Project Cost Control Tools & Techniques

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Executive Summary

This paper reviews certain tools and techniques that can be used in order to help those responsible for managing a project to potentially better control and manage project costs. The aspects of life-cycle costing are presented and opportunities for optimizing cost management are presented. Finally, a table summarizing the recommendations are presented in the conclusion.

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Introduction

The purpose of this paper is to review certain tools and techniques that can be used in order to help those responsible for managing a project to potentially better control and manage project costs. Given the wide array of potential possibilities and options on the topic, the scope of this paper will be limited to reviewing the inputs and outputs of Cost Management as defined by the Project Management Institute (PMI) in the 2004 edition of the Project Management Body of Knowledge (PMBOK.) Furthermore, an exhaustive list of options will not be presented but rather a sampling of alternatives in order to cultivate a better understanding of the possibilities.

The paper provides definitions for terms, and a review of PMI's perspective on Cost Management. The paper also provides an overview of each element to first develop an understanding of the aspect, and then presents potential alternatives for tools and techniques to improve those elements. A conclusion is presented at the end of the paper, summarizing the findings.

For the purposes of this paper, Cost Management is defined in the PMBOK as "the processes involved in planning, estimating, budgeting, and controlling costs so that the project can be completed within the approved budget." A holistic approach to managing project costs is later identified in the PMBOK as life-cycle costing. This is an approach that focuses not only on the elements needed to have project resources complete scheduled tasks but overall project decisions made that may affect costs as well. This paper evaluates tools and techniques from the perspective of life-cycle costing.

Table 1 below outlines the three elements or processes of Cost Management. Descriptions are adapted from the PMBOK. The elements are Estimating, Budgeting, and Controlling.

Table 1 Cost Management Elements

ELEMENT	DESCRIPTION
Cost Estimating	Developing estimates and measurement for the costs needed for a resource to complete the project tasks and activities.
Cost Budgeting	Collecting the cost estimates, combining them to develop an overall cost and baseline.
Cost Controlling	Managing and controlling factors that change or affect the budget.

The fundamental role of a project manager is to meet the cost, time, performance and quality goals of the project. In a recent Standish group report IT projects continue to struggle, with only 29 percent completed on time, 18 percent failed or terminated, and 53 percent behind schedule and over budget. [Cheryl Johnson] Effective Cost Management is essential to effective Project Management. "Increasingly keen competition and the demand for shorter times to market are driving innovative approaches within the product creation process…key opportunities for future improvements originate in initiatives that span both the process and technology environments." (Layer et al., 2002). It could be argued that the probability of greater success is quite low without the proper tools in place to control costs.

Analysis

Analysis of Cost Estimating

This section reviews the elements of estimation and techniques for improving estimates. The objective of cost estimating is to develop estimates for the costs needed for a resource to complete the project tasks and activities. Inputs to estimation include the project's Scope Statement and Work Breakdown Structure (WBS). These items define the work to be done and allow a foundation on which estimates can be made. Common methods to develop estimates are by comparing the project to previous efforts, using historical data and statistical models, or bottom-up estimation with each task. The more information that is available, the more accurate the estimate can be.

Accurate estimates however are not based solely on data and methods. There are other inputs and factors to take into account. From Arieh and Li (2003) "Modern manufacturing systems are characterized by fierce global competition over price, quality and time to market. A crucial element in successful competitive standing is the ability to generate quick and accurate cost estimates."

To produce effective and realistic estimates more has to be taken into consideration such as the current project environment, risks and risk management, and customer psychology. With regards to cost management, Brinke et al. (2004) stated that in order to be effective, cost management requires information that covers the entire process. In order to produce an effective estimate the Project Manager or individual responsible for ultimately delivering estimation needs to master techniques in multiple facets of the estimation process.

Communication

An accurate estimate is not an effective estimate if the scope of the work that is being estimated is incomplete or misunderstood. And while changes to the project can be facilitated through change management later in the project, this is not an optimal approach. Estimates that are based on clear and open communication of all aspects of the project, and with full understanding, are essential (Warko, 2001.) The more information that can be made available

during and after estimation, and the more feedback that can be garnered (Brinke et al. 2004) the more accurate the estimates will become.

