Earned Value Management for IT Projects

Introduction

If earned value management (EVM) is so good in determining the true status of a project, why is it that hardly any one uses it in information systems related projects?

Reason 1 *Because it is assumed to be only required to track costs for large initiatives.*

Reason 2 *Because EVM advocates often speak in difficult terms tantamount to a foreign language.*

Reason 3 *Because organizations do not have the maturity of processes and systems to budget for and track costs effectively.*

Reason 4 *Because sometimes management doesn't really want to know/forecast the full cost of a project and risk having it shut-down!*

And many more reasons can be cited.

In the information technology (IT) industry, when you ask most project managers what is the real status of their projects, often you get a response based on one or several of the following approaches, based on personally observed practices.

Technique	Freq'cy	Accuracy
$'s spent to budget	80%	~65%
Time against schedule	70%	~30%
Gut feel / opinion	50%	<20%
Earned value	<3%	>90%

Many project managers determine their percent complete based on expenditures against budget and not on work actually realized. Seldom do the project sponsor and the project manager accurately know how much of the work is really completed and what project completion really means. No wonder that many projects hit the 90% complete just to remain there for a long time!

While the EVM technique is relatively common in industries such as defense and construction, it is very difficult to use in IT – why?

- Effort and costs are seldom established at each work product (deliverable) based on a WBS,
- Many IT projects do not track actual effort and costs spent at the WBS level,
- IT projects delivery use a variety of methodologies (such as waterfall, agile, prototyping, spiral, etc.) which do not lend themselves or are practical to budget for and track expenditures.
- The approach for providing measurable indicators of project performance and completion is seldom defined in the project charter, often leaving status reporting to a very simplistic, opinion-based practice.

The approach to earned value management for IT projects, discussed in this paper, will allow you to report on the status and earned value of your program and component projects with a high degree of accuracy, independent of what development methodology (or lack thereof) is used.

The approach uses a outcomes-based framework comprised of stages, gates, earned-value industry standards for each stage, which can be compared to the progress made by each element in the WBS against outcomes performance indicators (OPIs). This framework is typically structured on the basis of how you manage projects in your organization – i.e. "*the way we do business here!*"

This paper discusses two levels of EVM:

- Portfolio/Program
- Project

At the portfolio level, each program/project reports the status of completion of the stages, as well as the budget, actual costs, cost performance index (CPI), and schedule performance index (SPI). The program level uses the same approach as the portfolio level, except that it provides a summary of all the projects within the program, as well as a report on key performance indicators specific to each program. Risk and complexity factors are also included to adjust the percent complete of each project within the program.

The project level reports on the status of each work product within each stage. Each stage can have different earned value indicators that track each work product to completion to determine its relative status of development. Risk and complexity factors are factored to adjust the percent complete of each work product within the stage.

The technique was developed in the late 70's as a paper based approach, and only took half a day a week to generate accurate results of a project status with over 700 work products to be tracked!

Audience

This paper should concern CIOs, project sponsors, portfolio and program-project managers interested in accurately determining the performance of their initiatives, programs, and projects in relation to scope, cost, schedule, and quality indicators.

Why EVM is Important?

Are we hitting our projects targets? Are we within budget to date? What is their percentage of completion on our initiatives? What's our estimate to completion? What is the probability of having the projects completed on time and on budget?

Starting projects is relatively easy compared with satisfying the management and stakeholders' demands for information on their status. As a portfolio or project manager, if you cannot provide accurate answers to the above questions on demand, you are not doing your job and your credibility will suffer.

Since EVM was introduced in the late 60s and accepted by the US' Department of Defense it contained lots of ugly terms. The approach was later accepted as an ANSI Standard (748). It was not until 1998 that the term Earned Value was introduced that management got the message as a useful tool to track and predict the end costs of a project.

In 2000, when PMI introduced the PMBOK[i] and references to the BCWS and BCWP (see glossary) were eliminated, which inhibited its use. As a result broader acceptance of the EVM approach began to occur. Yet, in the information technology sector, which uses comparatively smaller projects, it is hardly ever used despite its real benefits.

What is Earned Value?

