

Using Earned Value Management for COTS-Based Systems: Issues and Recommendations

Lisa Brownsword and Jim Smith

Carnegie Mellon Software Engineering Institute,
4301 Wilson Blvd, Suite 200, Arlington, VA 22203, USA
{llb, jds}@sei.cmu.edu

Abstract. Earned value management (EVM) has long been used by organizations to plan, monitor, and control the development and evolution of custom developed systems. EVM was developed for managing such projects, and assumes a waterfall development model. COTS-based systems (CBS), on the other hand, are formed and evolved through the selection and composition of pre-existing, off-the-shelf packages or components with potentially some number of custom components. Experience indicates that a spiral or iterative development process is a key to success with CBS. While EVM has been applied to CBS projects, the results have not been uniformly satisfying. This paper explores the fundamental challenges in using EVM with CBS, and proposes adaptations to some of the principals of EVM to render it more suitable for CBS development.

1 Introduction

Earned value management (EVM) is a recognized technique that integrates the technical, schedule, and cost parameters of a project [1]. EVM has been around since the 1960's, and has seen extensive use in projects ranging from very large, complex systems to small-scale development efforts [2]. Properly applied, EVM allows project managers to answer the fundamental question, "How much progress have I made against my original plan?" The validity of the plan, and the means to objectively measure against that plan are paramount to the success of EVM on any project.

As the use of commercial-off-the-shelf (COTS) products to provide significant capability in our delivered systems has grown, managers have found that the approaches traditionally used in custom software development to define, build, acquire, field, and evolve these systems require fundamental changes [3], [4], [5].

The key difference between the development of custom software systems and COTS-based systems (CBS) is the need to simultaneously define and make tradeoff between competing *spheres of influence*, such as stakeholder needs, current and target business processes, architecture, available COTS products, interfaces to legacy systems, ability of end-user community to accommodate operational changes, cost, schedule, and risk [6]. Practical experience has shown that a spiral or iterative development approach is necessary to facilitate the required discovery and negotiation to reconcile what users want and what the commercial marketplace can provide.

It is this requirement to use an iterative or spiral development process for CBS which gives rise to several challenges in applying EVM in their development, including:

- Conflict between the *product-oriented* work breakdown structure (WBS), which forms the basis for EVM, and a *process-oriented* WBS suitable for spiral development
- Difficulty in accommodating a high degree of uncertainty, in terms of cost, schedule, product selection, architecture, etc. within the constraints of a product-oriented WBS
- Inability to relate product-oriented earned value measurements to a process-oriented WBS

Published experience in using EVM has focused primarily on projects using a conventional waterfall development approach, but there has been some research into using EVM for spiral COTS development. An earlier report by Staley, Oberndorf, and Sledge offered an example of EVM applied to a small CBS, along with several promising adaptation strategies [7]. This paper provides an overview of some of the key aspects of EVM and CBS development, and briefly explores how the mismatch between their respective development models affects the use of EVM for CBS development. Building upon the earlier work by Staley and associates, this paper proposes further adaptations of EVM to improve its applicability to CBS development.

2 EVM Overview

EVM projects are managed through the establishment of a *performance management baseline* that represents the work that needs to be performed along with the needed resources and schedule. As Alexander notes, the fundamental requirement for using EVM on a project is to plan all work prior to beginning development [8]. Project progress is measured as *earned value* against the baseline.

EVM focuses a project manager on answering five essential questions:

1. What is the value of the work planned? – Budgeted Cost for Work Scheduled (BCWS)
2. What is the value of the work accomplished? – Budgeted Cost for Work Performed (BCWP)
3. How much did the work cost? – Actual Cost of Work Performed (ACWP)
4. What was the total budget? – Budget at Completion (BAC)
5. What do we now expect the total job to cost? – Estimate at Completion (EAC)

To use EVM, work to complete the project is arranged into a tree structure where the “leaves” of the tree are the individual *work packages* and *planning packages*. Near-term effort is divided into manageable work packages that can be planned in detail, covering technical content, budget, and schedule. Far-term effort is divided into planning packages that have less detail; over the course of the project, planning packages are refined into work packages which are then planned in detail. Work and planning packages are assigned start and end dates and arranged across the project time line. Thus, a WBS identifies all significant work and provides a framework to assign responsibilities, schedule, and budget. The performance measurement baseline (BCWS) is simply the sum of all work packages and planning packages over time.