// An Alternate Approach to Integrating Cost and Schedule

Dr. Dan Patterson, PMP
CEO & President, Acumen

May 2010

ACUMEN
Proven Project Analytics

+1 512 291 6261 // info@projectacumen.com
www.projectacumen.com

Table of Contents

Introduction

Creating and maintaining an integrated cost and schedule model is often seen as challenging at best, and at worst, quite simply not worth the effort. Eliminating the need for a common Work Breakdown Structure (WBS) or Cost Breakdown Structure (CBS), this whitepaper describes how effective cost/schedule integration can be achieved by adopting an alternate approach. Once established, such integration provides a powerful basis for intelligent schedule acceleration, cost reduction and risk mitigation.

The Need for Integrated Cost/Schedule Modeling

Before we examine how to achieve integrated cost and schedule models, it is important to firstly consider the need for such integration.

The basic premise of managing a project through planning and control techniques is to successfully execute and complete a project to a given plan. A project plan is essentially a roadmap to achieving a set of criteria such as a specific time frame, target cost and given quality (the triple constraint).

In reality, all three of these objectives are, to an extent, correlated with the most common correlation being schedule delays resulting in increases in project cost.

Being able to model how project costs align with activities over time in a schedule is a fundamental requirement of project management and helps during the forecasting process. Pinpointing the likes of schedule overruns at the same point in time as cost overruns or high schedule risk activities driving poor cost performance are examples of powerful project controls insight that can help improve the chance of project success.

Why is Scheduling on a Different Floor from Cost Estimating?

Scheduling and cost estimating disciplines often tend to be somewhat divorced with regards to project management integration. The development of a project schedule is carried out all too frequently as a separate exercise to that of the development of a project cost estimate (and often are developed by separate teams).
Schedules are typically developed using a top-down approach based on a Work Breakdown Structure with elaboration of the detailed schedule focusing on the work required to achieve deliverables.

Conversely, cost estimates are more often developed around a deliverable-centric hierarchy (such as a cost breakdown structure) rather than the work required to deliver these deliverables.

While the overarching objectives of both a schedule and cost estimate are common, the structure and hierarchy of each is typically different.

Figure 1 shows an example of a project schedule hierarchy being work-centric compared to the corresponding cost estimate being deliverable-centric. In short: the WBS/CBS hierarchies don't match, yet within their respective entireties, they both accurately represent the total scope of the project.

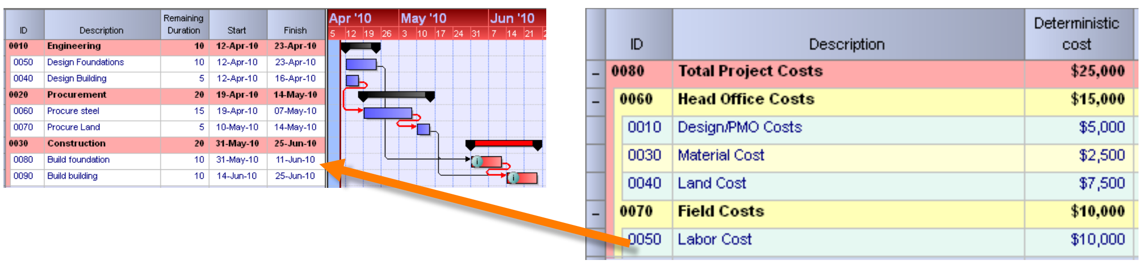

Figure 1 –Different Hierarchies Used for Schedule and Cost Estimate in Same Project

Why Costs and Resources Are Often Excluded from Complex Schedules

Today, most scheduling tools offer a means of integrating cost and schedule. Costs are generally analogous to resources in a scheduling tool and the integration of cost is achieved through assigning 'cost' type resources as resource assignments to an activity(s). In theory, this is an excellent approach as it means different cost types (such as labor, material, Other Direct Costs etc) can all be defined as different resource types (with their own rates and loading characteristics) and then assigned to the work in the schedule.

The downside to such cost loading is the degree of effort required to both setup the resources and resource assignments and then subsequently maintain and update them during execution. In working with over fifty US$2B+ projects over the past 12 months, not one of them has managed project cost through a cost-loaded schedule.

Current Approach to Integrating Cost/Schedule

One approach to overcoming the discrepancy between cost and schedule hierarchies has been to spread the costs from the CBS across the WBS based on the cost estimator and scheduler's knowledge of how a cost element is used between multiple activities e.g. a $10MM material cost may be spread 60/40 between 'build foundations' and 'build building' work. This process is effective, yet extremely time consuming and highly prone to subjective interpretation. The use of codes such as cost accounts to try and provide commonality between the cost estimate and the schedule has helped somewhat in this process.

Another approach has been to approximate the spreading of the cost estimate into the schedule through the use of hammock activities. Hammock activities are arbitrary groupings of activities (similar to summary activities within a WBS except hammocks can span multiple WBS elements). Costs are assigned to the hammocks rather than the activities themselves, which then provides a means of reflecting changes in cost as and when the underlying activity durations change i.e. hammock durations are driven by the durations of the activities that they contain. This is a good approximation technique for cost loading but still suffers from the complexity of the project team having to determine which activities fall within which groupings of the Cost Breakdown Structure.