Cost estimation is not only getting the estimates right but managing changes to the quality and nature of inputs, e.g. scope management and good work package definitions. Lutters et al. (2000) made the observation that unlike computers, humans can rely on their unique ability to interpret information based on knowledge and experience while computers cannot effectively deal with decision making with incomplete information. This supports the notion that computer or numerical models alone cannot produce effective cost estimates. Communication and the human element is critical to incorporate into effective cost estimation.

Curiosity should be a technique employed as well with regards to communication and effective estimation. Curiosity and asking questions can help alleviate uncertainty; the ability to keep asking questions until you get the answers you need (Warko, 2001.)

Looking into the future and proactively managing project scope creep can help improve the estimation process. Warko (2001) comments that documenting assumptions and managing scope are critical to developing good estimates. Two primary causes of cost overruns are spending more money to complete work than was budgeted, and adding work to the project without adding additional funding (Levine, 2001.) If scope is not managed, as the project progresses some of the estimates for tasks will no longer be accurate. As a technique to providing better estimates, recommendations for managing scope creep can also be applied to the estimation process. The table below outlines these techniques. (Adapted from Levine, 2001).

Table 2 Scope Management Techniques as Applied to Estimation

TECHNIQUE	RESULT
Standard practice for adding to the scope.	Provides a consistent model and process to alert the Project Manager when something may affect the nature of the estimates for the project.
Provide forms to facilitate the process.	Provides a consistent interface into the model where required information can be identified and input can be received in a consistent manner.

Identify roles and authorities.	Helps ensure that the correct people are involved in the process, or that the correct people can be notified if and when there are changes to an estimate.
Define changes as a list of work items.	Provides more detailed information that can help in a more accurate estimate and help facilitate the estimation process.
Identify the expected source of funding	Helps set expectations that could help facilitate the estimation process.
Maintain a history.	Provides historical data for future research, reference, and improvements.

Being Realistic

Project tasks are usually performed by people. It's been said that people are the most important resource on any project, but people are not resources on a spreadsheet. They have lives, families, events, and changes that can affect them at any time. Effective estimates take into account both effort and duration. The human factor of day-to-day life must be taken into account when performing cost estimates.

In the article *Half Plus Half Plus Half Equals Chaos* (Cabanis-Brewin, 2000) the author address the issue of unrealistic estimates and the effects on a project. Based on the laws of system dynamics, trying to multitask work on a project increases the duration to complete work. "The problem is…our sloppy, unrealistic manner of estimating the human capacity for work and translating it into time." The author goes on to note such items as spin-up time, having multiple roles on the job, work environment changes, or family issues. At the end of the article Cabanis-Brewin makes the point that trying to make up for unrealistic estimates can also affect quality. " Matter can neither be created nor destroyed, only transformed, so when we try to make a project out of nothing, it has a way of dipping into the "something" reserve—into loyalty, health, creativity, innovation, commitment or safety. When these crucial intangibles are depleted, tangible results suffer."

Warko (2001) reflects on the consideration of a resource's productivity. In *Prerequisites for good estimates*, Warko identifies human factors that affect estimates that need to be taken into

consideration. Some of those factors include organizational size and culture, skills, attitude, customer characteristics, and the risk of burnout.

With regards to software development, Jones (2002) states, "Not only are large systems expensive, but they also have one of the highest failure rates of any manufactured object in human history. The term "failure" in a software context refers to projects that are canceled without completion due to cost or schedule overruns, or which run later than planned by more than 25 percent."

Uncertainty

The earlier estimation is performed and the less information there is, the less accuracy there will be, thus more uncertainty. Mullaly (2001) states, " How many of us have actually had the luxury of waiting until the end of detailed design to provide an estimate on the project cost?... the earlier we are forced to submit an estimate, the less accurate it will be. There will be things overlooked or unplanned for--simply because it is too early in the lifecycle to fully understand what we are trying to build, and how we are trying to build it." Understanding that uncertainty is a large cause for inaccurate estimation is a step in the right direction. Coupled with effective communication and a realistic approach to estimation helps that much more in keeping the big picture in mind. "Uncertainty is reality as far as projects go. To deny it is futile." (Mullaly, 2001.)

