

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 to achieve each milestone* 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 skills. There is a danger, especially with a fixed project team, of selecting somebody to do work because he or she is available, not because he or she has 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. A leading engineering company in the United Kingdom has a committee with responsibility for scanning the functional organization to identify the best people to work on projects (Turner et al., 2008). There are three reasons to ensure the best people are identified to work on projects: for the sake of the organization, so good people are developed to work on and manage projects; for the sake of their career development; and to stop selfish functional managers from holding good people in dead-end functional jobs. 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 her or his time on normal duties.
4. *Assess the competence of the people available* to identify any shortfall in skills. Even after the selection of people with the correct skills, there may not be a perfect match to requirements. Figure 17.1 illustrates how this can be plotted. You plot the competencies required to undertake the project against some competency model. This may be the PMI PMBoK (Project Management Institute, 2013), the IPMA ICB (International Project Management Association, 2005) or national equivalent (Association for Project Management, 2008), or the company's own competence model for project managers (Turner et al., 2008). You then plot the competencies of the chosen team members. Figure 17.1 shows that team member 1 covers around one-half of the required competence and team member 2 most of the rest. They have a small area of overlap, but there is also a small area where neither of them meets the need. This can be overcome by appointing a third person to the team or by giving the two team members training.
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. In Fig. 17.1, team member 1 can

Planning a

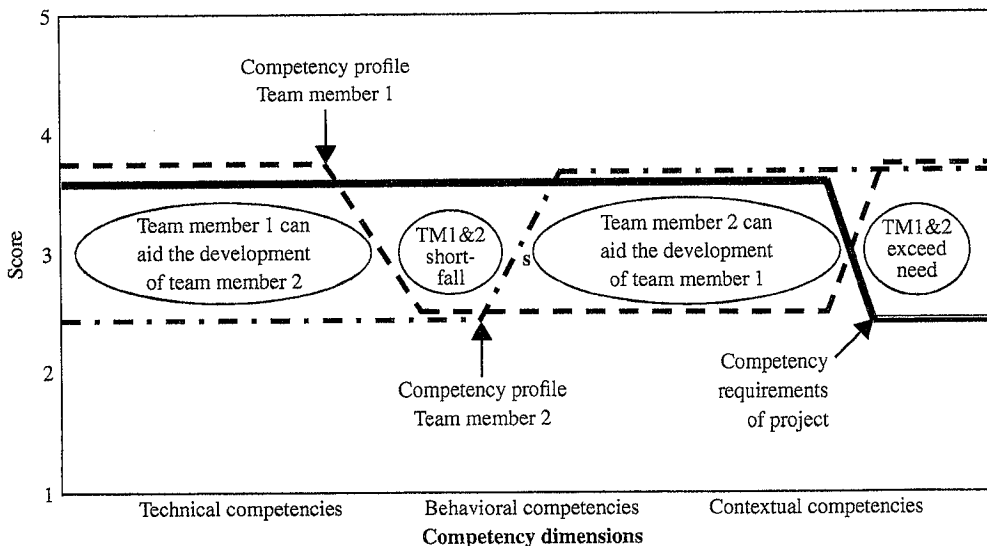


FIGURE 17.1 Matching the competence of team members to the needs of the project schedule.

provide on-the-job guidance to team member 2 where his or her competence is greater and vice versa.

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 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 may 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 appropriate facilities and equipment are available.* Facilities may include office space, meeting rooms, security arrangements, and transport. Equipment may include computers, computer software (including word processing, spreadsheets, and project management information systems), telephone, Internet access, and e-mail.

### Planning and Scheduling Activities

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. I did suggest in Sec. 8.4 that you can create a preliminary activity definition through work-package scope statements for early estimating.

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 that 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 percent of the work. In those circumstances the last activity often takes 80 percent of the effort.
  - *Have average duration roughly equal to the frequency of review* (Sec. 9.1).
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 (Fig. 17.1).
3. *Define roles and responsibilities.* The involvement of each team member in the activities is then identified. A responsibility chart can be a useful tool for this (Fig. 9.6).
4. *Estimate work content and durations.* The work content and durations are estimated by applying the processes used on 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 (Fig. 17.2) or bar chart (Fig. 17.3).

