EVM Methods for LOE Projects - 10940

National Defense Industrial Association

13th Annual Systems Engineering Conference

28 October 2010

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Agenda

- **Abstract**
  - Overview
  - Purpose
- **Research Review**
- **Earned Value Management (EVM)**
  - Background
  - Evolution
  - Terms and Quantities
- **Other Level-of-Effort (LOE) Approaches**
- **Model**
  - Development
  - Comparison
- **Summary**
- **Open Discussion**

Abstract

- **Overview**
  - Discuss how EVM used as a tool to gauge cost, monitor schedule, and measure performance. [1], [2]
  - Brief literature research found EVM methods used in other engineering disciplines. [3]
  - Review why System Engineering Managers (SEMs) lack an objective method to measure their performance for LOE task projects.
  - Review EVM methods to address Systems Engineering and Management performance for LOE task projects.
- **Purpose**
  - Discuss some preliminary doctoral research developing a quantitative method based on EVM fundamentals.
  - Describe the research methods used for model development.
  - Discuss plans for validating and verifying the research methods and models.
  - Solicit feedback to information presented on research methods and models.

Research Preview

- **Problem:** There's a lack of an EVM system *objective* approach for SEMs to monitor their schedule performance for LOE task projects.
- **Research Question:** How to use EVM methods to define an objective measure for SEMs to monitor their schedule performance for LOE task projects.
- **Goal and Objective:** Determine an objective method to measure SEMs' schedule performance for SEMs using LOE task projects.
- **Literature Review:**
  - Articles
  - Presentations
  - Government Documents
  - Subject-Matter Expert (SME) discussions

EVM Background

- **EVM** is "a program management tool that integrates the work scope, schedule, and cost parameters of a program, in a manner providing objective performance measurement and management." [4]
- **Effort Types**
  - **Discrete Effort (DE)** is measured based on defined tasks or activities identified as work and planning packages resulting in a particular product or service. [1-2], [4]
  - **Apportioned Effort (AE)** is a task interdependent to an appropriate DE work or a planned package, such as a review or an inspection, and is measured as part of that task that supports the results in a product or service. [1-2], [4]
  - **LOE** is "effort [work] of a general or supportive nature which does not produce definite end products and cannot be practically measured by discrete earned value techniques. Earned value is measured by the passage of time." The planned value is always equal to the earned value, and the Scheduled Performance Index (SPI) is always equal to the value of one (1). [4]
    - Tasking is difficult to quantify
    - SEMs' usage appears subjective
    - Recommend limited usage [5]

EVM Evolution

- Industrial Factory (late 1800s–early 1900s) [6-9]
- Program Evaluation Review Technique/Arrow Diagram Method (1950s–1960s) [7-8]
- Precedence Diagram Method (1960s) [7-8]
- Cost/Schedule Control Systems Criteria (1960s–1990s) [6-9]
- EVM (1990s–present) [10]

