

Project Control and Evaluation



Every step taken up to now has been for one purpose—to achieve control of the project. This is what is expected of a project manager—that organization resources be managed in such a way that critical results are achieved.

However, there are two connotations to the word *control*, and it is important that we use the one that is appropriate in today's world. One meaning of *control* is that of domination, power, command. We control people and things through the use of that power. When we say “Jump,” people ask, “How high?” At least they used to. It doesn't work that well today.

I have previously discussed the fact that project managers often have a lot of responsibility but little authority. Let's examine that and see whether it is really a problem.

I have asked several corporate officers (presidents and vice presidents), “Since you have a lot of authority, does that authority guarantee that people will do what you want done?”

Uniformly, they answer, “No.”

“What *does* get them to do what you want done?”

“Well, in the end analysis, they have to want to do it,” they say.

“Then what does your authority do for you?” I ask.

“Well, it gives me the right to exercise sanctions over them, but that’s all.”

So we find that having authority is no guarantee that you will be able to get people to do your bidding. In the end, you have to get them to do it willingly, and that says you have to understand the motivations of people so that you can *influence* them to do what needs to be done.

A second kind of authority has to do with taking actions unilaterally—that is, without having to get permission first. In this sense of the word, we *do* have a lot of organizational problems. I meet project managers who have project budgets in the millions of dollars (as much as \$35 million in one case), yet who must have *all* expenditures approved. If a project plan and budget have been approved before the work was started, and if the project manager is spending within the approved limits of the plan, why should she have to get more signatures for approved expenditures? Only if a deviation from the plan is going to result should more signatures be needed, and then the plan should be revised to reflect those changes.

Consider the messages being sent to these managers. On the one hand, they are being told, “We trust you to administer \$35 million of our money.” On the other hand, they are told, “But when you spend it, you must have every expenditure approved by someone of higher authority.” One is a positive message: We trust you. The other is negative. Which do you think comes through loud and clear? You bet! The negative.

Interestingly, we complain that people in organizations won’t take more responsibility for themselves; then we treat them as though they are irresponsible and wonder why they don’t behave responsibly!

There are two kinds of authority: One is power over people, and the other is the ability to make decisions and to act unilaterally.

A negative message always takes priority over a positive one.

The first meaning of control has a power connotation. Another meaning is summed up by the highlighted definition. This definition was introduced in an earlier chapter. Control is the act of comparing progress to plan so that corrective action can be taken when a deviation from planned performance occurs. This definition implies the use of *information* as the primary ingredient of control, rather than power. Thus, we talk about management information systems, and, indeed, these are the essence of what is needed to achieve control in projects.

control: to compare progress against plan so that corrective action can be taken when a deviation occurs

Unfortunately, many organizations have management information systems that are good for tracking inventory, sales, and manufacturing labor but not for tracking projects. Where such systems are not in place, you will have to track progress manually.

Achieving Team Member Self-Control

Ultimately, the only way to control a project is for every member of the project team to be in control of his or her own work. A project manager can achieve control at the *macro* level only if it is achieved at the *micro* level. However, this does not mean that you should practice micro-managing! It actually means that you should set up conditions under which every team member can achieve control of his or her own efforts.

To do this requires five basic conditions. These are shown separately. To achieve self-control, team members need:

- ▶ A clear definition of what they are supposed to be doing, with the purpose stated.
- ▶ A personal plan for how to do the required work.

- ▶ Skills and resources adequate to the task.
- ▶ Feedback on progress that comes directly from the work itself.
- ▶ A clear definition of their authority to take corrective action when there is a deviation from plan (and it cannot be zero!).

The first requirement is that every team member be clear about what her objective is. Note the difference between tasks and objectives, which was discussed in chapter 4. State the objective and explain to the person (if necessary) what the *purpose* of the objective is. This allows the individual to pursue the objective in her own way.

The second requirement is for every team member to have a personal plan on how to do the required work. Remember, if you have no plan, you have no control. This must apply at the individual as well as at the overall project level.

The third requirement is that the person have the skills and resources needed for the job. The need for resources is obvious, but this condition suggests that the person may have to be given training if she is lacking necessary skills. Certainly, when no employee is available with the required skills, it may be necessary to have team members trained.

The fourth requirement is that the person receive feedback on performance that goes directly to her. If such feedback goes through some roundabout way, she cannot exercise self-control. To make this clear, if a team member is building a wall, she can measure the height of the wall, compare it to the planned performance, and know whether she is on track.

The fifth condition is that the individual must have a clear definition of her authority to take corrective action when there is a deviation from plan, and it must be greater than zero authority! If she has to ask the project manager what to do every time a deviation occurs, the project manager is still controlling. Furthermore, if many people have to seek approval for every minor action, this puts a real burden on the project manager.

Characteristics of a Project Control System

The control system must focus on project objectives, with the aim of ensuring that the project mission is achieved. To do that, the control system should be designed with these questions in mind:

- ▶ What is important to the organization?
- ▶ What are we attempting to do?
- ▶ Which aspects of the work are most important to track and control?
- ▶ What are the critical points in the process at which controls should be placed?

