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Measuring Progress and Performance

Earned Value Management System (EVMS) Philosophy

(A white paper by David L. Woody – Zaetric Business Solutions, LLC - 2000)

I) SCOPE

A) The degree of management and control maintained on a project depends largely on the consistency, methodology and tools used to measure and report on progress and performance. Quite simply, knowing "where we are" as compared to "where we want to be" is the basic tenet for an Earned Value Management System (EVMS). By keeping frequent track of how our project resources are being utilized and comparing that against how the planned for them to be utilized, we can more effectively place resources where they are needed most. We will be more prepared to react to changes in priorities and unforeseen events within a project or plan for and manage the resource requirements for additional projects or tasks. The comparison of "where we are" and "where we want to be" will show real variance from plan and will give us information in order to generate the necessary corrective action.

B) Planning and preparation is the key. In order to measure performance, budgets for all resources on the project must sum to the budgeted total cost of the entire project resources. In doing so, each increment of resource or task is assigned a value (budget) that is relational to the total cost. When an increment of resource or task is done, its value is earned, hence the term "Earned Value".

C) This philosophy will outline the requirements to implement as well as how to use an EVMS to manage project costs and resources at a typical EPC (Engineering, Procurement and Construction) company.

II) What does an EVMS provide?

A) A properly managed EVMS will provide the following:
   1) Work progress status
   2) Relationship of planned cost and schedule to actual accomplishment in valid, timely and auditable data
   3) A basis for Estimate at Completion (EAC)
   4) Summaries developed at the lowest practical WBS and organizational level

III) Principles of EVMS

A) For an EVMS to be effective, it should do or be the following:
   1) Provide a measure of the physical quantities of work done
   2) Provide a measure of the current total scope of work of the project
   3) Express the work done as a percentage of the total current scope of work
   4) Be unbiased – it should not be significantly affected by optimism or pessimism
   5) Be realistic – it should reflect the many hard-to-measure items of work that, individually, may be small but which, collectively, contribute significantly to the scope of work
   6) Be agreed upon by those whose performance is being measure and by those who are doing the measuring
   7) Be fair to those who are doing the work and those who are paying for it
   8) Be efficient – it should not require excessive time to collect, analyze, and present the data.
   9) Be well documented to assure consistency
   10) Be independent of actual work-hours and cost – it should measure actual physical work done without regard to the number of work-hours spent.

IV) Steps to EVMS for Engineering, Procurement and Fabrication

A) Divide Scope of Work into Packages for Control

1) Engineering - The work package to use for structuring the EVMS is the Product Codes (AL = Anchor leg, LB = Lower Bearing, etc…). Each Product Code may involve various Engineering disciplines. For each discipline involved with a particular Product Code, the activities required to complete the scope of work for that Product Code and discipline must be defined (by the discipline lead responsible for the work). Additionally, the activity duration, number of resources and respective level of effort (full time, part time, 10 hrs/ wk, etc…) and any dependencies that relate this activity to other activities within the project scope, must be defined.
2) Procurement - The work package to use for structuring the EVMS is the Product Codes (AL = Anchor leg, LB = Lower Bearing, etc…). Each Product Code may involve various Vendors. For each vendor involved with a particular Product Code, the activities required to complete the scope of work for that Vendor's Product, must be defined by the Project Buyer responsible for the procurement of said item. Additionally, the activity duration, costs and any dependencies that relate this procurement activity to other procurement activities within the project scope, must be defined.
3) Fabrication - The work package to use for structuring the EVMS is the Product Codes (AL = Anchor leg, LB = Lower Bearing, etc…). Each Product Code may involve various Fabrication activities and assembly of owner furnished equipment in accordance to the BOM. For each Fabrication activity involved with a particular Product Code, the activities required to complete the scope of work for that Product Code must be defined by the Site Manager responsible for the work. Additionally, the activity duration, estimated or budgeted cost and any dependencies that relate this activity to other activities within the project scope must be defined.

B) Establish the Standard Work Unit
1) Engineering - Cost will be the established Standard Work Unit. Cost will be determined by using the duration and level of effort (from work package definition) and multiply that by the overhead cost of the applicable resources to get the time-phased cost of the Standard Work Unit for each discipline.
2) Procurement - Cost will be the established Standard Work Unit. Cost will be determined by Proposal budgetary amounts established when the project is turned over to Operations for execution. This will be a joint effort between the Project Buyer and the Cost Engineering use a definitive Project Bill of Materials (BOM) furnished by Engineering at the beginning of Project execution.
3) Fabrication - Cost will be the established Standard Work Unit. Cost will be determined by Proposal budgetary amounts established when the project is turned over to Operations for execution. This will be a joint effort between the Project Manager and the Cost Engineer using a definitive project Fabrication Progress Report (FPR) furnished by the Site Manager prior to fabrication kick-off.