A New and Alternate Approach to Integrating Cost and Schedule

Rather than trying to overcome the complexity of spreading or distributing a single cost element amongst multiple activities, why not develop a model that recognizes that such spreading is not easily achievable? Instead, consider developing an integrated cost/schedule model that is linked by some other common attribute such as start and end dates. The underpinnings of the timeline of a project schedule are start and end dates of activities (that are calculated through Critical Path Methodology/CPM, the basis behind all scheduling tools). In a similar manner, if start and end dates (or periods) can be extracted from cost elements directly from within a cost estimate (e.g. using time phased cost data), then these two models can be overlaid through the commonality of 'time' to achieve cost/schedule integration.

Integration of Cost/Schedule through Project Ribbons

Project Ribbons simplify how work within a project is grouped together and displayed to the project team. Most projects contain some type of hierarchy and grouping (such as WBS or discipline). Project Ribbons are a means of flattening such hierarchies so as to show a simplified continuous sequence of work through a project. Figure 2 shows an example project with work grouped into three disciplines (Engineering, Procurement and Construction).

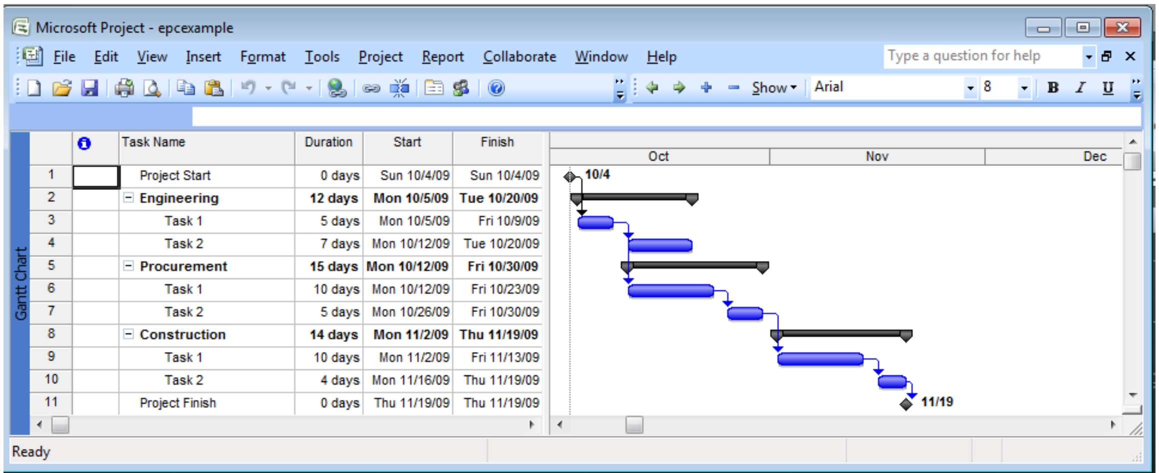

Figure 2 – Traditional Representation of Multiple Disciplines

A Project Ribbon is the simplest form of analysis ribbon and is created without any specific grouping (such as WBS or discipline). Figure 3 shows a project ribbon displaying all activities for the whole project and additionally indicates which periods of time carry a high ‘density of work’. Figure 3 shows overlapping (concurrent) work during specific phases of time.

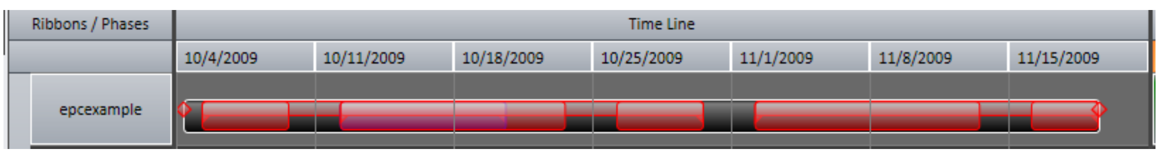

Figure 3 – A Single Project Ribbon with Overlapping Activities

The following section describes the three steps in achieving cost/schedule integration through ribbons.

Step 1 – Create a Ribbon Containing all Activities within the Schedule

Using the example shown in figure 1, the schedule is first flattened into a single “project ribbon”. This creates a timeline of activities taking into account the overlapping of work.

A simple metric such as remaining duration can be assigned to this ribbon to show the overlap of work per period. Figure 4 shows the Project Ribbon for our example project.