If you adopt rolling-wave planning, estimates of work content and duration at the activity level will be made at a later stage 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 outturns for the total project after activity estimating should fall within the range after work-package estimating (Fig. 15.2). If the estimates consistently fall outside the range of those prepared at the work-package level, then the estimating data used for the latter need to be improved. It is therefore important to feed the results back to the estimators so that they can improve their data.

If it is not possible to schedule the activities to deliver the milestone on time (subject to the allowable error), then 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.

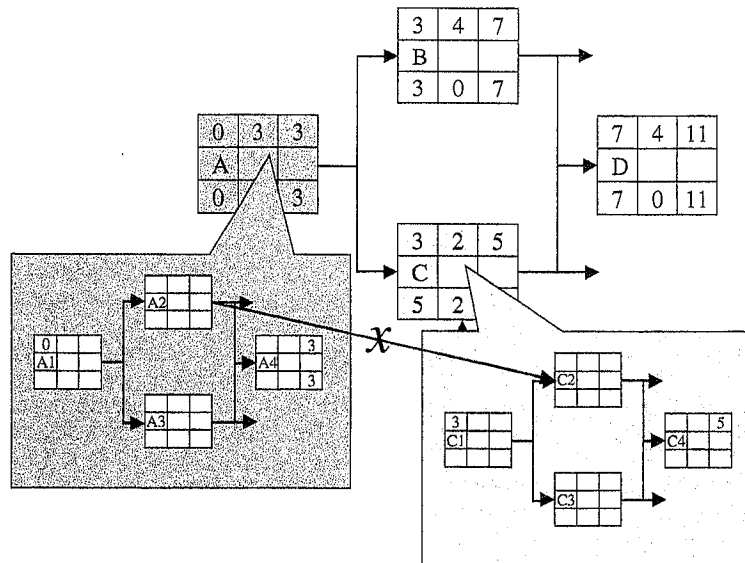


FIGURE 17.2 Nested networks.

### Allocating Work

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

1. *Work package.* The persons or resources are given the activity schedules for all work packages on which they are working, as a responsibility chart or estimating sheet.
2. *Time period.* They are given a listing of the activities they are assigned to for a given period of time from all work packages they are working on. The period is typically the current control period and one or two periods into the future. 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 (Fig. 9.6) or output from a computer system (Table 17.1). It is now quite common for the output to be sent from the master plan to the individual's workstation electronically, and it 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



TABLE 17.1 Computer-Generated Work-to List and Time Sheet

Act no.	Description	Orig dur (d)	Rem dur (d)	Sched start	Sched finish	Actual start	Actual finish	M (h)	Tu (h)	W (h)	Th (h)	F (h)	WE (h)	Work rem (h)
S31	Identify jobs	5		Feb. 2	Feb. 6	Feb. 2	Feb. 6							
S32	Specify skills	15		Feb. 9	Feb. 27	Feb. 9								
S33	Specify experience	15	5	Feb. 9	Feb. 27	Feb. 9								
S34	Specify personality	15	6	Feb. 9	Feb. 27	Feb. 9								
S35	Determine competence	5	5	Feb. 23	Feb. 27	Feb. 27								
S36	Essential competencies	5	5	Feb. 23	Feb. 27	Feb. 27								
S37	Determine assessment	5	5	Feb. 23	Feb. 27	Feb. 27								
S38	Consultation	20	20	Mar. 2	Mar. 27									
S39	Approve final version	1	1	Mar. 30	Mar. 30									

At the end of the control period the work-to list will become a *turnaround document* (Sec. 17.2) through which the project team reports 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 (Fig. 16.1).

## 17.2 CONTROLLING PROGRESS

Everything I have covered up to this point has brought us to the point where we are doing work. As the work is done, we must ensure we achieve the planned results; that we deliver the new asset and desired changes and performance improvement to the desired specification, and within the cost and time at which it was thought to be worthwhile. Furthermore, as the project output 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. As we have seen several times up to now, there are four essential steps to the control process (Fig. 11.2):

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, I deal with the other three steps in turn. I start by explaining the requirements for effective control.