Layer et al. (2002) identified three different types of estimate calculations during the production process, along with a diagram illustrating the concept of determining costs vs. incurring costs over time. Pre-calculation estimates the future costs before productions starts and is used for cost-based decision making. Post-calculation is used for cost accounting and reflects the actual costs incurred. Intermediate calculations are performed during the project for the purposes of cost control.

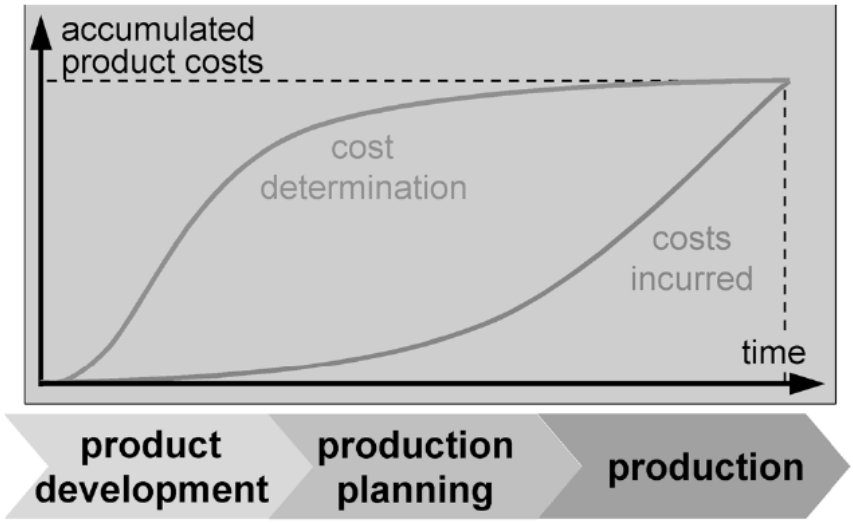

Figure 1 Cost determination vs. incurred over time. Layer et al.

The above figure illustrates the uncertainty present at the beginning of the process. Post-calculation estimates can be retained for future use as pre-calculation estimates in order to help improve their accuracy, but the authors proceed to identify some of the shortcomings in dealing with uncertainty and some cost estimation methods. Adapted from Layer et al. (2002):

- Statistical and analogous models generally determine estimates in a lump-sum fashion. As a result they are not able to identify the cost-driving characteristics at a low level because of a lack of detail and differentiation.
- Integration of additional cost factors with the estimate are not solved satisfactorily.
- Cost estimation using statistical and analogous models can only be performed with historical data. New projects or initiatives have no direct historic data to refer to.

Park and Seo (2004) also point out the importance of determining a cost is consideration whether or not a concept is feasible together with other requirements. These points help to support not only the need to address uncertainty in estimation but the need again for realistic estimation as well. In the article *Risk management process in building services cost estimation*, Mok et al. (1996) identifies the use of risk management process when preparing cost estimates to help ensure a more systematic (i.e. life-cycle cost) and rational approach for developing a better understanding of the overall project and thus, better estimates, both initially an ongoing.

Big Picture

Projects generally need funding in some fashion to be completed. Understanding the concerns of the organization with regards to estimation and funding is also a good technique for improving the estimation process. In many corporate environments estimates are needed up-front to receive funding. Because there is less information available at the beginning of the project, the estimates are less accurate, and budgets are overestimated as a precaution. Ultimately this ties up valuable funding can may not be used. Vast amounts of money can be stranded, with as much as 50% of funds remaining unspent for the given budget year (Mullaly, 2001.) Traditional cost estimation systems are known to distort information by using traditional overhead allocation methods that rely on direct items such as labor (Arieh and Li, 2003.) Helping the organization to understand the nature of estimation and the benefits to both the project and the organization to either allow for more time and information for estimation, or for flexibility in budgeting can help improve the effectiveness of the estimation process.

Quoting Jones (2002) again, " The construction of large software systems is one of the most hazardous activities of the business world. The failure or cancellation rate of large software systems is over 20%. Of the large systems that are completed, about two thirds experience schedule delays and cost overruns."

Techniques in Tandem

Estimation processes must be flexible. Brink et al. (2004) made the observation that different situations require different estimation types. An effective estimation process needs to be able to handle fundamentally different cost estimation approaches and be able to use them in a hybrid concept.

For Software projects, function point analysis in tandem with other techniques to help reduce costs, foster understanding, and produce more effective results. The table below is adapted from *You're worth your weight in gold* (Jones, 2000).