Control should be exercised over what is important. On the other hand, what is controlled tends to become important. Thus, if budgets and schedules are emphasized to the exclusion of quality, only those will be controlled. The project may well come in on time and within budget, but at the expense of quality. Project managers must monitor performance carefully to ensure that quality does not suffer.

Taking Corrective Action

A control system should focus on response—if control data do not result in action, then the system is ineffective. That is, if a control system does not use deviation data to *initiate corrective action*, it is not really a control system but simply a monitoring system. If you are driving and realize that you have somehow gotten on the wrong road but do nothing to get back on the right road, you are not exercising control.

One caution here, though. I once knew a manager whose response to a deviation was to go into the panic mode and begin micro-managing. He then got in the way of people trying to solve the problem and actually slowed them down. Had he left them alone, they would have solved their problem much faster.

Timeliness of Response

The response to control data must be timely. If action occurs too late, it will be ineffective. This is frequently a serious problem. Data on project status are sometimes delayed by four to six weeks, making them useless as a basis for taking corrective action. Ideally, information on project status should be available on a *real-time* basis. In most cases, that is not possible. For many projects, status reports that are prepared weekly are adequate.

Ultimately, you want to find out how many hours people *actually* work on your project and compare that figure to what was *planned* for them. This means that you want accurate data. In some cases, people fill out weekly time reports without having written down their working times daily. That results in a bunch of fiction, since most of us cannot remember with any accuracy what we did a week ago.

As difficult as it may be to do, you need to get people to record their working times daily so that the data will mean something when you collect them. What's in it for them? Perhaps nothing. Perhaps future estimates will be better as a result of collecting accurate information on this project. In any case, you need accurate data, or you may as well not waste your time collecting them.

When information collection is delayed for too long, the manager may end up making things worse, instead of better. Lags in feedback systems are a favorite topic for systems theorists. The government's attempts to control recessions and inflation sometimes involve long delays, as a result of which the government winds up doing the exact opposite of what should have been done, thereby making the economic situation worse.

There is one point about control that is important to note. If every member of the project team is practicing proper control

When people fill out time reports weekly, without writing down what they did daily, they are making up fiction. Such made-up data are almost worse than no data at all.

methods, then reports that are prepared weekly are just checks and balances. This is the desired condition.

Designing the Right System

One system is not likely to be correct for all projects. It may need to be scaled down for small projects and beefed up for large ones. Generally, a control system adequate for a large project will overwhelm a small one with paperwork, while one that is good for small projects won't have enough "clout" for a big project.

Practicing the KISS Principle

KISS stands for "Keep it simple, stupid!" The smallest control effort that achieves the desired result should be used. Any control data that are not essential should be eliminated. However, as was just mentioned, one common mistake is to try to control complex projects with systems that are *too simple!*

To keep control simple, it is a good idea to check periodically that reports that are generated are actually being used for something by the people who receive them. We sometimes create reports because we believe the information in them should be useful to others, but if the recipients don't actually use it, we kid ourselves. To test this point, send a memo with each report telling people to let you know whether they want to receive future reports; if you do not hear from them, their names will be removed from the distribution. You may be surprised to find that *no one* uses some of your reports. Those reports should be dropped completely.

No problem is so big or so complicated that it can't be run away from.

—Charlie Brown (Charles Schultz, *Peanuts*)

Project Review Meetings

There are two aspects to project control. One can be called maintenance, and the other aims at improvement of performance. The maintenance review just tries to keep the project on track. The

improvement review tries to help project teams improve performance. Three kinds of reviews are routinely conducted to achieve these purposes. They are:

- ▶ Status reviews
- ▶ Process or lessons-learned reviews
- ▶ Design reviews

Everyone should do status and process reviews. Design reviews, of course, are appropriate only if you are designing hardware, software, or some sort of campaign, such as a marketing campaign.

A status review is aimed at maintenance. It asks where the project stands on the PCTS measures that we have used throughout this book. Only if you know the value of all four of these can you be sure where you are. This is the subject of the next chapter.

Process means the way something is done, and you can be sure that process always affects task performance. That is, *how* something is done affects the outcome. For that reason, process improvement is the work of every manager. How this is done is covered in the next section.

Project Evaluation

As the dictionary definition says, to evaluate a project is to attempt to determine whether the overall status of the work is acceptable, in terms of intended value to the client once the job is finished.

Project evaluation appraises the progress and performance of a job compared to what was originally planned. That evaluation provides the basis for management decisions on how to proceed with the project. The evaluation must be credible in the eyes of everyone affected, or decisions based on it will not be considered

**e•val•u•ate: to
determine or judge
the value or worth of**

—*The Random House
Dictionary*

valid. The primary tool for project evaluation is the *project process review*, which is usually conducted at major milestones throughout the life of the project.