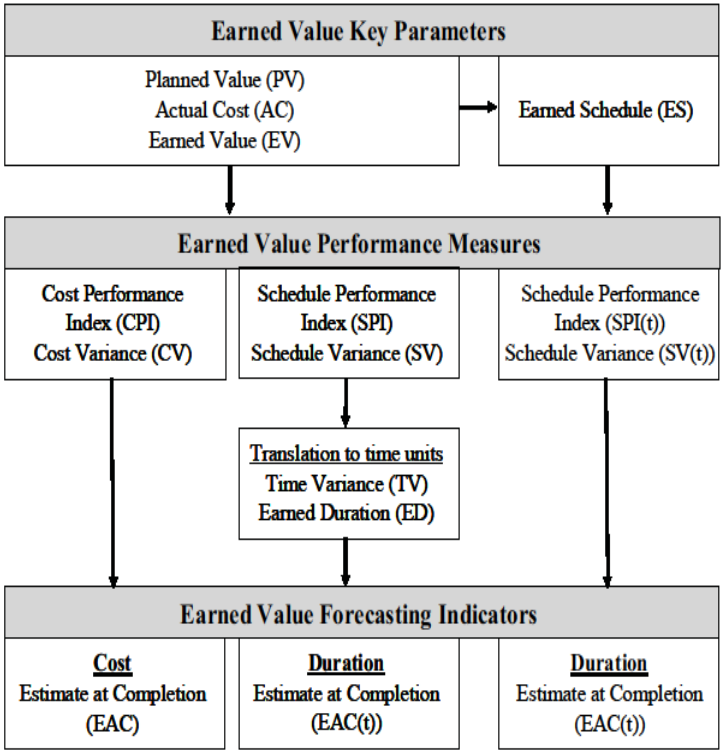

Figure 1 EVM: key parameters, performance measures and forecasting indicators.

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EVM Terms and Quantities

PMI Terms	DoD Terms	Standard Quantities	Innovative Terms & Quantities
PV	BCWS	SPI	BV
EV	BCWP	SV	BPI
AC	ACWP	CPI	BPI
		CV	SPI(t)
EV(LOE)	BCWP(LOE)	BAC	AD
		EAC	PD
		TCPI	AT
			ED
			ES

- **Project Management Institute (PMI) Terms [1-2], [8]**
- **DoD Terms [1-2]**
- **Standard Quantities [1-2], [8]**
- **Innovative Terms and Quantities [9-11]**
- **Proposed Terms**
  - Earned Value [EV (LOE)]
  - Budgeted Cost Work Performed [BCWP(LOE)]

Other LOE Approaches

- Hunter Approach: [12-13]
  - Based on budgeted cost of EV and Planned Value (PV)
  - Subjective based on staffing plan
    - SPI =0 : task NOT staffed
    - SPI = 1: task IS staffed
- Kondur Approach: Effort based CPI and SPI [12], [15]
  - EV calculation method determined by hours earned
  - Uses the difference between baseline (planned) work and remaining (estimated) work
  - Formula:
    - Baseline – Remaining = EV
    - Range: 0 ≤EV ≥ Baseline Work (after task 100 percent)
- Fleming & Koppelman Approach: [16], [17]
  - Quantify LOE into discrete effort tasks
  - Separate LOE tasks outside of discrete project measures

Other LOE Approaches (cont'd)

- Booker & Cleary Approach: [12], [16]
  - Effort separated
    - DE (same as industry defined)
      - Apportioned effort treated as DE
    - Operational effort
      - Separates DE and LOE in vector form calculation
      - Defined as phased, escalating, consistent, or work used for continual improvement for tasking without a defined method of measure
  - Formula Expression:
    - AC = [Discrete, Operational]
    - BAC = [Discrete, Operational]
    - CV = [Discrete, Operational]
  - Recommends separate performance measurement baselines
  - Ordered pairs provide:
    - Provides variances
    - Measured based on accomplishments

Model Development

- Hypothesis:
  - There is a relationship of artifacts collected and tracked to a SEM performance measure
  - SEM performance measure is related to overall project outcome
- Assumptions:
  - Systems Engineering Acquisition Process
  - Allocated resources
    - Adequate staffing
    - Appropriate funding
  - Design reviews are milestone events
    - Preliminary Design Review
    - Critical Design Review
  - Entrance and exit criterion are defined by each design review
  - Findings or actions are documented for each design review
    - Database maintained
    - Scope growth is probable based on further analysis of findings or actions
- Test:
  - Hypothesized small sample of numbers used based on assumptions
  - Change in effort follow hypothesis based on assumptions

Model Development (cont'd)

- **EV** = The value for tasking or part of tasking that has been completed
- **PV** = The expected value for the completion of tasking
- **SPI** = a task performance index illustrating a ratio between the amount completed versus expected
- **Yi** = Uses the current time (t) status of open or unresolved issues of artifact being used. Example: the current month number of open action items in database
- **Yi -1** = Uses the previous time (t-1) status of opens or unresolved issues of artifact being used. Example the previous month number of open action items in database.
- **Xi** = Uses the current time (t) status of total issues of artifact being used. Example: the current month number of total open and closed action items in database
- **Xi-1** = Uses the previous time (t-1) status of total issues of artifact being used. Example: the previous month number of open and closed total action items in database.