Earned Value is an objective measurement of how much work has been accomplished on a project.

Earned Value is a technique that clearly shows whether you're getting "Value for Money" as your project progresses to completion. It is a major component of Best Practices in Project Management. The technique essentially identifies the value of the useful work done at any given point in time, in all areas and at all levels within the project.

PMI's PMBOK defines earned value as "the value of completed work expressed in terms of the *budget* assigned to that work for a *schedule* or *work breakdown structure component (WBS)* – also referred to as *Budgeted Cost of Work Performed (BCWP).* "

Earned Value Management, is also defined as "a management methodology for integrating schedule, scope and resources, and for objectively measuring project performance and progress. Performance is measured by measuring the earned value (i.e. budgeted cost of work performed) and comparing it to the actual cost (i.e. actual cost of work performed).

As work is accomplished, it is "earned" using the same selected budget term. Earned Value compared with planned value provides a work accomplished against plan. A variance to the plan is noted as a schedule or cost deviation.

Progress (% complete) is measured by comparing the earned value to the planned value." A very simple concept but often hard to implement in most IT projects.

Benefits of Earned Value

Using the earned value process, management can readily compare how much work has actually been completed against the amount of work planned to be accomplished. Earned Value requires the project manager to plan, budget, and schedule the authorized work scope in a time-phased plan. The time phased plan is the incremental "planned value" culminating into a performance measurement baseline.

By comparison with the original plan, Earned Value can be used to identify other parameters such as time to completion, cost to completion and expected final costs. It also enables project managers to identify those areas of the project that are proceeding well, those that are in trouble, and enables percentage progress and performance indexes to be calculated.

Normally established accounting systems provide accumulation of actual cost for the project. The actual cost is compared with the earned value to indicate an over or under run condition. Planned Value, Earned Value, and Actual Cost data provides an objective measurement of performance, enabling trend analysis and evaluation of cost estimate at completion within multiple levels of the project.

Earned Value can be used in almost any project situation and in almost any project environment. It may be used on large projects, medium sized projects, tiny projects (in cut-down form), complex and simple projects and in any market sector. Some people, of course, know all about earned value, they have used it for years - but perhaps not as effectively as they could have?

Good project management will produce good Earned Value Data. Poor project management will produce poor Earned Value Data. The skilful interpretation and application of Earned Value information will make a major contribution towards ensuring project success.

Earned Value improves on the normally used approach budget versus actual incurred cost by requiring the work in process to be quantified.

Problems Associated with Earned Value

Historically, EVM has been used on massive projects, particularly in defense contracts. This has created the perception that it is hugely complicated. Common criticisms are that it is only good for large projects, far too complicated for us, far too costly for us.

A common problem with small or non-project oriented organizations is that they do not have internal mechanisms that can budget for and can collect effort and costs to individual projects or subcomponents. Other problems may be associated with the culture of the organization not used to reporting meaningful progress information.

What Can Earned Value do for You?

It provides simple but powerful answers to many questions such as:

- Where are we now? Exactly!
- How much is it going to cost by the finish?
- When is it going to finish?
- Where are our problem areas?
- How does this compare with other projects?
- How much is it really costing us to earn each unit of forecast value?

It will not however guarantee a successful project. Only people can do that.

The IT-EVM Delivery Framework

The IT-EVM discussed herein can be applied to any project, when the owners of the final product wish to ensure that the expended resources were used efficiently and effectively.

In the IT industry it is very difficult to use earned value since most projects are planned using duration rather than effort to determine the cost and effort of all work products within the WBS. Also, the nature of the work varies considerably depending on the project phase a project is executing (i.e. requirements, programming, testing, etc.), making it very difficult to have a consistent approach to estimate the effort and cost for each work product.

Since the 70's I have employed this technique which is surprisingly simple, yet very effective, to determine the status of any project. In those days, there were no personal computers and inexpensive tools to estimate and track costs. As necessity is the mother of invention, the technique uses a standard reference framework based on stages and gates as follows:

Stages

Most IT projects, no matter what methodology is used to its delivery, have to go through the following typical stages:

Initiate Define, justify and receive authorization for the project via a project charter, budget, and delivery plan.