Purposes of Project Evaluation

Sports teams that practice without reviewing performance may get really *good* at playing very *badly*. That is why they review game films—to see where they need to improve. In other words, the purpose of a review is to learn lessons that can help the team to avoid doing things that cause undesired outcomes and to continue those that help. The review should be called a *lessons-learned* or *process review*.

I have deliberately avoided the word *audit*, because nobody likes to be audited. Historically, an audit has been designed to catch people doing things they shouldn't have done so that they can be penalized in some way. If you go around auditing people, you can be sure they will hide from you anything they don't want you to know, and it is those very things that could help the company learn and grow.

As Dr. W. Edwards Deming has pointed out in his book, *Out of the Crisis*, there are two kinds of organizations in this world today—those that are getting better and those that are dying. An organization that stands still is dying. It just doesn't know it yet.

The reason? The competition is not sitting by idly. It is doing new things, some of which may be better than yours. If you aren't improving, you will be passed by, and soon you won't have a market.

The same is true of every part of an organization. You can't suboptimize, improving just manufacturing. You have to improve every department, and that includes how you run projects.

In fact, good project management can give you a real competitive advantage, especially in product development. If you are sloppy in managing your projects, you don't have good control of development

Good management of projects can give you a competitive advantage.

costs. That means that you have to either sell a lot of product or charge large margins to cover your development costs so that the project is worth doing in the first place. If you can't sell a lot of widgets, then you have to charge the large margin.

If your competitor, on the other hand, has good cost control, it can charge smaller margins and still be sure that it recovers its investment and makes money. Thus, it has a competitive advantage over you because of its better *control* of project work.

Additionally, in order to learn, people require feedback, like that gained by a team from reviewing game films. The last phase of a project should be a final process review, conducted so that the management of projects can be improved. However, such a process review should not be conducted only at the end of the project. Rather, process reviews should be done at major milestones in the project or every three months, whichever comes first, so that learning can take place as the job progresses. Furthermore, if a project is getting into serious trouble, the process review should reveal the difficulty so that a decision can be made to continue or terminate the work.

In order to learn, we must have feedback. Furthermore, we tend to learn more from mistakes than from successes, painful though that may be to admit.

Following are some of the general reasons for conducting periodic project process reviews. You should be able to:

- ▶ Improve project performance together with the management of the project.
- ▶ Ensure that quality of project work does not take a back seat to schedule and cost concerns.
- ▶ Reveal developing problems early so that action can be taken to deal with them.
- ▶ Identify areas where other projects (current or future) should be managed differently.

- ▶ Keep client(s) informed of project status. This can also help ensure that the completed project will meet the needs of the client.
- ▶ Reaffirm the organization's commitment to the project for the benefit of project team members.

Conducting the Project Process Review

Ideally, a project process review should be conducted by an independent examiner, who can remain objective in the assessment of information. However, the process review must be conducted in a spirit of learning, rather than in a climate of blame and punishment. If people are afraid that they will be “strung up” for problems, then they will hide those problems if at all possible.

Even so, openness is hard to achieve. In many organizations, the climate has been punitive for so long that people are reluctant to reveal any less-than-perfect aspects of project performance. Dr. Chris Argyris, in his book, *Overcoming Organizational Defenses*, has described the processes by which organizations continue ineffective practices. All of them are intended to help individuals “save face” or avoid embarrassment. In the end, they also prevent organizational learning.

Process reviews conducted as witch-hunts will produce witches.

Two questions should be asked in the review. The first is, “What have we done well so far?” and the second is, “What do we want to improve (or do better) in the future?” Notice that I am not asking, “What have we done badly?” That question serves only to make everyone defensive, because they assume that you will punish them for things done wrong. Furthermore, there is always the possibility that nothing has been done wrong, but there is always room to improve.

Finally, the results of the review should be published. Otherwise, the only people in the organization who can take advantage of it are the members of the team just reviewed. If other teams

know what was learned, then they can benefit from that information. In the next section, we look at what the report should contain.

The Process Review Report

A company may decide to conduct process reviews in varying degrees of thoroughness, from totally comprehensive, to partial, to less formal and cursory. A formal, comprehensive process review should be followed by a report. The report should contain as a minimum the following:

- ▶ *Current project status.* The best way to do this is to use earned value analysis, as presented in the following chapter. However, when earned value analysis is not used, status should still be reported with as great accuracy as possible.
- ▶ *Future status.* This is a forecast of what is expected to happen in the project. Are significant deviations expected in schedule, cost, performance, or scope? If so, the report should specify the nature of the changes.
- ▶ *Status of critical tasks.* The report should describe the status of critical tasks, particularly those on the critical path. Tasks that have high levels of technical risk should be given special attention, as should those being performed by outside vendors or subcontractors, over which the project manager may have limited control.
- ▶ *Risk assessment.* The report should mention any identified risks that could lead to monetary loss, project failure, or other liabilities.
- ▶ *Information relevant to other projects.* The report should describe what has been learned from this process review that can/should be applied to other projects, whether in progress or about to start.
- ▶ *Limitations of the process review.* The report should mention any factors that may limit the validity of the process

review. Are any assumptions suspect? Are any data missing or perhaps contaminated? Was anyone uncooperative in providing information for the process review?