C) Define the "Yardstick" for Measuring Progress
1) Engineering- From definition of the activities that make-up the Product Code, the resource hours (cost) required for each activity will represent a known percentage of the work activities within Product Code and discipline.
2) Procurement - The cost required for each item furnished in accordance with the BOM would represent a known percentage of the cost for all items within the Product Code. The buyer shall be responsible for establishing milestones within each product code so as to effect proper control. Example of milestones are; PO issued, receipt of raw materials, manufacturing, test/hold/ witness points, final delivery and transportation logistics/schedule.
3) Fabrication - Using the field progress report, the Site Manager will report on the progress expressed in percent complete of each fabrication task. Weighting of the fabrication activities making up the field progress report shall be determined by the Site Manager in conjunction with the Project Manager, Cost Engineer and the Fabricator.

D) Define the Method for Aggregating Progress
1) Engineering - The resource hours (cost) for each Product Code will be compared to the total amount of resource hours for all Product Codes on the Project, as a percentage.
2) Procurement - The cost for purchased item making up each Product Code in accordance with the BOM, will be compared, as a percentage, to the total amount of cost for the purchased item of all Product Codes on the Project.

3) Fabrication - The cost for each Fabrication activity will be compared to the total amount of costs for all Fabrication activities as a percentage for that particular Fabrication Contract. Percentages from multiple Fabrication Contracts on the same project will be combined at the summary level.

E) Define Who Will Measure Progress and How Often
1) Engineering - Progress will be measured and reported to the Cost Engineer twice monthly by the Engineering discipline leads responsible for the work activities within a Product Code
2) Procurement - Progress will be measured and reported to the Cost Engineer twice monthly by the responsible Buyer.
3) Fabrication - Progress will be measured and reported to the Cost Engineer weekly by the Site Manager responsible for the work activities within a Fabrication contract

V) EVMS Data Analysis

A) Definitions
1) Budgeted Cost for Work Scheduled (BCWS) – The sum of the budgets for all work packages scheduled to be accomplished (including in-process work packages) plus the amount of level of effort schedule to be accomplished within a given time period.
2) Budgeted Cost of Work Performed (BCWP) – the sum of the budgets for completed work packages and completed portions of open work packages, plus the appropriate portion of the budgets for level of effort. *A.k.a. – "EARNED VALUE"*
3) Actual Costs of Work Performed (ACWP) – The costs actually incurred and recorded in accomplishing the work performed within a given time period.
4) Cost Variance (CV) – The numerical difference between earned value (BCWP) and actual costs (ACWP)
5) Schedule Variance (SV) – The numerical difference between earned value (BCWP) and the budget plan (BCWS)
6) Budget at Completion (BAC) – The sum of all budgets (BCWS) allocated to the project. This is the BASELINE against which all performance is measured.
7) Estimate at Completion (EAC) – A value periodically developed to represent a realistic appraisal of the final cost to complete an effort and includes a sum of all direct and indirect costs to date, plus the estimate of cost for all authorized work remaining.
8) Estimate to Completion (ETC) – A mathematically or intuitively derived estimation of the remaining work to be completed in terms of dollars or man-hours.
9) Task Manload – forecast of manpower required to perform the activities for a given Product Code – based on the resource loaded activities in the schedule.

B) The Analysis Methodology
1) Origination of Cost Data
(a) BCWS – come from a combination of; the resource loaded schedule from Engineering, cost loaded schedule from Procurement and the cost loaded schedule from the Site Manager.
(b) BCWP – comes from Lead Engineer's status reports on schedule Product Code activities, statused schedule from Project Buyer and weekly field progress report from Site Manager.
(c) ACWP – comes from Solomon data base (weekly time cards) and Solomon accounting data (project transactions)
(d) Manload – comes from resource loaded schedule for Engineering.
(e) ETC – comes from Lead Engineer's analysis of remaining work for a specific task.
2) Mathematically Derived Data
(a) CV = BCWP – ACWP
(b) SV = BCWP – BCWS
(c) BAC = Sum of all BCWS
(d) EAC = ACWP + remaining items to complete
(e) ETC = EAC - ACWP
3) What does the mathematically derived data mean and how do we use it?