Define Determine detailed requirements of what needs to be delivered (work products), as well as the conditions of acceptance (or acceptance criteria) for all work products in the WBS.

Figure 1 – EVM IT Projects Delivery Framework

Build The work products defined in the WBS are produced and tested.

Accept Stakeholders conduct user acceptance testing of the solution to determine if it is "fit for use" before it is deployed.

Deploy Transition and change management activities are performed to implement the new system/application.

Any stage may be divided into two or more transition points or phases, to accommodate various IT delivery methodologies. For example, the define stage may include requirements definition and architecture design; likewise, the build stage may include detailed requirements and design, coding, unit testing, etc.

Work management streams are parallel activities (or sub-projects) required to enable and support the execution of the project. They may use all or a subset of the stages. For example, change management (getting the organization ready for a new system); production transition, are activities needed to ready operational systems and infrastructures to receive the application under development.

Gates

The end of each stage is governed by a gate, whose purpose is to determine whether the work products within the stage have met performance and quality criteria, before allowing the project to proceed to the next stage.

If a project has not met the criteria for that gate, it is typically "gated" and stopped until deficiencies are remedied, as a risk management measure. Often, projects are often allowed to proceed (at some risk) on condition that the deficiencies are resolved at some pre-defined point within the next stage.

In the IT-EVM framework, each gate has an "earned value" that a project should have reached, based on past experience or agreed-to industry standards.

Determining the Gate' Earned Value

If the organization has not captured statistical information about project expenditures, research organizations, have surveyed and published opinions on industry expenditures by project phase, resulting in the following table:

Phase	Total Life Cycle Cost	Relative Software Dev Cost
Concept and Definition	2.0%	4.9%
Project Go-Ahead	0.0%	0.0%
Requirement Definition	4.0%	9.8%
Software Architectural Design	7.0%	17.1%
Detail Software Design	6.0%	14.6%
Code and Unit Test	7.0%	17.1%
Integration and System Test	12.0%	29.3%
Acceptance Testing	3.0%	7.3%
Release	0.0%	0.0%
Replication, Storage, and Shipment	1.0%	NA
Delivery, Installation, and Training	2.0%	NA
Maintenance	55.0%	NA
Retirement	1.0%	NA
Total	**100.0%**	**100.0%**

Table 1 – Software Lifecycle Cost

Based on an agreed to reference model, an organization can use statistically derived performance measurements of prior projects, or arbitrarily define the relative cost benchmark that a project is expected to reach at each gate as shown in Table 2 below.

This means that if a project has successfully completed the define stage and has spent 39% of the project budget, its cost performance index is therefore 1.11 (39%/35%); so at this point, assuming that the similar performance is maintained, the forecast cost to completion can be anticipated to be 11% over budget.

Stage	EV	Cumulative
Initiate	5.0%	5.0%
Define	25.0%	30.0%
Build	40.0%	70.0%
Accept	7.0%	77.0%
Deploy	23.0%	100.0%

Table 2 – Stage Cost Benchmark

The problem with this approach is that the above table does not reflect other indirect and project support costs, which do not necessarily produce work products such as:

- Project management,
- Enterprise architecture, standards and infrastructure management,
- Sourcing/procurement management,
- Change management, training and support,
- Production readiness transition costs,
- Etc.

These can be treated as individual "stages" or be lumped together in a "support stage" and track its costs as a percentage of the project, evenly divided by each month.

At first this seems complicated or time consuming, but it is a deceptively simple process – remember it was developed as a paper based approach in the late 70's and only took half a day a week to generate accurate results of a project with over 700 work products to be tracked!

The Portfolio/Program View

In order to visualize the solution, let's assume that you need to know the status of all the projects within an IT portfolio. A simple, typical portfolio status report, using the stage cost/completion factors listed in Table 2 would look as follows:

IT Portfolio		INI	DEF	BLD	ACC	DEP	100%
ID	Project Name	5%	25%	40%	7%	23%	
1	Project 1						50.0%
2	Project 2						30.0%
3	Project 3						73.5%
4	Project 4						17.5%
5	Project 5						0.0%
Portfolio % Complete		3.6%	16.1%	8.6%	0.5%	0.0%	34.2%

Figure 2 – Portfolio/Program Earned Value Status

When a stage is initiated a credit of 50% (or any other factor) is assigned and will remain fixed until the conditions of acceptance for the gate are met. Initially, the project shows a positive balance at the start of the stage but, as actual effort and costs are captured and tabulated, it will soon place pressure in the schedule and cost performance indexes until the gate is deemed satisfied and closed for each stage.