As a general comment, the simpler and more straightforward a project process review report, the better. The information should be organized so that planned versus actual results can be easily compared. Significant deviations should be highlighted and explained.

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Key Points to Remember

- ▶ The meaning of control that is important to project managers is the one implying the use of information; comparing progress to plan so that action can be taken to correct for deviations from plan.
 - ▶ The only way a project is really in control is if all team members are in control of their own work.
 - ▶ The effort used to control a project should be worthwhile. You don't want to spend \$100 to purchase a \$3 battery, for example.
 - ▶ If you take no action in response to a deviation, you have a *monitoring* system, not a control system.
 - ▶ Project working times must be recorded daily. If people wait a week to capture what they have done, they rely on memory and end up writing down *estimates* of what they did. Such data are no good for future estimating.
 - ▶ Project evaluation is done to determine whether a project should continue or be canceled. Process reviews also should help the team learn in order to improve performance.
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Project Control Using Earned Value Analysis

Control is exercised to achieve project objectives, and we know that there are performance, cost, time, and scope targets that are always important. Furthermore, we have seen that control is exercised by comparing performance to plan and, when deviations or *variances* occur, taking corrective action to bring performance back on target.

As I said in chapter 7, the review that is concerned with maintenance or straightforward project control is the *status* review. This review asks where the project is in terms of all four PCTS variables. Each time progress is reviewed, you must ask these three questions:

1. Where are we (in terms of PCTS)?
2. When there is a deviation, what caused it?
3. What should be done about the deviation?

Note that there are only four actions that can be taken (in response to question 3). These are:

1. Cancel the project.
2. Ignore the deviation.
3. Take corrective action to get back onto the planned progress.
4. Revise the plan to reflect a change in status that can't be corrected.

Sometimes a project gets so far off track that it is no longer viable, and the best thing to do is to cancel it. Of course, this step is not taken lightly, but it should be taken in cases where you are just going to throw good money after bad. Cut your losses and get on with something better.

As for ignoring a deviation, if you can control to within a certain percentage tolerance and you are within those limits, you should usually ignore a deviation unless it shows a trend that will definitely eventually take it outside the limits. Otherwise, tweaking may just make the situation worse.

As for taking corrective action, there is no way to tell what this means, as it is specific to each project. Sometimes working people overtime gets a project back on track. Or perhaps you need to add people, or cut scope, or change the process. You must determine what must be done for your project.

In the event that the project is still viable but nothing can be done to get it back on track, you may have to revise the plan. Of course, you can also consider working overtime or reducing scope, since these were not originally called for. What I am really referring to here, however, is a situation in which you cannot recover, and you are revising the plan to show that the costs will increase, the deadline will slip, or some other change to the plan will occur.

**Another day,
another zero.**

—Alfalfa (Carl Switzer)
Our Gang comedy series

Measuring Progress

One of the hardest things to do in managing projects is to actually *measure* progress. When you are following a road map, you monitor the road signs and see whether they agree with your planned route. In well-defined jobs, such as construction projects, it is generally fairly easy to tell where you are. You can measure the height of a brick wall or see whether all the conduit is installed, and so on. That is, you can tell where you are when a part of the work is actually *finished*. When work is poorly defined, and it is only partially complete, however, you have to *estimate* where you are.

This is especially true of knowledge work—work done with one’s head, rather than one’s hands. If you are writing software code, designing something, or writing a book, it can be very hard to judge how far along you are and how much you have left to do.

Naturally, if you can’t tell where you are, you can’t exercise control. And note that use of the word *estimate* in measuring progress. What exactly is an estimate?

It’s a guess.

And so we are guessing about where we are.

Yes. We’ll know where we are when we get there. Until we actually arrive, we’re guessing.

Does this not sound like something from *Alice in Wonderland*?
Heavens.

What was that definition of control again? Let’s see—compare where you are . . .

How do you know where you are?

We’re guessing.

. . . against where you are supposed to be. . . .

How do you know where you’re supposed to be?

Oh, that’s much easier. The plan tells us.

But where did the plan come from?

It was an estimate, too.

Oh. So if one guess doesn’t agree with the other guess, we’re

supposed to take corrective action to make the two of them agree, is that it?

That's what this guy Jim Lewis says in his book.

Must be a book on witchcraft and magic.

Well, since it is impossible to know for sure where we are, then perhaps we should just give up on the whole thing and keep running projects by the seat of the pants. Right?

Wrong.

The fact that measures of progress are not very accurate does not justify the conclusion that they shouldn't be used. Remember, if you have no plan, you have no control, and if you don't try to monitor and follow the plan, you definitely don't have control. And if you have no control, there is no semblance of managing. You're just flailing around.

What is important to note, however, is that some projects are capable of tighter control than others. Well-defined work, which can be accurately measured, can be controlled to tight tolerances. Work that is more nebulous (e.g., knowledge work) has to allow larger tolerances. Management must recognize this and accept it. Otherwise, you go crazy trying to achieve 3 percent tolerances. It's like trying to push a noodle into a straight line or nail jelly to a wall.