### Effective Control

For control to be effective, each step in this four-step process must be effective.

**Effective Planning.** 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, then 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 authorize them before they are included in the master plan. Work is done against current work-to lists, issued regularly.

**Effective Reporting.** There are six requirements for effective reporting.

1. *Reports should be made against the plan.* To ensure people are interpreting the reports in the same way, the reports should be made against the plan. Example 3.6 describes a case in which the project manager and team members were working on 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. Turnaround documents are a tool for reporting against the plan.
2. *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 a set of closed 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 below.
3. *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 time, people rightly complain they are being distracted from productive work (Example 17.1). Simple, friendly tools means single-page reporting nested in the work breakdown structure (WBS) and reports against the plan

with defined criteria requiring numeric or yes/no answers. Reports are often filed against work-to lists. These are *turnaround documents*. The work-to list contains space for the report, and is returned at the end of the reporting period (Table 17.1).

**Example 17.1** Simple, Friendly Tools

I used to work on ammonia plant overhauls, each a 4-week project. Every day, supervisors came to a 1-hour control meeting in the morning, a 2-hour meeting in the afternoon, and spent 1 hour after work completing daily returns. They quite reasonably complained that they should spend more time on the patch motivating their workers.

4. *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 and accurately. The frequency of the reporting period depends on
  - The length of the project
  - The stage in the project
  - The risk and consequence of failure

On a year-long project, you may report fortnightly at the activity level. In areas of high risk, you may report more often. Toward the end you may report weekly or even daily.

5. *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. To keep the meetings short and effective, the discussion should focus on identifying problems, and responsibility for solving them, but the meeting should not attempt to solve the problem.
6. *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 ways of taking effective timely action.

**Effective Reviews.** Using the data, the team determines whether the project is behaving as predicted and if not, calculates the size and impact of the variances. The two quantitative measures of progress are cost and time, and so they receive the greatest attention. The team uses the reports to forecast time and cost at completion, and calculates any differences 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 fulfill 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 functions of project management. 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 taking timely effective action to stop them from getting worse and preferably reducing or eliminating them.

## Gathering Data

The first step in the control process is to gather data on progress. These are usually collected at the activity level but may be collected at the work-package or task level. When collected at a lower level, the data can be aggregated to report at a higher level. The use of these data in the control process is described below.

I said above that data are most effectively gathered against defined criteria using turnaround documents and work-to lists issued at the start of the reporting period and used at the end of the period to gather data. Turnaround 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 use a data projector to project the turnaround document onto a whiteboard. The team can fill in the

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document on the board in a group meeting. This process encourages creative discussions to identify any problems, but also enables the meeting to be kept short. Figure 17.4 is a manual turnaround document encompassing the activity schedule from Fig. 9.6. Table 17.2 contains a computer-generated turnaround document. Figure 17.5 is a turnaround document at the milestone level.

The required time and cost data can be gathered using people's time sheets. At the start of the week, individuals are given blank time sheets listing the activities they should be working on day by day; they enter the amount of time spent working on each activity, and at the end of the time period they enter the amount of time left to work on each activity:

- The first time he or she books time against an activity is actual start.
- Total time booked gives effort to date.
- Effort remaining is entered at the end of the period.
- When this is zero, you can look back to find the last time he or she entered time against the activity for actual completion.
- Forecast completion can be extrapolated from effort to date and effort remaining.