Table 3 Failure rates with regard to project complexity. Jones, 2000.

FUNCTION POINTS	EARLY DELIVERY	ON-TIME DELIVERY	DELAYED DELIVERY	CANCELED	SUM
1 FP	14.68%	83.16%	1.92%	0.25%	100.00%
10 FP	11.08%	81.25%	5.67%	2.00%	100.00%
100 FP	6.06%	74.77%	11.83%	7.33%	100.00%
1,000 FP	1.24%	60.76%	17.67%	20.33%	100.00%
10,000 FP	0.14%	28.03%	23.83%	48.00%	100.00%
100,000 FP	0.00%	13.67%	21.33%	65.00%	100.00%
Average	5.53%	56.94%	13.71%	23.82%	100.00%

Note that the data reflects that the more complicated the project becomes, the more unlikely it is to be delivered on time, and the more likely it is to be cancelled. At approximately $1,000/FP a 10,000FP project costs $10,000,000 but the cost of cancellation and failure is actually closer to $1,500/FP (Jones, 2000.) The bigger the project is, the more risk, more financial impact, and more likely it is the project will fail. Using a technique like function point analysis in conjunction with other techniques helps promote better understanding of the size and risk, and can be considered an investment that can increase the understanding of the scope of the work, thus estimates, increasing the odds of a successful outcome from less than 30% to more than 75%. And characteristics of more successful projects were ones that made the investment in software estimating tools rather than just manual estimating methods. (Jones, 2000.)

Analysis of Cost Budgeting

In the most common of terms project cost budgeting involves the aggregation of individual project activities costs into a whole or total cost baseline for measuring project performance. Other activities include reserve analysis and Funding limit reconciliation. In the case of small projects or in small organization this process could in fact be included in the project cost estimating process. The purpose of the section of the paper is to review in detail cost budgeting

tools and techniques. The tools to be examined include contingency and allowance budgeting and strategic budgeting.

Contingency and Allowance Budgeting

Contingency and Allowance budgeting is necessary to ensure that the proper amount of budget is established to accommodate for risk or unforeseen cost increases. Not allocating for such events could hamper proper project execution. The problem budgeters' face is what is known as the Information / Influence gap, shown in Figure 1. Karslen and Lereim explain that early on in the project the activities that typically have the highest amount of influence on project costs have relatively low amounts of information available to make good budgeting decisions. [Karslen and Lereim] Detail project schedules and design just don't exist at this time.

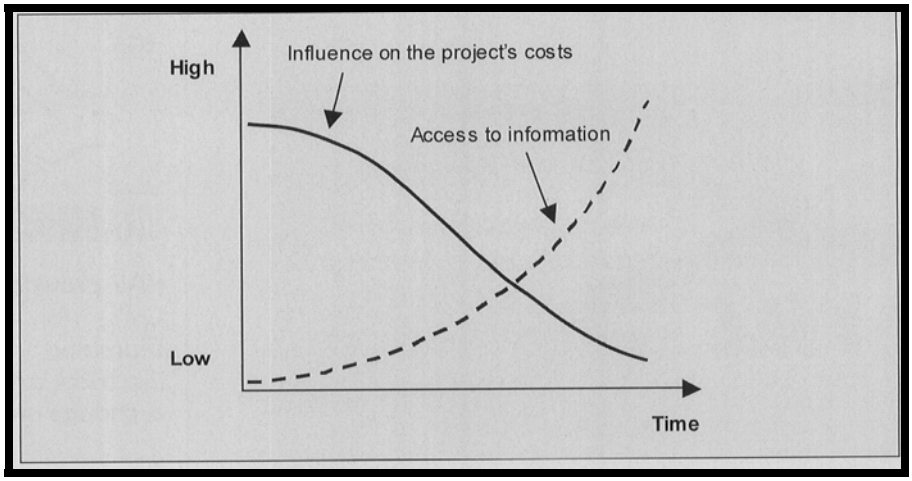

Figure 2 The Information / Influence Gap

One approach to overcome such gaps in project cost management is to develop and communicate the cost build-up process within the organization. The starting point for building the budget starts with clear understanding of budgeting components that includes the base estimates, contingency estimates, allowances and budget reserves. Karslen and Lereim provide a graphical representation of these components as shown in Figure 2.