The difficulty of measuring progress does not justify the conclusion that it shouldn't be done. You cannot have control unless you measure progress.

Measuring Project Performance/Quality

If you think measuring progress is hard, try measuring quality. Were the bolts holding the steel beams together put in properly? Are all the welds sound? How do you tell?

This is the hardest variable to track, and one that often suffers as a consequence. Also, so much attention tends to be focused on cost and schedule performance that quality of the work is often sacrificed. This can be a disaster, in some cases resulting in the fil-

ing of lawsuits against a company for damages that result from poor quality.

Project managers must pay special attention to the quality variable, in spite of the difficulty of tracking it.

Earned Value Analysis

It is one thing to meet a project deadline at any cost. It is another to do it for a *reasonable* cost. Project cost control is concerned with ensuring that projects stay within their budgets, while getting the work done on time and at the correct quality.

One system for doing this, called *earned value analysis*, was developed in the 1960s to allow the government to decide whether a contractor should receive a progress payment for work done. The method is finally coming into its own outside government projects, and it is considered the correct way to monitor and control almost any project. The method is also called simply *variance analysis*.

Variance analysis allows the project manager to determine trouble spots in the project and to take corrective action. The following definitions are useful in understanding the analysis:

- ▶ *Cost variance*: Compares deviations and performed work.
- ▶ *Schedule variance*: Compares planned and actual work completed.
- ▶ *BCWS*: (Budgeted cost of work scheduled): The budgeted cost of work scheduled to be done in a given time period, or the level of effort that is supposed to be performed in that period.
- ▶ *BCWP*: (Budgeted cost of work performed): The budgeted cost of work actually performed in a given period, or the bud-

Work quality is most likely to be sacrificed when deadlines are tight. Constant attention is required to avoid this tendency.

geted level of effort actually expended. BCWP is also called *earned value* and is a measure of the dollar value of the work actually accomplished in the period being monitored.

- ▶ **ACWP:** (Actual cost of work performed): The amount of money (or effort) actually spent in completing work in a given period.

Variance thresholds can be established that define the level at which reports must be sent to various levels of management within an organization.

$$\begin{aligned}\text{Cost Variance} &= \text{BCWP} - \text{ACWP} \\ \text{Schedule Variance} &= \text{BCWP} - \text{BCWS} \\ \text{Variance: Any deviation from plan}\end{aligned}$$

By combining cost and schedule variances, an integrated cost/schedule reporting system can be developed.

Variance Analysis Using Spending Curves

Variances are often plotted using spending curves. A BCWS curve for a project is presented in Figure 9-1. It shows the *cumulative spending* planned for a project and is sometimes called a *baseline plan*.

In the event that software is not available to provide the necessary data, Figure 9-2 shows how data for the curve are generated. Consider a simple bar chart schedule. Only three tasks are involved. Task A involves forty labor-hours per week at an average loaded labor rate of \$20 per hour, so that task costs \$800 per week. Task B involves 100 hours per week of labor at \$30 per hour, so it costs \$3,000 per week. Finally, task C spends \$2,400 per week, assuming sixty hours per week of labor at \$40 per hour.

At the bottom of the chart we see that during the first week \$800 is spent for project labor; in the second week both tasks A and B are running, so the labor expenditure is \$3,800. In the third week, all three tasks are running, so labor expenditure is the sum of the three, or \$6,200. These are the *weekly* expenditures.

Figure 9-1. BCWS curve.

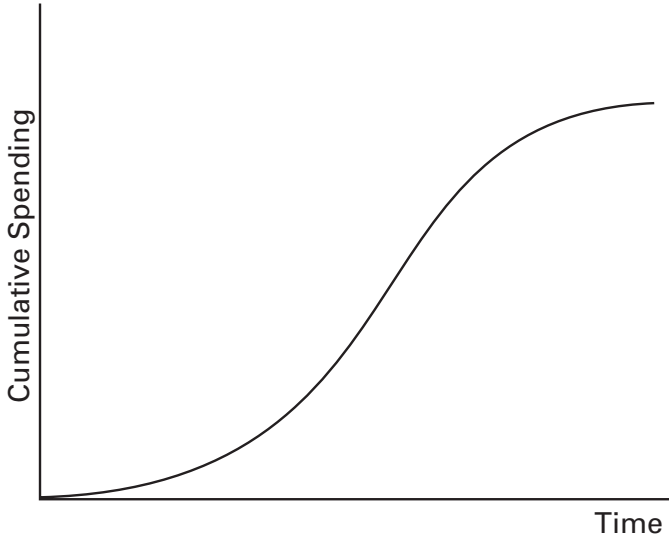


Figure 9-2. Bar chart schedule illustrating cumulative spending.