### Calculating Progress

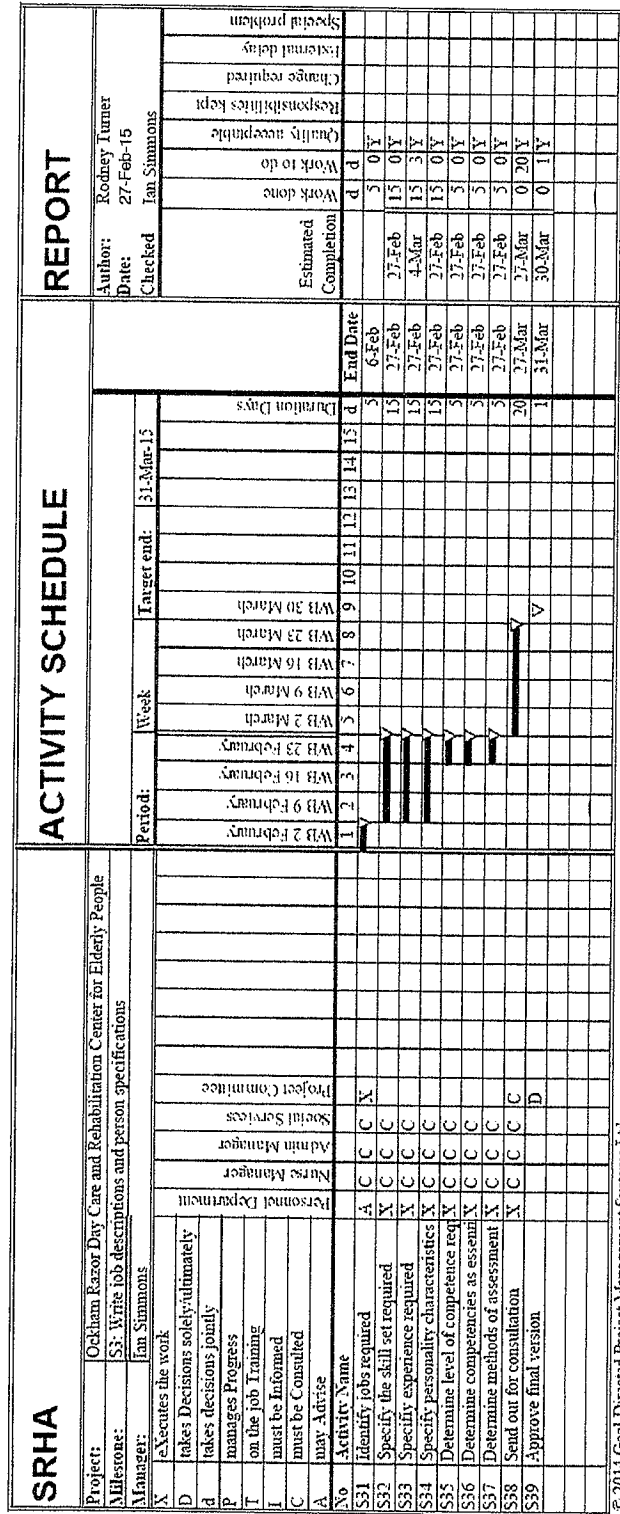
The data gathered are used to calculate progress on all seven project management functions: time, cost, quality, project organization, stakeholder satisfaction, scope, and risk. In particular, with the first two we try to forecast the final outturn, the time and cost to completion, as this gives better control than reporting the actual time and cost to date. This concept is part of the forward-looking control. This is an important principle of project management—you can control only the future, not the past. The only value of the past is to give you information to help you control the future. But you cannot undo the past; all you can influence is the future, and so it is the future you need to control. You drive by focusing on the road ahead, not by constantly looking in the rearview mirror. Thus we try to forecast time and cost to completion.

**Forecasting Time to Completion.** Time is the simplest function to monitor, and that is perhaps why it receives the greatest attention. All you have to do is to schedule the rest of the project in the same way you scheduled it initially. Tracked bar charts and milestone tracker charts (Fig. 13.15) help in this process. If critical milestones have been delayed, or if the critical path has been delayed (and no other path has become "more critical"), then likely 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.* If there is a consistent estimating error, this will be indicated by a trend. The estimates of duration can be revised accordingly.

*By indicating the cause of delays.* Table 17.3 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 is over budget, in which case there may be minor errors but the team is coping, perhaps by working unplanned overtime. The project may be late but no additional effort has been expended. Then the cause of the delay must be due to external factors—perhaps other people failing to fulfill their responsibilities, late delivery of some materials, or the project team members have been occupied on work of higher priority (to them). 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. A trend will indicate the first as described above, and so you will need to monitor effort and duration over several reports. You can see from Table 17.3 how the complete set of control data can help initiate discussion over the likely causes of delays, and help in their elimination.