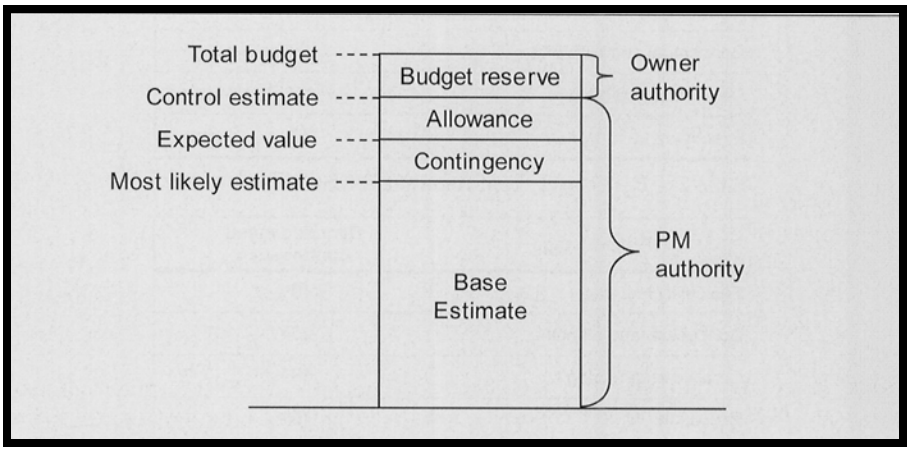

Figure 3 Cost Build-up Components

Base estimates are estimates that are most likely to occur in the absence of risk. But, because such risk free projects are rare, if not non-existing, additional budgeting most occur. The first is a contingency reserve. Additional dollars are allocated to the task to ensure the probability of a cost overrun is the same as an under run. The some of the base estimate and contingency amount is known as the expected value.

Additional budgeting accuracy can be achieved by building into the budget some amount of risk reserves. It is important to mention at this time that these three budgeting assignments are under the authority of the project manager. Establishing a risk reserve starts with an identification of each risk and then assessing the impact of each. By doing this risk analysis project managers gain a quick understand of where potential overrun exists and budget appropriately. Although this method sounds simple, E. Zastrozny believes that this allowance is frequently determined by feel. [Zastrozny] This is fine for someone of experience, but disastrous if left up to the novice. They're various methods for evaluating the impact of risks. Osama Moselhi states that most of the methods are traditional algorithms, both deterministic and stochastic. This includes Monte Carlo simulation and PERT. [Moselhi] The additional budget of a risk reserve added to the estimate budget results in a controlled estimate.

If the project owner, not the project manager, wants to ensure a greater level of budgetary compliance an overall budget reserve can be established. This is typically based on company or project owner policy. This is to accommodate for unanticipated proceedings or main project changes.

Not many would argue the need to produce more accurate budget estimates, but finding the method to do so that balances the time it takes with accuracy of results is the ultimate goal. Creating and communicating the cost-build up approach is a good place to start. Once everyone in the organization knows the key elements for establishing a budget, including contingency and risk reservoirs, efforts can then be focused on refining the methods for computing the various budgets.

Strategic Budgeting

Imagine being able to reduce costs by 37.6% just by altering your budgeting methods. Many large organizations such as DaimlerChrysler, Lucent Technologies, and Harris Semiconductor experienced such gains. [Taylor and Rafai] The budgeting methodology used by these and other companies was a technique developed by Eliyahu Goldratt in his 1997 book, *Critical Chain*.

In the book, Goldratt introduced a practice to offset unnecessary bloating of estimates in project tasks. During the planning phase time estimates are reduced by fifty percent and then grouped together to create a "saved time buffer" or "project buffer". The save time buffer is then cut by fifty percent again and placed at the end project. The net result is a reduction in project time by at least one third of the initial estimate. [Goldratt]

Goldratt constructed the Strategic Budget based on two key observations. First, project estimation are relatively accurate in the aggregate but not at the unit level. Second, managers have an inclination to overestimate the time needed to perform a task to protect them from missing a milestone or budgetary target and procrastination.[Goldratt] This notion was supported by Mohammed Onsi study on budgetary slack. Onsi documented that 80% of the managers he interviewed admitted that they "bargain for slack." [Onsi]

It is not so surprising that so many are in favor of a budgeting process that is so simple and yields such great results. The process probably makes sense as a short-term method to improving budgeting success in large organizations. However two key points could be made that could affect the long-term viability of such a process. They too are simple: trust and learning.