		(40 Hrs/Wk)(20 \$/Hr) = \$800/Wk						
Task A		(100 Hrs/Wk)(30 \$/Hr) = \$3,000/Wk						
Task B		(60 Hrs/Wk)(40 \$/Hr) = \$2,400/Wk						
Task C								
Weekly Spending	800	3,800	6,200	5,400	5,400	2,400	2,400	
Cumulative Spending	800	4,600	10,800	16,200	21,600	24,000	26,400	

The *cumulative* expenditures are calculated by adding the cost for each subsequent week to the previous cumulative total. These cumulative amounts are plotted in Figure 9-3. This is the spending curve for the project and is called a BCWS curve. Since it is derived directly from the schedule, it represents *planned performance* and therefore is called a *baseline plan*. Furthermore, since control is exercised by comparing progress to plan, this curve can be used as the basis for such comparisons so that the project manager can tell the status of the program. The next section presents examples of how such assessments are made.

Examples of Progress Tracking Using Spending Curves

Consider the curves shown in Figure 9-4. On a given date, the project is supposed to have involved \$40,000 (40K) in labor (BCWS). The actual cost of the work performed (ACWP) is 60K. These figures are usually obtained from Accounting and are derived from all the time cards that have reported labor applied to the project. Finally, the budgeted cost of work performed (BCWP) is 40K. Under these conditions, the project would be behind schedule and overspent.

Figure 9-5 illustrates another scenario. The BCWP and the ACWP curves both fall at the same point, 60K. This means that the project is ahead of schedule but spending correctly for the amount of work done.

Figure 9-3. Cumulative spending for the sample bar chart.

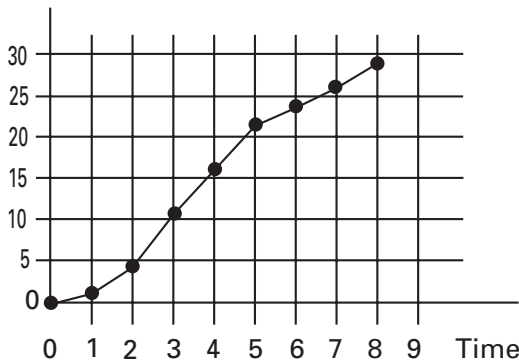
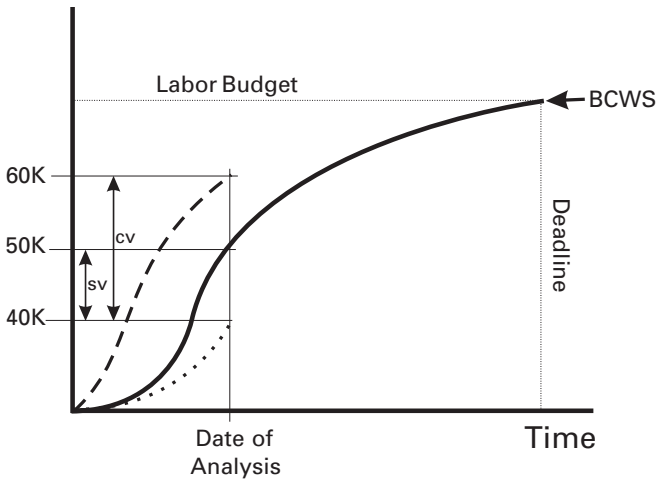
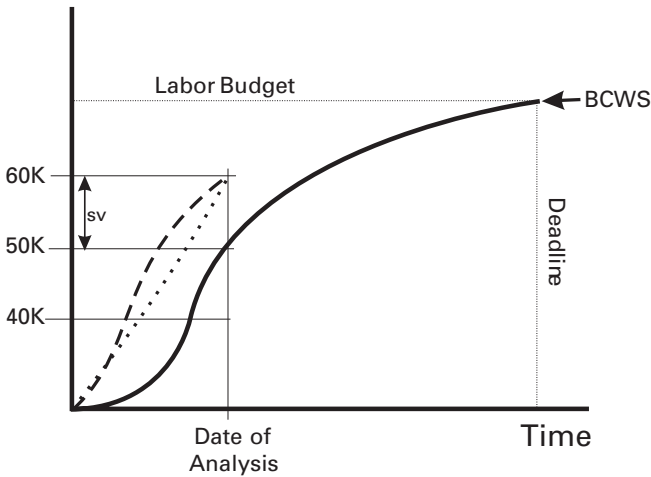


Figure 9-4. Plot showing project behind schedule and overspent.



cv = cost variance - - - - - ACWP
 sv = schedule variance BCWP

Figure 9-5. Project ahead of schedule, spending correctly.



cv = cost variance - - - - - ACWP
 sv = schedule variance BCWP

The next set of curves illustrates another status. In Figure 9-6, the BCWP and the ACWP curves are both at 40K. This means the project is behind schedule and under budget. However, because the manager spent 40K and got 40K of value for it, spending is correct for what has been done. There is a *schedule variance*, but not a spending variance.

Figure 9-7 looks like Figure 9-4, except that the ACWP and the BCWP curves have been reversed. Now the project is ahead of schedule and underspent.