Model Development (cont'd)

Current Method

- EV = PV
- SPI = EV/PV= 1
- Recall from previous

  EV = The value for tasking or part of tasking that has been completed
  PV = The expected value for the completion of tasking
  SPI = a task performance index illustrating a ratio between the amount completed versus expected

Developed Method

- DELTA= Yi-1/Xi-1 - Yi/Xi
- EV(LOE) = [EV + EV(Delta)]
- SPI(LOE) = [EV(LOE)]/PV
- Recall from previous

  Yi = Uses the current time (t) status of open or unresolved issues of artifact being used. Example: the current month number of open action items in database
  Yi -1 = Uses the previous time (t-1) status of opens or unresolved issues of artifact being used. Example the previous month number of open action items in database.
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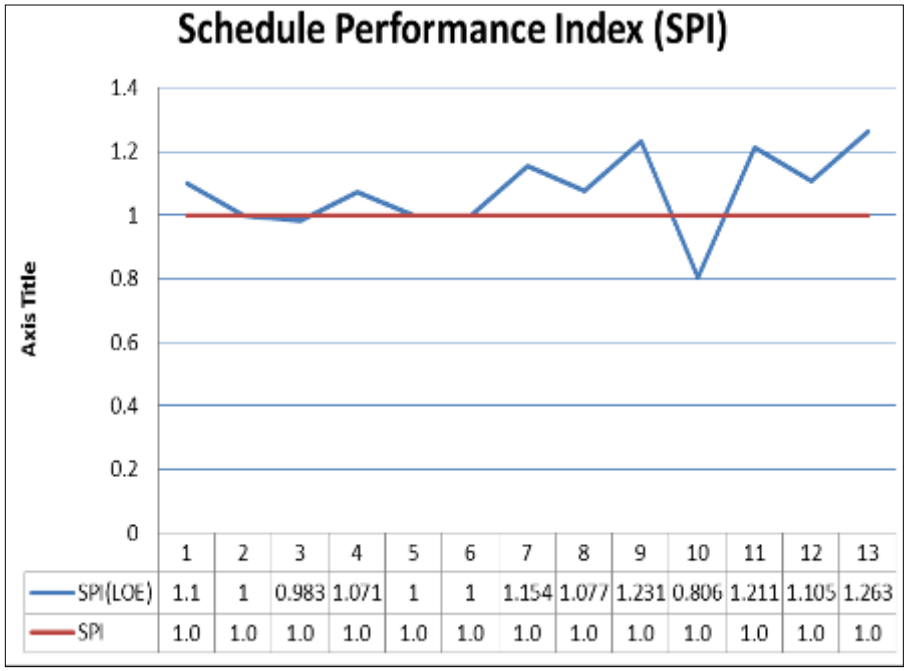
Model Comparison

Instantaneous View

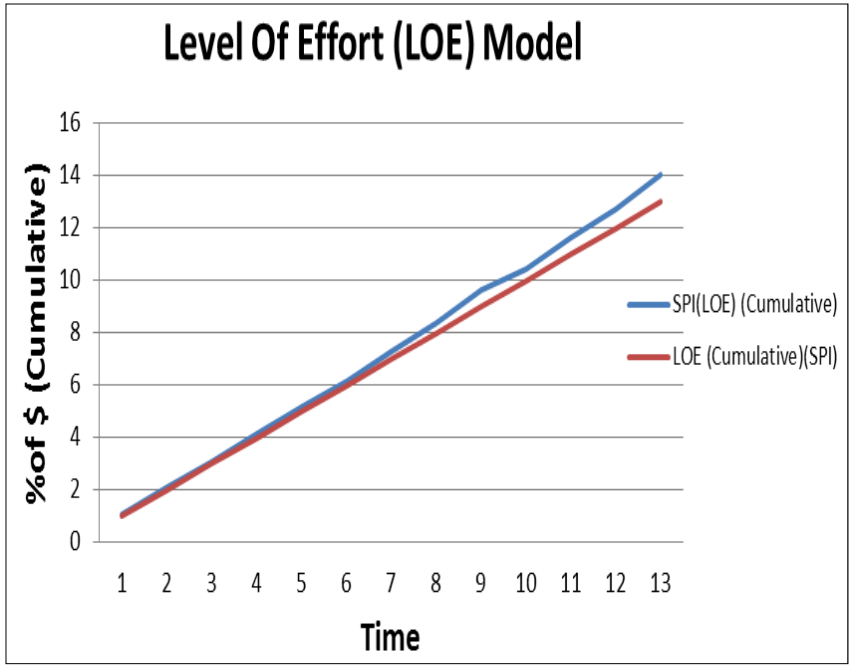
- Change indicates objective effort performed
- (Free to discuss results)