Developing a budget based on the fact that the Management cannot trust the estimates provided by the employees or experts is clearly a problem. As soon as the employees understand that their expert opinions are being only partially weighted, or only considered to a degree one could

expect moral issues. This could lead to personnel performance issues, which ironically will affect performance with respect to the budget and plan.

Furthermore, assuming management has the ability to keep employee moral high one could expect employees to become wiser. Depending on the employee, wiser could mean inflating the project estimates even more to make up for the "project buffer". This would results in far less that 30% savings. Or, wiser could mean learning from the process and reducing submitted estimations. Although this is a good result, this to could lead to under budgeting, since the attempts to reduce bloated budgeting estimates would be doubled. There is only so much time that can be removed from project plan before the project is adversely affected.

Cost Budgeting Conclusion

In this section of the paper a review of two cost budgeting tools was conducted: Contingency and Allowance Budgeting and Strategic Budgeting. Both techniques make attempts at improving the budgeting process. This is where the similarity ends. In the case of contingency and allowance budgeting attempts are made to develop and communicate a plan for achieving better estimates with all employees. A grass roots approach. This is much more desirable and more likely to be successful in the long term than arbitrarily cutting 50 percent on the initial project estimates as recommended by Strategic Budgeting.

Analysis of Cost Control

Introduction

The fundamental role of a project manager is to meet the cost, time, performance and quality goals of the project. In a recent Standish group report IT projects continue to struggle, with only 29 percent completed on time, 18 percent failed or terminated, and 53 percent behind schedule and over budget. [Cheryl Johnson] It could be argued that the probability of greater success is quite low without the proper tools in place to control costs. It is important to provide team members with all the information they require in order to recognize what happened historically, what is happening currently and to accurately forecast the future. The ability to over come negative variances in both cost and schedule requires timely and accurate information to make sound judgments. Gerald R. Kunz writes, "Project Controls are decision making tools for management. When properly designed, maintained and used, they are the crystal ball that allows

management to forecast the future"[Kuntz]. This section of the essay will focus on one such crystal ball or tool, more specifically earned value management. After a brief review of earned value concepts we will examine the positives and negatives of using such a tool.

Earned Value Analysis Concepts

According to Hayes and Miller, the Department of Defense first started using earned value analysis more that forty years ago. [Hayes and Miller] Over the years the methodology grew unnecessarily complex. As a result many organization chose to shy away or not use the tool at all. Because the failure rates of projects have been so high, as reported by the Standish group, there is no wonder why earn value is gaining new popularity. Project managers and the sponsoring companies are looking for better control. In some cases that tool of choice is earned value analysis.

Today a standard exists thanks to American National Standards Institute and Electronic Industries Alliance Standard. In ANSI / EIA –748, thirty-two criteria are documented in an effort to provide structure and guidance to successful operation of earned value management systems. Again, the intent of this portion of the paper is not a complete review of all thirty-two criteria, but an overview of the core criteria.

It is important to state that before any earn value analysis can occur a few fundamental project management activities must happen with each project. They are listed below.

1. Divide the project into manageable parts or packages of authorized work. This is commonly referred to as establishing the work breakdown structure or WBS.
2. Ensure that the parts are defined in a manner so that each activity can be allocated duration of time to be complete and a cost to complete.
3. Allocate cost and effort to all parts across the entire project. Essentially establishing a baseline.

Once the above steps have been completed and the project has started earned value analysis can begin. Earned value analysis provides an early warning system to potential dangers and opportunities. The simple and repeatable process steps are outlined below.

1. Update the schedule based upon the current progress.

2. Update the actual costs associated to the current progress
3. Calculate and graph key values, variance, and ratios.
4. Analyze the results and take corrective actions.

A graphical representation of many of these key values is shown in the chart below.