Appendix A shows an example of a detailed analysis of the portfolio completion status and earned value report. The stages are expanded to include the costs and effort associated with conducting stage gate reviews, assuming a .5% of effort for each gate. The report shows:

- How each project contributes to the organization's strategic thrusts;
- The relative importance/complexity weight of the project, used in determining the percent completion of the portfolio;
- The risk factors associated with each project, used in determining the completion date and total costs;
- The project parameters showing the planned start and end dates, budget, full time equivalent (FTE), and average cost per hour, used to determine the earned value as the project status of each phase is reported;
- Who is accountable for the project and actual start date;
- The status of the project showing not started, started and completed stages, used to determine the earned value;
- The percent complete of the project based on the completed stages;
- The analysis of accrued (earned value) person days compared to actual expenditures to determine the schedule performance index (SPI);
- The estimated completion date based on balance to complete information, adjusted with the SPI; and
- The cost performance of the project, showing the accrued (earned value) cost and actual expenditures to determine the cost performance index (CPI) and budget at completion.

It usually takes no more than two hours per month to complete the report. The document will provide guidance to management to decide which projects require further inspection, based on the SPI and CPI information.

The Project View

In contrast with the portfolio view, the project earned value analysis is a bit more involved. However, competent project managers that purport having the PMI certification and extensive experience will find it relatively easy to implement and use.

A major issue in IT projects has always been how to determine the progress made on a work product/deliverable. Some work products (i.e. coding) often take significant amounts of time and it is difficult to measure progress.

In the IT-EVM approach, each stage lists all of the deliverables which need to pass through a set of work verification gates as illustrated in Figure 3.

1) A good practice in systems development starts with the work being assigned along with setting expectations documented in the work package instructions. In the illustration, this effort is estimated at about 2% of the total effort.
2) Once the work is assigned, the individual(s) accountable for executing the work need to develop the understanding of what needs to be done (i.e. review requirements).
3) The best results are achieved if a quality management plan and conditions of acceptance for the work package is prepared with all concerned stakeholders before the work starts.[ii]
4) Once each team member understands what is expected to do the job right, the work can be executed.
5) When the work is completed, a best practice is to conduct a quality review to verify that the work has met the criteria outlined in the quality plan, and to note any deficiencies to be corrected.
6) Final revisions (if required) are performed to finalize the work before it is used at the next step of the project.
7) The work package is signed off by the concerned stakeholders.
8) Finally, the work documentation is collected and archived (e.g. configuration management).

This practice will allow tracking the status of each work product as it is performed, to provide a better measurement of the project status.

The following example shows three assigned items that are below the average percent complete of the stage.

Project Stage		Assign	Rev Reqm'ts	Quality Plan	Execute	Quality Review	Revisions	Sign-off	Archive	
WBS	Work Package	2%	8%	2%	60%	5%	18%	2%	3%	100%
WP1	Work Package 1									98.5%
WP2	Work Package 2									86.0%
WP3	Work Package 3									72.0%
WP4	Work Package 4									42.0%
WP5	Work Package 5									6.0%
WP6	Work Package 6									1.0%
	Stage % Complete	1.9%	6.3%	1.4%	38.6%	2.1%	5.1%	0.3%	0.2%	50.9%

Figure 3 – Project Stage Work Verification Gates

Earn value is calculated based on the percentage assigned to each work verification gate. This approach requires very little time and effort to document the project status, as the project manager only needs to verify what gates have been completed as part of the status reports.

Appendix B shows the summary EVM report of a project using a different framework, following typical SDLC project phases. It also provides an illustration of a project stage (Definition) and its work products. The example shows a number of activities falling behind the norm, and the actual cost to-date of the first activity exceeding the earned vale estimated by the model.

