Earned Value Management

Practical EVM

An Earned Value Management System (EVMS) is a performance management system. An effective EVMS should be designed to assist the performance of the project's management team at predefined control points within the overall structure of the project's management and control systems. The purpose of the EVMS is to:

1. Objectively measure performance to date

2. Identify issues and opportunities for performance improvements

3. Predict outcomes based on performance to date (ie, the expected outcome if the identified opportunities for improvement are not actioned).

In our article *Earned value management: 6 things people don't get!*[1] We highlighted six common misunderstandings around Earned Value Management (EVM) that can waste a lot of time and money, and will quickly lead to an EVMS failing. Three of the key points in '*6 things*' paper are:

1. EVM is not a pretty 'S-Curve' chart, in fact a chart like this does not exist in ISO 21508:2018[2]. The project time slippage and estimated cost curve cannot be calculated from standard EVM data[3]. The chart may be a useful presentation tool, but is too general for use managing the project.

2. EVM is not a cost management tool and cannot be run out of the project accounting systems.

3. EVM is not a scheduling tool and cannot be run out of scheduling software.

Making EVM Work

The project control tool at the center of the EVM system is the Work Breakdown Structure (WBS). The WBS breaks the project's deliverables down to a series of work packages with a Control Account Manager (CAM) assigned to manage the work within each work package. This means each work package needs to be big enough to have a manager appointed with sufficient authority to direct and manage the work, and the work package needs to be open long enough for the EVM reporting to make a difference. A more detailed discussion on this is in our article *Sizing Work Packages*[4].

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[1] Download *Earned value management: 6 things people don't get!* from:
https://mosaicprojects.com.au/Mag_Articles/AA011_EVM_Things_people_dont_get.pdf

[2] ISO 21508:2018 *Earned value management in project and programme management*

[3] Earned schedule will calculate a finish date, but not the curve profile, this can only be assumed.

[4] Download *Sizing Work Packages* from:
https://mosaicprojects.com.au/Mag_Articles/AA012_EVM_Sizing_Work_Packages.pdf

The design of the WBS is central to the effective implementation of EVM, the work packages need to align the project deliverable, with the management hierarchy, relevant sections of the project cost system, and a subset of the activities in the project schedule:

- A clear point of management responsibility is required.
- Each schedule activity should only roll up into a single work package, represented by a summary activity in the schedule.
- Ideally in any given time period costs accrued against a line item in the project chart of accounts should only relate to one work package. This is more difficult to achieve, but the need to split cost items across two or more current work packages should be minimized.

A well designed WBS, and its work packages, are focused on the points of management responsibility for the completion of each of the deliverables needed to complete the project. The assigned manager is responsible for managing the details of how the deliverable he or she is responsible for will be created which includes having a detailed schedule, and detailed cost information to assist in the management and control of the work.

What does this look like in practice?

Let's consider the design and construction of a reasonably simple new railway bridge, budget cost $15 million with a 10-month timeframe (the picture below is a random image).
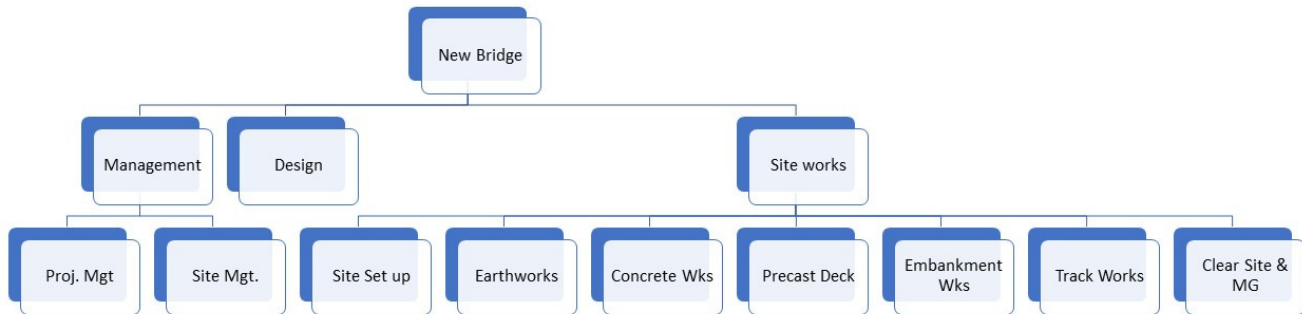