Cumulative View

- Change in line show effort trends
- (Free to discuss results)



	1	2	3	4	5	6	7	8	9	10	11	12	13
SPI(LOE)	1.1	1	0.983	1.071	1	1	1.154	1.077	1.231	0.806	1.211	1.105	1.263
SPI	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0



Model Comparison (cont'd)

Current Method (SPI)

- Strengths
  - Curve shows straight line (constant)
  - Staffing accomplishments has no impact to SPI
  - Simplified reporting
- Shortfall(s)
  - Adverse Influence to overall project schedule performance
  - Lacks schedule variance
  - Consistent projected outcome

Developed Method (SPI)

- Strengths
  - Impacts demonstrated based on staffing accomplishments
  - Curve shows alternative shape (change)
  - Incorporates select artifact(s)
- Shortfall(s)
  - (Free to discuss)

Summary

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- Research Review
- EVM
- Other LOE Approaches
- Model
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Open Discussion

Comments

Questions

Concerns

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Backup

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Author Biography

Lynwood ("Skip") Townsend received his Bachelors of Science in Electrical Engineering from the University of North Florida, his Masters Engineering Management from Old Dominion University, and he is a doctoral candidate at The George Washington University in Systems Engineering and Engineering Management program. Mr. Townsend has 28 years experience working with the Department of Navy, Naval Sea Systems Command, and Naval Surface Warfare Centers Dahlgren and Indian Head Divisions. His experience includes 20 years of active duty naval service as operations and maintenance (O&M) technician and manager in various computing, display, and combat weapon systems. Over the past 8 years, Mr. Townsend has been a systems engineer and manager in ship and system integration of combat and weapon systems on Aegis and Aircraft carrier surface combatants. His previous positions included In-Service/Lifecycle Engineering Agent representative as Fleet and operations support lead to Aegis and Aegis Ballistic Missile Defense (ABMD) surface combatants; Deputy and later the Warfare Systems Engineering Manger for USS *Nimitz* (CVN 68)-class aircraft carriers for refueling and overhaul service; Principal for Safety; and Environmental, Safety, Occupation, and Health Integrated Product Team lead for an Anti-Torpedo Defensive System. Mr. Townsend now serves as the Warfare System Engineering Manager Deputy for the PCU *Gerald R. Ford* (CVN 78)-class aircraft carriers for Naval Surface Warfare Center Dahlgren Division (NSWCDD).

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Shahram Sarkani, Ph.D., P.E., is professor of Engineering Management and Systems Engineering at GWU, and he has been a member of the faculty since 1986. His administrative appointments at GWU include Chair of the Civil, Mechanical, and Environmental Engineering Department, Interim Associate Dean for Research and Development for the School of Engineering and Applied Science, and Faculty Adviser and Academic Director of EMSE Off-Campus Programs. In his current role, Dr. Sarkani designs and administers world-wide off-campus programs in 20 locations with over 1,000 graduate students pursing Master of Science and Doctor of Philosophy degrees in several areas within the fields of systems engineering and engineering management.