The model can be adapted to tracking earned value when other methodologies are used – such as agile. The key is to determine the control stages and then the tracking criteria (KPIs) for the work performed under each stage.

Many projects also have support activities where there are no work products – such as project management and architecture support. The effort is usually budgeted for and consumed equally as each month passes. The following example shows accruing equal earned value of the project for all project support activities as time progresses.

Project Mgmt and Delivery Support		April	May	June	July	August	September	October	November	
WBS	Work Package	13%	13%	13%	13%	13%	13%	13%	13%	100%
PJM	Project Mgmt									18.8%
ARC	Architecture Supp									18.8%
MTG	Meetings									18.8%
AUD	Project Audits									18.8%
SRC	Sourcing Mgmt									18.8%
OTR	Ops Transition									18.8%
	Stage % Complete	12.5%	6.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18.8%

Figure 4 – Evenly Distributed Earned Value

Implementation Considerations

The implementation of this IT-EVM model is quite straight forward and takes little effort. The following is an overview of typical implementation activities.

1) Awareness and communication sessions with executive sponsors and project managers
2) Documentation of the EVM model, including the determination of the stages, gates and earned value factors
3) Creation of a WBS framework upon which all projects' WBS will be based – *e.g. the way we do business here!*
4) Documentation and implementation of time and cost tracking processes
5) Preparation of the EVM process documentation and reference guides
6) Awareness and communication sessions with project team members

Conclusions

The IT-EVM model permits the management of the status of any IT project with a higher degree of accuracy than that used by traditional approaches – such as measuring cost and effort spent to budget. The method provides 95%+ degree of accuracy regarding the percent complete of work products, as it is based on measuring the accomplishment of outcomes not "sweat"

In summary, setting up the project's EVM requires, as a minimum:

- A standard framework for stages and gates that will apply to all projects;
- The determination of the relative cost for completing a stage, based on industry standards or past project performance;
- The definition of the work breakdown structure, outlining the work products/deliverables to be produced at each stage/phase of the project;
- The total effort associated with producing each work product;
- The standard rate per hour for each project – the model uses standard rates to avoid disclosing the salaries/costs associated with the team members;
- The number of resources assigned to each work product, which together with the estimated effort and standard cost determines the total cost for each work product;
- A procedure to capture actual effort and costs associated with each work product in order to report deviations from the scheduled earned value determined by the model.

Glossary

Earned Value (EV) = An objective measurement of how much work has been accomplished on a project (also *Budgeted Cost of Work Performed)*.

Planned Value (PV) = The authorized budget assigned to the scheduled work to be accomplished for an activity or WBS component (also *Budgeted Cost of Work Scheduled)*.

Actual Cost (AC) = Total costs actually incurred and recorded in accomplishing the work performed for a given time period (also *Actual Cost of Work Performed (ACWP)*.

Schedule Variance (SV) = Difference between plan and portion of work completed

Cost Variance (CV) = Difference between planned cost of work completed and actual cost of work completed

Estimate at Completion (EAC) = The expected total cost of a scheduled activity, a WBS component, or the project at the point when the defined scope or work will be completed.

Estimate to Complete (ETC) = The expected (forecasted) cost needed to complete all the remaining work for the schedule activity, WBS component or the project.

Cost Performance Index (CPI) = A measure of cost efficiency on a project. It is the ratio of earned value (EV) to actual costs (AC).

Schedule Performance Index (SPI) = A measure of schedule efficiency on a project. It is the ratio of earned value (EV) to planned value (PV).

Work Performance Index (WPI) – A measure of the accuracy of effort estimates. It is a ratio of the total actual effort to the planned effort. This ratio is used in refining estimating processes for future projects.

PRSL's Perform™ Program & Project Management Methods and practices provide an array of tools (from basic to advanced) that allow a project manager to track a project or program status with minimal effort.

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References

[i] *PMBOK – Project Management Body of Knowledge, published by the Project Management Institute (PMI)*

[ii] *See PRSL's Project management 5th Discipline white paper – www.prsl.ca/access*