(a) CV is the relationship of actual cost against the budget. Shows cost over or under run as it related to dollars. If CV is a positive number the project is over the budgeted cost through that period. If the CV is a negative number the project is under the budgeted cost through that period. This data is used by PM (Project Manager, PEM (Project Engineering Manager), Eng Lead, Buyer and Site Manager to determine where their responsibilities are within their given budget.
(b) SV is the difference between earned value and the budgeted baseline. If SV is a positive the project is behind schedule for that defined work package through that period. If the SV is a negative number the project is ahead of schedule for that defined work package through that period. This data is used by PM, PEM, Eng Lean, Buyer and Site Manager to determine where their responsibilities are within their given schedule.
(c) BAC is budgeted cost of the project at completion. This is a non time-phased baseline representing the sum of all the costs associated with the project. This data is used by the PM to report project cost status to management
(d) EAC is an estimate of BAC and represents the forecasted cost at completion of the project. This data is used by PM, PEM, Eng lead, buyer and Site Manager to know their project final costs.
(e) Other data interpretations
  (i) If SV is a positive number and CV is a negative number then you are ahead schedule and under budget. If performance is above expectation or effort required was over estimated in the budget. Corrective action – review estimate for over estimations and adjust EAC.
  (ii) F SV is a negative number and CV is a positive number then the project is behind schedule and over budget. Performance is below expectation or effort required was under estimate in the budget. Corrective action – review estimate for under estimations and adjust EAC. Investigate lack of performance.
  (iii) If SV and CV are both positive number then the project is ahead of schedule and over budget. This may not necessarily indicate a true over budget situation. Most likely means the project has over allocated resources (too much manpower applied). Corrective action – decrease manpower allocation (move resources to other tasks/projects).
  (iv) If SV and CV are both negative number then the project is behind schedule and under budget. This may not necessarily indicate a true budget under run. Most likely means that not enough resources are allocated to the project to meet schedule requirements. Corrective action – increase man power allocation (move resources from other tasks/project or hire additional resource)
  (v) If ETC causes EAC to exceed BCWP then the project will be over budget. This means the job was under estimated or that performance was less than expected. Corrective action – improve performance or adjust EAC to reflect reality or extend project completion date.

4) EVMS Data Formats
  (a) CV - graph
  (b) SV - graph
  (c) BAC – cost report
  (d) EAC – cost report
  (e) ETC - spreadsheet
  (f) BCWP, ACWP, BCWS – graph
  (g) Manload - graph

VI) EVMS Responsibilities of the Project Team

A) Cost Engineer
  1) Gather EVMS data from Project Team and Solomon system
  2) Perform EVMS calculations
  3) Distribute EVMS data to Project Team

B) PM
  1) Supervise and expedite delivery of EVMS data to Cost Engineer from PEM, Project Buyer and Site Manager
  2) Monitor EVMS data from Cost Engineer and highlight corrective action to Project Team members
  3) Report EVMS data to management

C) PEM
   1) Furnish EVMS progress data to Cost Engineer for analysis
   2) Monitor EVMS output data relating to Engineering activities for each Product Code
   3) Distribute EVMS data to respective Lead Engineers
   4) Liaise with Lead Engineer to determine any corrective action that may be required as identified by the EVMS data
   5) Follow-up with Lead Engineer to make sure that corrective actions have been taken

D) Engineering Leads
   1) Maintain a resource schedule for the discipline and product code(s) being managed. This schedule must reflect the same tasks as identified in the task manloads. This schedule must be auditable and identical in format for all discipline leads and use of consistent data formats across all reporting periods
   2) Furnish Product Code activity status to PEM for EVMS analysis
   3) Furnish ETC & EAC data in terms of man-hours
   4) Review EVMS output data and determine, with PEM, if corrective action is required
   5) If corrective action is required, define said same and effect
   6) Manage Engineering resource associated with their assigned Product Code activities

E) Project Buyer
   1) Furnish procurement progress data and activity status to Cost Engineer
   2) Review EVMS output data and determine, with PM and Cost Engineer, if corrective action is required
   3) If corrective action is required, define said same and effect
   4) Manage Vendor associated with their assigned Product Code activities

F) Site Manager
   1) Furnish Fabrication progress data and activity status to Cost Engineer
   2) Review EVMS output data and determine, with PM and Cost Engineer, if corrective action is required
   3) If corrective action is required, define said same and effect
   4) Manage Fabrication Contractor associated with their assigned Product Code activities

VII) EVMS Policy Management

A) EVMS Procedure Maintenance - The EVMS procedure shall the responsibility of the Project Controls Department which will be responsible for its storage and performance auditing

B) EVMS Procedure Changes - Any employee can recommend changes to the EVMS policy. All recommended changes shall be made in writing to the Director of Project Controls or their designee. A committee will be formed with a representative from Project Controls, Project Management, Engineering and the person (or a representative from their group) requesting the change. The merits of the change will be presented by the change requester and will be discussed in detail by the committee. The committee will make a recommendation to management. Upon management approval, the procedures will be changed and all personnel involved in the EVMS will be made aware of the change and its impact, if applicable on their performance of work.

C) EVMS Auditing - The EVMS will be audited at least once every 12 months to verify conformance to procedure. The Director of Project Controls or their designee shall perform the audit. Spot audits between the 12-month normal audit periods shall be allowed if evidence of non-conformance to procedure is noted.