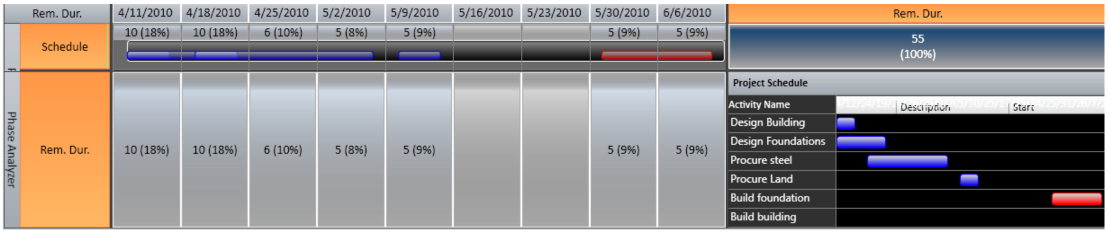

Figure 4 – Activities Ribbonized by Project

Step 2 – Add a Ribbon Containing all Cost Elements within the Cost Estimate

The second step in achieving cost/schedule integration is to create a corresponding ribbon for the cost estimate. In order to do this, we need to ensure that the cost estimate elements also carry start and end dates (or assigned periods). Figure 5 shows the line items from the original cost estimate with their corresponding start/end dates referencing when the cost will be spent.

	A	B	O	P	U	V
1	ID	Description	Start	Finish	Remaining Cost	Total Cost
2	10	Design/PMO Cost	4/12/2010	4/23/2010	$5,000.00	$5,000.00
3	30	Material Cost	4/12/2010	4/12/2010	$2,500.00	$2,500.00
4	40	Land Cost	4/12/2010	4/12/2010	$7,500.00	$7,500.00
5	50	Labor Cost	4/12/2010	5/7/2010	$10,000.00	$10,000.00

Figure 5 – Cost Estimate with Associated Period Dates

When the cost estimate is added as a second ribbon, integration is achieved by the commonality of time. By visualizing and calculating cost and schedule metrics by time period, insight into not only cost/schedule correlation is achieved but equally importantly, cost and schedule discrepancy can also be determined.

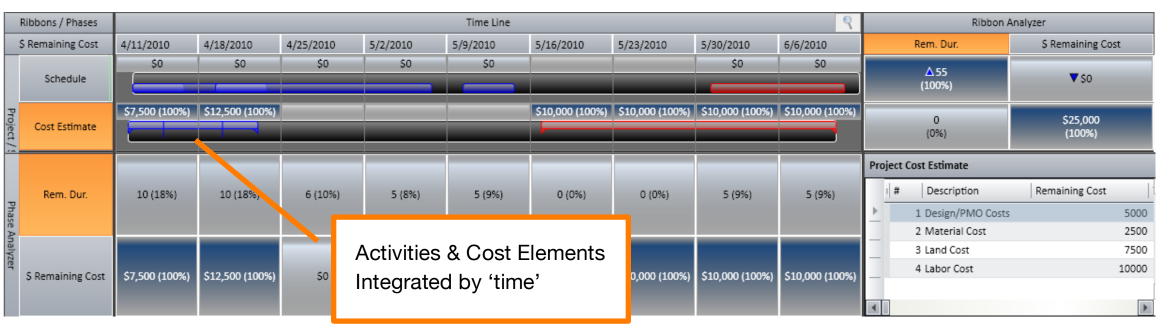

Figure 6 – Integration of Cost Estimate and Schedule Activities

The integration achieved in figure 6 is extremely useful in providing time phased insight into:

- Periods of work and their associated costs
- Periods of work not carrying costs
- Periods of completed work with outstanding remaining cost
- Periods of planned work with actualized costs
- Activities not carrying associated costs
- Cost of work per period
- Status discrepancies between cost and schedule

Step 3 – Establish Integrated Cost/Schedule Metrics

Once integration is established through the cost and schedule ribbons, metrics can be applied that encompass both cost and schedule. Consider the following three powerful insights into cost/schedule integration:

1. Average cost of work per day per period
2. Cost elements that don't align with activities
3. Activities that don't carry costs

Average cost of work per day provides an insight into the 'burn' or expenditure rate relative to the amount of work being performed. *Cost Elements that don't align with activities* is an excellent means of flagging discrepancies between the schedule and the cost estimate. *Activities that don't carry costs* is a good secondary indicator that the cost estimate and the schedule don't correctly align.

Figure 7 shows these three metrics being applied to the cost/schedule example. It can be seen that the most efficient time period (lowest cost per day) is the first time period in the project.

Most importantly, when examining periods of time that carry *cost without corresponding activities*, it can be seen that two periods (5/16/2010 and 5/23/2010) have errors that need addressing: either the schedule is incorrect or the time phasing of the cost estimate is wrong. This is an indication of a serious discrepancy in the project plan/estimate that must be resolved.

Thirdly, when reviewing periods that carry *activities without cost*, it can be seen that three periods (from 4/25/2010 to 5/9/2010) have activities without costs assigned. While not necessarily an error, these discrepancies are a strong indicator that the integration of cost and schedule should be reviewed for these activities/cost elements.

Figure 7 – Interrogation of Cost/Schedule Integration through Metrics

Conclusions

Historically, creating and maintaining an integrated cost and schedule model has been challenging. Given this, many projects now tend to build separate cost and schedule models. This in turn generates an additional challenge of ensuring integrity and integration between the two.

The method described in this paper, provides an alternate approach to not only achieving such integration but also validating and flagging any errors and discrepancies between the two. While not a silver bullet to automatic project success, this approach is a significant step in helping to ensure stronger project planning and associated project controls.