



Cost, Schedule, *and* Resource Control

by Jim Borland

Probably no business needs an *effective* cost control system more than the construction business. CFMA's *1999 Construction Industry Annual Financial Survey* shows a composite, after-tax, net earnings of only 2% of revenue. Because construction companies operate on such a small profit margin, cost control cannot be over emphasized. Every dollar wasted on a job lowers before-tax earnings by one dollar.

Due to these low profit margins, construction companies must perform large dollar volumes of work in order to create adequate returns on their investment. This results in a substantial financial risk and, without adequate cost control, that risk is increased.

Cost estimating, planning, scheduling, and project control taken together form an integrated system of project management. A project control system is used throughout actual construction to monitor progress and help contractors finish projects on time and within budget.

To better understand this integration, let's examine the construction cycle. A job's cost estimate is prepared before getting the job and is based on historical cost data (i.e., knowing how much it cost to do similar work on previous jobs). If the contractor obtains the job, the estimate is then used as the basis for planning and scheduling.

During the construction process, the job is controlled by comparing actual progress to the plan. When a job is finished, the record of what was actually spent is used to update the historical cost database and adjust the unit prices. This cycle is ongoing; the next project will have a more accurate cost estimate due to efforts expended during the control phase of the previous job.

Project Control Systems

Project managers must control a job during the construction phase in order to complete it on time, within budget, and with the required quality. It's important to remember that project control is a process. If any of these three objectives begin to slip, the project control system should identify the deviation early and allow a correction to be made before it's too late.

A project control system has two main duties: **1)** to establish project standards (targets) for time and cost and **2)** to set up a system to measure actual performance and compare it to the targets. The *cost estimate* is used to establish the overall project budget (cost target); the *construction schedule* defines when specific work items need to be accomplished (time target). Project control depends on and is connected to the operations of cost estimating and scheduling.

During the construction phase, project managers measure performance (actual field data) against the plan and constantly ask questions like: "Are the project requirements being met? Do we need to modify the plan?" This project control cycle (or feedback loop) allows all participants to measure the success of their past decisions so that adjustments can be made and learning occur. Without it, people might continue to make the same mistakes over and over again.

The cost control element of project control operates on the premise that it is not acceptable to wait until a job is finished to find out the job's gross profit or loss. There *must* be an ongoing system in place to measure and control the expenditures incurred during construction and to report the findings to management. Managers must have access to accurate cost and schedule data so the trend of the cost can be determined as soon as possible, and corrective action taken if needed.

It is important to document project production and costs quickly because the budget is based on these estimates, and estimates are just that – *predictions* of probable cost. And, these predictions can be somewhat uncertain because every job is different, unlike manufacturing industries that perform repetitive tasks.

The theory behind project control is simple: To manage a whole project, manage and control its parts, or the individual work activities. A project is *estimated* by activities, *planned* using activities, *scheduled* by activities, and *controlled* by activities. For control purposes, the total project needs to be subdivided to a level such that each defined work activity is measurable and controllable, and that each activity's cost, schedule, and product output is clearly understood.

The WBS

Ideally, a company should use the same Work Breakdown Structure (WBS), or a very similar one, to define the activities for the cost estimate and the construction schedule. The same applies to the WBS used for control purposes, especially if actual cost data will be used in the historical database to assist in the preparation of future cost estimates. Let's take a closer look at the preparation of a WBS.

The WBS divides a project into manageable units and creates a hierarchy of work that must be accomplished to finish the

project; thus, the WBS makes it much easier to plan, organize, and control the project.

The Structure

Start by dividing the total job into its major subsystems. These subsystems are further broken down to greater levels of detail resulting in a list of all the work items, or activities, that must be accomplished to complete the project. An *activity* is characterized by the fact that its completion requires an expenditure of the resources of construction – labor, materials, and construction equipment. Time is also required, and the work will have a total cost.

Each piece of the subdivided project above the activity level is called a *work package*, so each work package is made up of several activities. Every work package must have a well-defined scope of work, and it must be a logical piece of the total project, easy to identify, with a clear beginning and end.

The WBS has several levels, the top being the final product (*Level One*), with increasingly detailed levels of work shown below. *Level Two* contains the project's major subcomponents and, at *Level Three*, each major subcomponent is broken down into work packages. There could be another level with a further detailed breakdown (*Level Four*), but the lowest level will always be the individual work activities.

For example: A building project could be divided into the major subsystems of site work, foundation, structural frame, exterior closure, roof, interior finish, and so forth. The foundation system could be further broken down into Level Three work packages of excavating for footings, formwork, reinforcing steel, and concrete. The concrete work package could be divided into the Level Four work activities of placing concrete, finishing concrete, stripping and cleaning forms, and curing concrete. This is just one example; there are no rigid rules to define which components should be at a particular level in the WBS, except this:

The lowest level in the WBS is where the actual work is done and where the dollars are spent and tracked.

