, which people may take off as a long weekend. Likewise, the meeting at the activity level should be held just before the less frequent meeting at the work-package level. Figure 12.13 shows a procedure for monitoring and control which achieves this balance, while holding reviews fortnightly at the activity level and six weekly at the work-package, or milestone, level. This concept of nesting the reporting cycles is further illustrated in Figure 12.14.

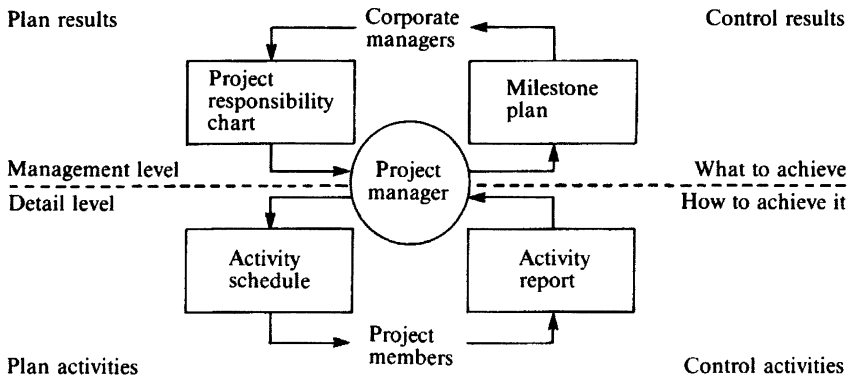

Figure 12.14 Nesting of control cycles in the work breakdown structure

12.9 Summary

1. The process of resourcing a project includes the following steps:
   - identify what is to be achieved
   - identify the skills and skill types required
   - identify the people available
   - assess their competence
   - identify any training required
   - negotiate with the resource provider
   - ensure appropriate project facilities are available.
2. The five steps of activity planning are:
   - define the activities to achieve a milestone or work package
   - ratify the people involved
   - define their roles and responsibilities
   - estimate work-content and durations
   - schedule activities within a work package.

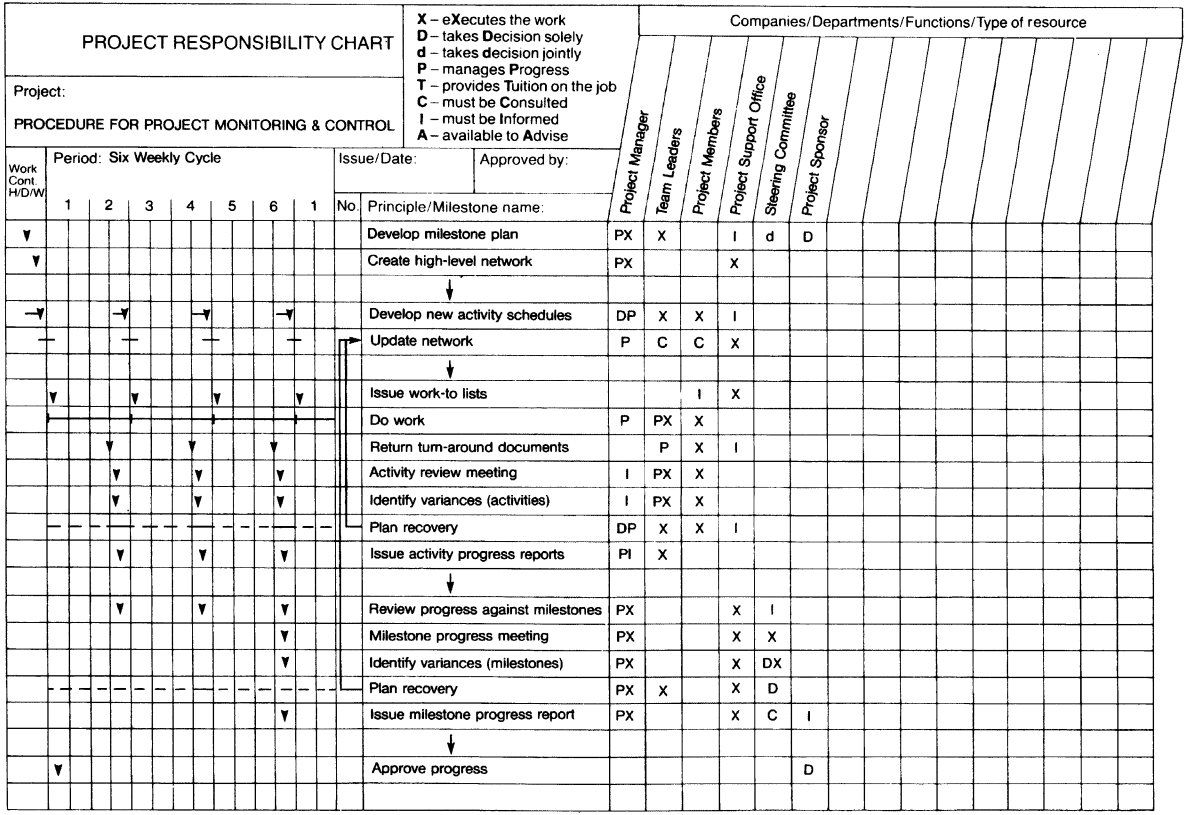

Figure 12.13 Procedure for monitoring and control

3. After creation of the activity schedule, it is entered into the master plan, and at appropriate intervals work is allocated to people. Both these steps must be authorized by the project manager.
4. Activity schedules may be represented by:
   - responsibility charts
   - estimating sheets
   - nested networks
   - nested bar charts.
5. Work is allocated to people via work-to lists, by:
   - time period
   - work package.
6. The four steps in the control cycle are:
   - plan future performance
   - monitor achievement against plan
   - calculate variances and forecast out-turn
   - taking action to overcome variances.
7. For control to be effective, each step in this cycle must be effective. Requirements for effective planning have already been described, and in particular are stated in the five principles of project management at the end of Chapter 4.
8. Requirements for effective reporting include:
   - reports against the plan
   - defined criteria for control
   - simple, friendly tools
   - reporting at defined intervals
   - formal review meetings
   - creative discussions.
9. This can be achieved by gathering data using turn-around documents, which can be used to gather data to control the five objectives:
   - time
   - cost
   - quality
   - organization
   - scope.
10. Time is controlled by recording progress on the critical or near-critical paths, or by comparing the cost of work actually completed to that planned to have been completed. In order to do this, the following progress data is collected:
    - revised start/finish
    - actual start/finish
    - effort to date
    - effort remaining

- costs to date
- costs remaining.

11. Cost is controlled by comparing costs incurred to the planned cost of work actually completed. In order to do this, the same data is required. Costs are said to be incurred when the expenditure is committed, not when the invoices are paid, because at that time the plan can still be recovered.
12. S-curves provide a visual representation of progress against both cost and time.
13. When the divergence of achievement from the plan becomes too great, the project must be recovered. The ten-step problem solving cycle can be applied to find the solution to plan recovery. Possible courses of action include:
    - rearranging the plan
    - compromising time
    - compromising cost
    - compromising scope
    - aborting the project.

References

1. Machiavelli, N., *The Prince*, 1514, reprinted, Penguin, 1961, Chapter 3.
2. Brooks, F.P., *The Mythical Man-Month,* Addison-Wesley, 1974.

Note

a. Section 12.7 incorporates material from the first edition based on a contribution originally made by Dr Mahen Tampoe, associate of Henley Management College.