*Through the earned value calculation.* The schedule variance, calculated as part of the cost control process (Sec. 12.4), will indicate whether the project is on average ahead or behind schedule.

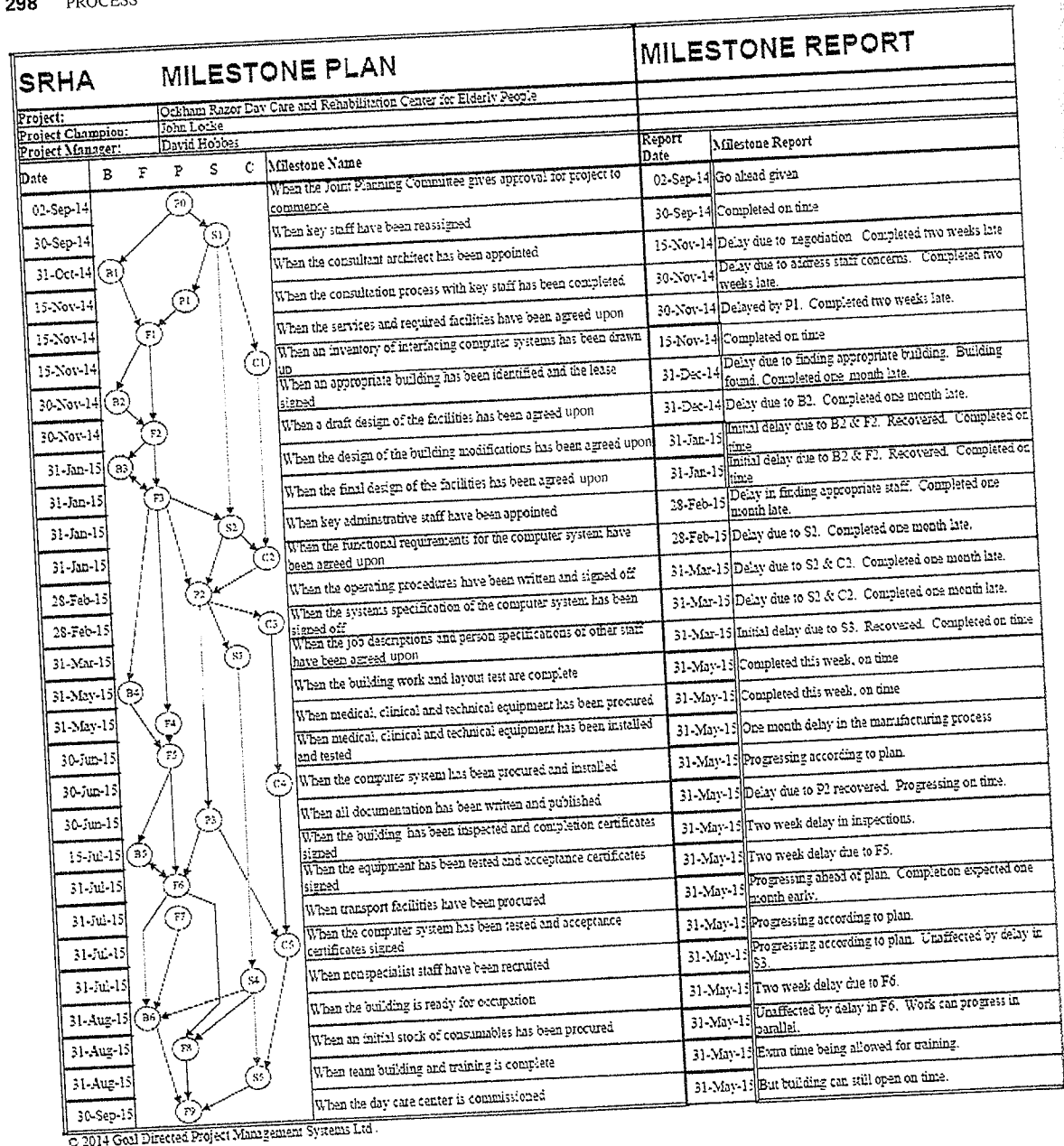


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FIGURE 17.4 Manual turnaround document encompassing the activity schedule.