Variance Analysis Using Hours Only

In some organizations, project managers are held accountable not for costs but only for the hours actually worked on the project and for the work actually accomplished. In this case, the same analysis can be conducted by stripping the dollars off the figures. This results in the following:

- ▶ BCWS becomes Total Planned (or Scheduled) Hours
- ▶ BCWP becomes Earned Hours (Scheduled hours × % work accomplished)
- ▶ ACWP becomes Actual Hours Worked

Using hours only, the formulas become:

$$\text{Schedule Variance} = \text{BCWP} - \text{BCWS} = \\ \text{Earned Hours} - \text{Planned Hours}$$

$$\text{Labor Variance} = \text{BCWP} - \text{ACWP} = \\ \text{Earned Hours} - \text{Actual Hours Worked}$$

Tracking hours-only does lead to one loss of sensitivity. ACWP is actually the composite of a labor rate variance times a labor-hours variance. When only labor-hours are tracked, you have no warning that labor rates might cause a project budget problem. Nevertheless, this method does simplify the analysis and presumably tracks the project manager only on what she can control.

Figure 9-6. Project is behind schedule but spending correctly.

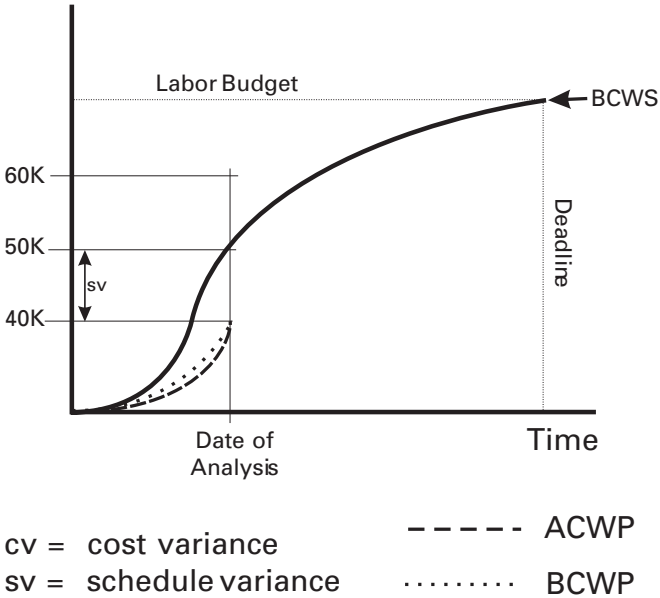
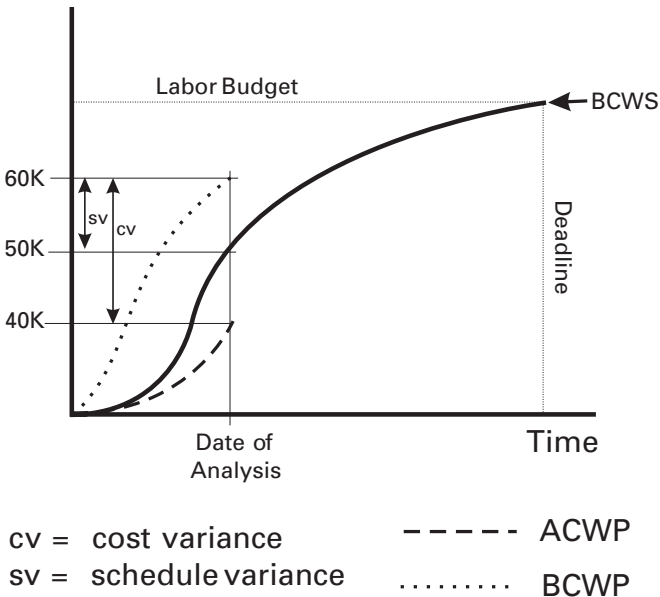


Figure 9-7. Project is ahead of schedule and underspent.



Responding to Variances

It is not enough to simply detect a variance. The next step is to understand what it means and what caused it. Then you have to decide what to do to correct for the deviation. Earlier I explained that there are four responses that can be taken when there is a deviation from plan. Which of these you choose will depend in part on what caused the deviation. Following are some general guidelines:

▶ When ACWP and BCWP are almost equal and larger than BCWS (see Figure 9-5), it usually means that extra resources have been applied to the project, but at the labor rates originally anticipated. This can happen in several ways. Perhaps you planned for weather delays, but the weather has been good and you have gotten more work done during the analysis period than intended, but at the correct cost. Thus, you are ahead of schedule but spending correctly.

▶ When ACWP and BCWP are nearly equal and below BCWS (see Figure 9-6), it usually means the opposite of the previous situation; that is, you have not applied enough resources. Perhaps they were stolen from you, perhaps it has rained more than you expected, or perhaps everyone has decided to take a vacation at once. The problem with being in this position is that it usually results in an overspend when you try to catch up.