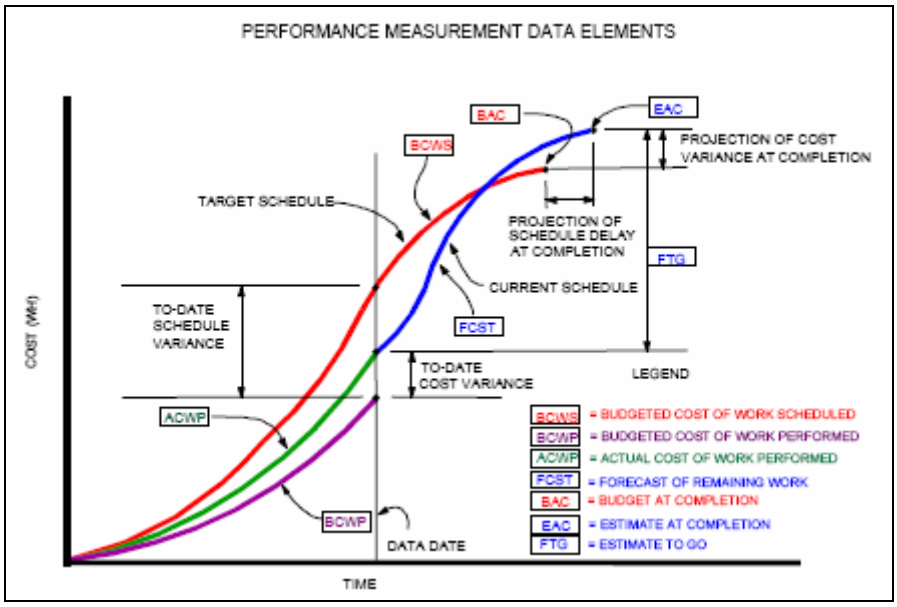

Figure 4 Earned Value Example (Wilkens)

1. **Budgeted Cost of Work Scheduled** (BCWS)= this is the original base line cost of work schedule.
2. **Earn Value or Budgeted Cost of Work Performed** (BCWP) = Percentage of work complete * the original budgeted cost to complete.
3. **Actual Cost of Work Performed** (ACWP)= the actual cost to complete the work.
4. **Schedule Variance** (SV) = BCWP - BCWS
5. **Cost Variance** (CV) = BCWP – ACWP

It is important to note this chart represents cumulative totals. Let's start with the cost of planned activities or BCWS. In this example the entire cost of the project was planned to cost $100 Million. At the time of the analysis the budgeted cost of work performed (BCWP) was $34 million, but the actual cost to complete the work was $40 million (ACWP). The cost variance (BCWP – ACWP) is -$6 million. So for the work performed we over spent, resulting in a negative variance. Furthermore, at this point in the project life cycle we had schedule to spend

about $80 million, but the budgeted cost to perform the work is only spent $34 million. This difference represents a negative scheduling variance. Remembering that schedule variance is the BCWP at the time of analysis minus BCWS at that same time. In this example the variance is $34 - $80 million or $46 million in schedule variance. In conclusion not only is the project behind in schedule but is also overspending on the work that is actually getting completed.

Earn Value Analysis Why Not?

All of this earn value analysis can be very helpful to ensure that one completes the project on time and on budget, but there are several reason why a organization may choose not to use it. First, if the organization is successful in completing projects already there are probably no compelling reasons to rip out and replace what is working so well. Alternatively, organizations could elect to augment what is in place with this tool.

Second, some organizations do not have the appropriate foundation built to perform earned value analysis. For example, if basic project management skills are not available or in place it will be impossible to perform any meaningful analysis. Something as simple as not being able to identify the scope at the start of a project would hinder the usefulness of this tool. Some organizations have fallen into the trap, sometimes by design, of a rolling scope review. Without a solid scope establishing a work breakdown structure with allocated costs and efforts becomes a moving target.

Finally, organization might not see the value in the effort that is necessary to accurately track project cost and schedule status. Again, without accurate cost and schedule information the tool's results are useless. For this tool to work there needs to be an organization commitment.

Why Earned Value Analysis

The intent of this section is to answer the questions: Why would an organization want to use earned value analysis as cost management tool. What are the positive reasons for using this tool?

First, it may be a condition to do business or be a requirement. Cheryl Johnson writes that ANSI / EIA - 748 is now mandatory for the United States government cost reimbursable contracts or agreements valued greater than or equal to $20 million, revised down from $73 million. She goes onto say contracts over $50 million require contractors to use a validated earned value management system. [Johnson].