It's important to document material usage, measure productivity, calculate labor and equipment costs, and record progress for each activity that culminates in a work package. The financial and schedule data at the activity level can be summarized at each higher level in the WBS, culminating at the top where information is summarized for the entire project. This allows a periodic review of the budget and schedule at different levels of detail during the control cycle. Therefore, we can present summary information, while retaining an audit trail to whatever level of detail may be of interest to any specific manager.

Two descriptive terms used in this context are to *roll-up* the cost and schedule detail to a higher summary level, and to *drill down* and take a look at the lower levels to see greater detail.

Cost Centers

Costs are incurred and controlled at cost centers. Each activity is a cost center, with unique cost codes assigned in the job cost accounting system to permit the capture of budgeted/actual financial and other performance information.

Cost coding provides the framework by which information is gathered and stored on a project. (Think of it as an address for information.) A well-designed code of cost accounts will be structured so that each cost code contains several items of information. This could include: the project number; area (floor, phase, or location); the type of operation; whether it is a direct or an indirect cost; and whether it is labor, material, or another type of cost. Cost codes can be very long with dashes or periods used to visually separate several subgroup classifications. Also, cost codes must be designed to facilitate consolidation of information at various levels of detail, ranging from the very broad to the very specific.

A project control system needs to capture four categories of data: labor hours, equipment hours, costs, and *in-place* quantities. Labor and equipment hours come from payroll and from time cards prepared in the field. Costs come from the accounts payable area of the financial accounting system, and in-place quantities come from field measurements. The measurement of in-place quantities is used to calculate a production rate and as a comparison to the estimated quantity to determine the percent complete. Either of these can be used to calculate the projected final cost of the project.

Data on cost and resource usage can provide management with timely decision-making information, and is presented by the use of variances. There are two types of variances: *cost variances* (the difference between budgeted dollars and actual dollars spent) and *schedule variances* (the difference between budgeted work hours and actual work hours). Using these definitions, positive variances are favorable.

Managers study the variance columns on each progress report and follow a policy of "management by exception." The detection of deviations from budgeted cost, schedule, and/or resource usage provides an early warning signal so that schedule slips and cost overruns can be corrected early on.

Two words used in this context are *trending* and *forecasting*. Trending is looking back in time to see how the project has succeeded or failed. Forecasting is looking ahead, projecting current trends into the future to predict future costs and completion dates.

Job cost and progress reports often include the following data and forecasted values for each activity:

- Production (units per day)
- Percent complete
- Budgeted cost
- Actual cost-to-date
- Cost-to-complete
- Cost-at-completion
- Variance (estimated cost minus final cost)

Responsibility Centers

Once the project is broken down into its individual elements of work, the activities can be grouped into areas of control and assigned to a manager who then has responsibility for each

segment of production and cost. Every work activity must be clearly defined and assigned to a specific manager, superintendent, or foreman. The responsibility for specific costs and work activities should always rest with the person who is in a position to control that activity.

Every manager must understand what his or her responsibilities are, what results are expected, and how much each activity should cost. If the major company goal is to improve profit (and it ought to be), all project managers should direct their efforts toward a further reduction of costs (and an increase of revenue) whenever possible.

Obstacles

There are several difficulties that must be overcome when implementing an effective project control system, but most are normal characteristics of the construction industry, such as:

- the variable nature of the projects, type of work, and the physical environment;
- fluctuations in labor and material costs;
- a high dependence on labor;
- the difficulty of documenting worker productivity because field personnel are not attuned to paperwork; and/or
- the communication problems that result when jobs are built at a distance from the company's home office.

One key point to remember: Project control techniques must be easy to understand and easy to use, or they will not be used at all. Also, everyone involved, at all levels, must perceive the value of the control system as a way to save time and money on the project.

One other benefit received from the documentation and analysis of project/company costs is the prediction and control of cash flow. Given the large dollar volume of their work, construction companies need to maintain a significant amount of cash to pay bills. Many companies have failed financially as a result of their inability to meet their cash needs. A properly designed project cost control system will contribute critical data and assist in analyzing and managing cash flow.

Conclusion

In summary, all the costs incurred in the construction process must be accumulated, analyzed, and recorded to provide a basis for control of the project. There needs to be continuous measurement of actual progress and spending against a plan in order to predict the final costs and final schedule results for the project. The rest is up to management. The best control system cannot make up for a poorly managed and loosely organized company. The success of project planning and control depends overwhelmingly on the attitudes and behavior of the management team.

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