▶ When ACWP is below BCWS and BCWP is above BCWS (see Figure 9-7), you are ahead of schedule and underspent. This generally happens because the original estimate was too conservative (probably padded for safety). Another possibility is that you had a lucky break. You thought the work would be harder than it was, so you were able to get ahead. Sometimes it happens because people were much more efficient than expected. The problem with this variance is that it ties up resources that could be used on other projects. The economists call this an *opportunity cost*. There is also a good chance that if you were consistently padding estimates and were bidding against other companies on projects, you probably lost

some bids. If your competitor is using average values for time estimates while you are padding yours, then your figures are likely to be higher, and you will lose the bid.

Acceptable Variances

What are acceptable variances? The only answer that can be given to this question is, “It all depends.” If you are doing a well-defined construction job, the variances can be in the range of $\pm 3\text{--}5$ percent. If the job is research and development, acceptable variances increase generally to around $\pm 10\text{--}15$ percent. When the job is pure research, the sky is the limit. Imagine, for example, that you worked for a pharmaceutical company and your boss said, “Tell me how long it will take and how much it will cost for you to discover and develop a cure for AIDS.”

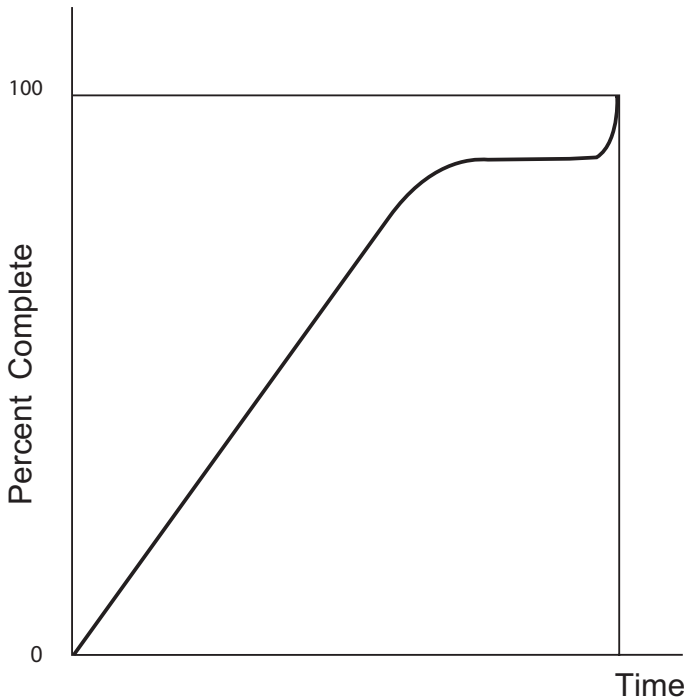
For every organization, you have to develop tolerances through experience. Then you start trying to reduce them. All progress is an attempt to reduce variation in what we do. We will never reduce it to zero, without eliminating the process altogether, but zero has to be the target.

Using Percentage Complete to Measure Progress

The most common way to measure progress is to simply estimate percentage complete. This is the BCWP measure, but BCWP is expressed as a dollar value, whereas percentage complete does not make that conversion.

When percentage complete measures are plotted over time, you tend to get a curve like the one shown in Figure 9-8. It rises more or less linearly up to about 80 or 90 percent, then turns horizontal (meaning no further progress is being made). It stays there for a while; then, all of a sudden, the work is completed.

The reason is that problems are often encountered near the end of the task, and a lot of effort goes into trying to solve them. During that time, no progress is made.

Figure 9-8. Percent complete curve.

Another part of the problem is in knowing where you are to begin with. We have already said that you are generally estimating progress. Consider a task that has a ten-week duration. If you ask the person doing that task where he is at the end of the first week, he is likely to tell you, “10 percent”; at the end of week two, “20 percent”; and so on. What he is doing is making a reverse inference. It goes like this. “It is the end of the first week on a ten-week task, so I must be 10 percent complete.” The truth is, he really doesn’t know where he is. Naturally, under such conditions, control is very loose. Still, this is the only way progress can be measured in many cases.

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Key Points to Remember

- ▶ Control is exercised by analyzing *variances* from the plan.
 - ▶ Well-defined projects can achieve tighter control over variations than poorly defined ones.
 - ▶ There is a tendency to sacrifice quality when deadlines are difficult to meet.
 - ▶ It is not enough to recognize a variance. Its cause must be determined so that corrective action can be taken.
 - ▶ Acceptable variances can be determined only through experience. Every system has a capability. Your team may have the ability to maintain better tolerances on their work than another team.
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Exercise

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Consider the report in Figure 9-9, showing earned value figures for a project. Answer the questions by analyzing the data. Answers are provided in the Answers section at the back of the book.

Figure 9-9. Earned value report.

WBS #	Cumulative-to-date			Variance		At Completion		
	BCWS	BCWP	ACWP	SCHED.	COST	BUDGET	L. EST.	VARIANCE
301	800	640	880	-160	-240	2,400	2,816	-416

Questions:

1. Is the task ahead or behind schedule? By how much?
2. Is the task overspent or underspent? By how much?
3. When the task is completed, will it be overspent or underspent?