TABLE 17.2 Computer-Generated Turnaround Document and Time Sheet

Act no.	Description	Orig dur (d)	Rem dur (d)	Sched start	Sched finish	Actual start	Actual finish	M (h)	Tu (h)	W (h)	Th (h)	F (h)	WE (h)	Work rem (h)
S31	Identify jobs	5		Feb. 2	Feb. 6	Feb. 2	Feb. 6							
S32	Specify skills	15		Feb. 9	Feb. 27	Feb. 9	Feb. 25	6	6	6			18	0
S33	Specify experience	15	5	Feb. 9	Feb. 27	Feb. 9	Feb. 25	6	6	8	7		21	6
S34	Specify personality	15	6	Feb. 9	Feb. 27	Feb. 9	Feb. 25	5	6	3	3		17	0
S35	Determine competence	5	5	Feb. 23	Feb. 27	Feb. 23	Feb. 23	8					8	0
S36	Essential competencies	5	5	Feb. 23	Feb. 27	Feb. 23	Feb. 24		8				8	0
S37	Determine assessment	5	5	Feb. 23	Feb. 27	Feb. 23	Feb. 25			8			8	0
S38	Consultation	20	20	Mar. 2	Mar. 27	Feb. 25	Feb. 25						8	0
S39	Approve final version	1	1	Mar. 30	Mar. 30	Mar. 27	Mar. 27			8			8	0



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 FIGURE 17.5 Turnaround document at the milestone level.

**TABLE 17.3** Determining the Cause of Delays by Comparing Effort and Completion Dates

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

**Forecasting Cost to Completion.** I showed in Sec. 12.4 how to use the cost data gathered to forecast the cost at completion:

$$\text{Forecast cost at completion} = \text{actual cost to date} + \text{forecast cost remaining}$$

This adheres to the principle of forward-looking control. I described this more fully in Sec. 12.4. The S curve (Fig. 12.8) provides a highly visual representation of the progress to date.

**Controlling Quality.** Data gathered can show where deviations have occurred from the specification. These quality variances may be identified as part of the quality control process or may be noticed by team members.

**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 upon in the responsibility chart. Table 17.3 also shows how the control process can indicate the impact of these organizational delays on time and cost.

**Satisfaction of Stakeholders.** This is difficult to monitor but is the second-to-last step in the stakeholder engagement process (Fig. 10.2). You need to work closely with the stakeholders and in that way try to judge their satisfaction. You can also conduct marketing surveys, or just ask them directly if they are happy.

**Controlling Scope.** 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 17.3). 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 nonfinancial. The latter includes safety.
6. Accept or reject the change based on marginal investment criteria. A return of 40 percent per annum is possible for marginal criteria compared to 20 percent for the project as a whole.

If this procedure is applied rigorously, many changes do not get past step 3. Table 17.3 is a form to aid this process.

**Monitoring Risk.** Finally you need to monitor risk. You should review the risk register (Table 14.4) regularly, focusing on those risks that may occur in the near future. Consider whether anything has happened to raise or lower the likelihood or consequence of a risk, and so whether it has changed in its ranking in Fig. 14.1.

**TABLE 17.4** Change Control Form

Project:			
Milestone:			
Activity:			
Description of change:			
Impact of change:			
Cost of change:			
Value of change:			
Proposed by:	Name	Signature	Date
Checked by:	.....	.....	.....
Approved by:	.....	.....	.....

**Taking Action**

Once we have identified that a project is deviating from plan, we must take appropriate action. The earlier action is taken, the better, because it is cheaper to recover or abort the project should it prove nonviable.

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

**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 reaction is understandable, it is often wrong because of the emotional state of the team. Sometimes stock responses can initiate feedback loops that actually make the situation worse (Turner et al., 2010). Keep cool, calm, and collected. Remember the first law of holes: if you find yourself in a hole, stop digging (Example 17.2).