Secondly, unlike many other tools earn value combines the analysis of actual cost and schedule performance with what was planned to provide a complete picture. Project managers will be able to identify negative variances and risk before the become a larger issue. Earn value is an early warning system that alerts on future issues. Paula spinner, a senior cost and economist for Robbins-Gioia explained, " In the past, people monitored their costs by looking at what they budgeted and what was actually spent, then calculated a variance and determining whether or not they were over or under cost." The point here is that results are skewed because it does not relate cost to project schedule. Earned value accounts for this critical element and provides a whole view.

Finally, earn value is a tool that provides a standardized unit of measure of progress. This is important because often time's projects have many tasks that on the surface are difficult to report on and compare from a progress perspective. An example will help clarify this point.

This project in this example is the development of an online store front for national retail store. Lets assume that the project manager wanted to know the current status of the project. At a high level the WBS includes the following summary tasks and status:

1. Conceptual Design (100% complete)
2. Program Specification (100% complete)
3. Java Programming (50% complete)
4. User Documentation (50% complete)
5. Testing (0% complete)
6. Installation (0% complete)

What is the overall project status? With two of six major work units complete and another 2 halfway finished one could guess 50%. The real answer is it depends. The 50% estimate assumes that each major task is of equal weight. What we don't know is how one task equates to another. If the project manager would add expected effort to the calculation the true picture would become clearer.

1. Conceptual Design (100% complete and 200 Hours)
2. Program Specification (100% complete and 100 Hours)
3. Java Programming (50% complete and 100 Hours)
4. User Documentation (50% complete and 75 Hours)
5. Testing (0% complete and 100 Hours)
6. Installation (0% complete 25 Hours)
7. The project is in fact 67% complete; 387 hours of the planned 600 have been consumed. The effort acts a weighting factoring.

Section Conclusion

In conclusion, this section of the paper provided a brief overview of one cost management tool, earned value, which is available to project managers. It also provided several reasons why an organization would chose not to employee such a tool. This included a lack of project management fundamentals in the organization, a lack of commitment to perform the need tasks such as cost allocation and detailed time entry and finally some organization have successful tools already in place and have no compelling reason to change. In these cases it is recommended to augment the current cost management tool set with earned value. The paper also provides the following reason why an organization should choose to use this tool for cost management. First, it may be a requirement in order to business. Next, earn value analysis act as an earlier warning system for risk associated to scheduling and cost variances. Finally, earned value provides a standardized unit of measure.

Conclusions

As outlined above, cost management includes estimation, budgeting, and control. The cost management process can be optimized through various tools and techniques. While this paper does not attempt to provide an exhaustive list of tools and techniques, a holistic approach to cost management and life cycle costing was presented as well as some potential approaches to optimizing the cost management process. The various issues and potential techniques are summarized in the tables below.

Cost Estimation

Table 4 Cost Estimation Issues and Techniques

ISSUE	TECHNIQUE
Factors affecting inputs to estimates	• Reinforce effective communication. • Manage change that may affect estimates. • Manage uncertainty and risk and account for it in the estimation process. • Understand why projects fail and be proactive.
Factors affecting accurate estimates	• Develop realistic estimates by taking into account all factors affecting work and duration. • Use appropriate techniques in tandem and be flexible. • Understand the limitations of techniques such as analogous and parametric estimaiton. • Use techniques such as function point analysis to develop a big picture of the project. • Invest in estimation tools.

Cost Budgeting

Table 5 Cost Budgeting Issues and Techniques

ISSUE	TECHNIQUE
Information / Influence gap	Contingency and Allowance Budgeting • Develop and communicate the cost build-up process. • Develop knowledge of the key elements for establishing a budget. • Focus on refining the methods for computing the various budgets
Budget Bloat	Strategic Budgeting • During the planning phase time estimates are reduced by fifty percent, grouped together to create a "saved time buffer" or "project buffer". • The save time buffer cut by fifty percent again and placed at end of project.

Cost Control

Table 6 Cost Control Issues and Techniques

ISSUE	TECHNIQUE
Potential for project failure	• Use Earned Value Analysis (EVA) to proactively monitor project progress and be able to react to variance. • Understand when EVA is appropriate and how it will impact an organization.

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