**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.

**Develop Options and Select a Likely Course.** Explore every avenue and develop a range of solutions. Establish decision criteria so options can be evaluated against agreed upon conditions. If necessary, return to the original financial evaluations, recost and retime each option, air them with the client, and then select one that meets the decision criteria.

**Win Support for the Chosen Option.** It is important that there is support from all those involved. There is hard work ahead, and uncommitted team members will falter at the first hurdle.

**Act.** Once the agreed upon course of action has been accepted, every effort must be made to implement it. Deviations from the agreed upon plan will only add to the confusion and make the situation worse.

**Continue to Monitor.** Monitor the impact of any actions to ensure they have the desired effect. If they do not, then the recovery process must be repeated.

**Example 17.2** If You Find Yourself in a Hole, Stop Digging

I was working for an IT vendor and came across a group of salespeople who seemed to be running around like headless chickens. So I asked them what the problem was. They said they were trying to prepare a bid for an order which, if they won it, would make them the largest

supplier for a certain line of equipment in Europe. But they said they were making no progress and looked as though they would not complete the bid on time. I suggested they treat the bid as a project and spend 3 days in a start-up workshop with me. They said they had no time to spend in a start-up workshop with me; they had a bid to prepare. I asked them if they were going to be successful. They said at the rate they were going, no! So I asked what had they to lose, and in fact they might save themselves heart attacks. So they came and spent 3 days with me in a start-up workshop, successfully won the bid, and became the largest supplier in Europe of that line of equipment.

### 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 project's objectives in a way that 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 resources either as overtime or as additional people, machines, or material to recover the lost time. This is usually the instant reaction to project delays. However, Brooks's law (1999) states

Adding resources to a late software project makes it later still.

So actually adding people can have the opposite of the desired effect. The rationale is that existing people must take time out to bring the new people up to speed. If you want to add people, you need to carve out a bit of the project and give it to them, rather than increase the number of people working on a bit of the project already underway.

**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 feasibility and communicated to the project team as part of the project strategy. Be careful about running activities in parallel, or "crunching the network." Turner et al. (2010) describe a case where overlapping activities cause interference between them, and that through feedback loops caused much greater delay.

**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 acquire 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 around." The fact is that once an organization makes an emotional commitment to a project, the organization 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. After 10,000 Americans had been killed, the government justified the continuation of the Vietnam war by saying, "Our boys shall not have died in vain." So 20,000 more Americans were killed, and eventually the

United States withdrew, and people realized the argument had been fallacious. Unfortunately I have heard people justify the continuation of the war in Afghanistan by saying, "Our boys shall not have died in vain." And so it goes. 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.

## SUMMARY

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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 as follows:
  - 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.
3. After the activity schedule is created, it is entered into the master plan, and at appropriate intervals work is allocated to people. Both steps must be authorized by the project manager.
4. Work is allocated to people via work-to lists by
  - Time period
  - Work package
5. The four steps in the control cycle are as follows:
  - Plan future performance.
  - Monitor achievement against plan.
  - Calculate variances and forecast outcome.
  - Take action to overcome variances.
6. For control to be effective, each step in this cycle must be effective. Requirements for effective planning have already been described, and in particular they are stated in the five principles of project management at the end of Chap. 3.
7. Requirements for effective reporting include these:
  - Reports against the plan
  - Defined criteria for control
  - Simple, friendly tools
  - Reporting at defined intervals
  - Formal review meetings
  - Creative discussions
8. This can be achieved by gathering data using turnaround documents, which can be used to gather data to control the five objectives:
  - Time
  - Cost
  - Quality
  - Organization
  - Scope

9. 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. To do this, the following progress data are collected:
- Actual start/finish
  - Revised start/finish
  - Effort to date
  - Effort remaining
  - Costs to date
  - Costs remaining
10. Cost is controlled by comparing costs incurred to the planned cost of work actually completed. To do this, the same data are 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.
11. When the divergence of achievement from the plan becomes too great, the project must be recovered. The 10-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