The WBS for this project, decomposed to the work package level, could look something like this:
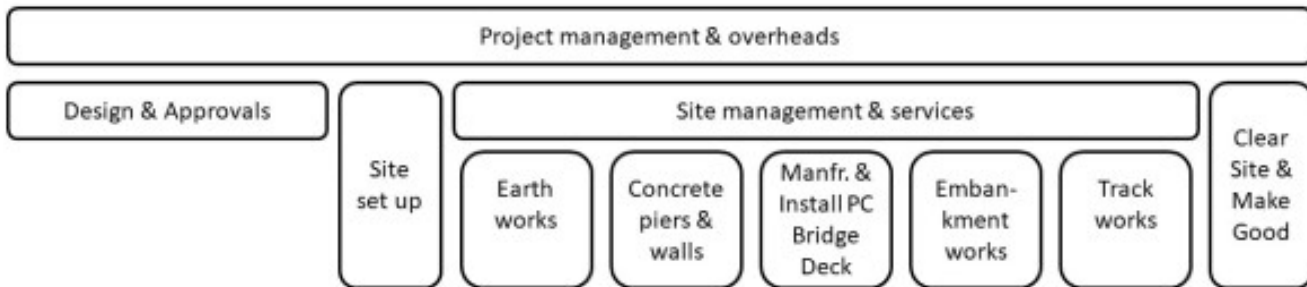
New Rail Bridge – WBS

The general arrangement of the work packages in a block diagram would be:

New Rail Bridge – Work Packages

The various work packages vary between around $300,000 and $5,000,000. The key element is grouping similar works into the one work package (aligned with the major subcontractors) and making the transfer of costs from the project accounts into the work package as simple as possible.

This WBS is not *the correct answer*, it is just one possible answer; different organizations may choose to create a different pattern of work packages. The key consideration ensuring the breakdown of the work aligns with the organizations management structure and the intended way of working. If this is achieved, we have a starting point for an effective EVMS.

The next step is to look at the system needed to process earned value calculations. There are a range of software tools available with varying levels of sophistication (and cost)[5]. A fully featured tool will link to the organizations scheduling tool, cost control system, and will maintain the various logs and other records and reports required for a fully functional EVMS that complies with ISO 21508, or another appropriate standard.

However, for an organization looking to explore the value of EVM, this level of investment may not be appropriate at first. To this end we have developed a simple spreadsheet that offers the basic EVM functionality, allowing the primary benefits derived from an EVMS to be assessed without undue expenditure of time and effort.

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[5]   A listing of some of the available **EVMS tools** can be seen at:
https://mosaicprojects.com.au/PMKI-SCH-030.php#Cost

Earned Value Management

mosaic	*Easy EVM* Workbook														
Sample Rail Bridge EVM							Update Date:	21-Feb-22		ETC: $10,867,781.44	EAC: $15,059,281.44	VAC:	-$59,281.44		

WP #	WP Description	Baseline Values			Actual This Update				AC	%*	Planned Value	Earned Value	SV	SPI	CV	CPI	Errors
		Start	End	$ Budget	Start	End	Account Costs	Acrual Costs									
	Project totals =	15-Nov-21	15-Sep-22	$15,000,000.00	15-Nov-21	-	$3,669,000.00	$522,500.00	$4,191,500.00	-	$4,010,642.33	$4,175,000.00	$164,357.67	1.041	-$16,500.00	0.996	
1.1	Project management and overheads	15-Nov-21	15-Sep-22	$850,000.00	15-Nov-21		$266,000.00	$8,000.00	$274,000.00	32.00%	$274,013.16	$272,000.00	-$2,013.16	0.993	-$2,000.00	0.993	
1.2	Site management and services	02-Jan-22	15-Sep-22	$600,000.00	10-Jan-22		$82,000.00	$9,500.00	$91,500.00	15.00%	$117,187.50	$90,000.00	-$27,187.50	0.768	-$1,500.00	0.984	
2	Design & Approvals	15-Nov-21	31-Jan-22	$1,550,000.00	15-Nov-21	20-Jan-22	$1,558,000.00		$1,558,000.00	100.00%	$1,550,000.00	$1,550,000.00	$0.00	1.000	-$8,000.00	0.995	
3.1	Site set up	02-Jan-22	31-Jan-22	$300,000.00	15-Jan-22	10-Feb-22	$255,000.00	$60,000.00	$315,000.00	100.00%	$300,000.00	$300,000.00	$0.00	1.000	-$15,000.00	0.952	
3.2	Earth works	20-Jan-22	20-Mar-22	$1,500,000.00	25-Jan-22		$900,000.00	$210,000.00	$1,110,000.00	75.00%	$813,559.32	$1,125,000.00	$311,440.68	1.383	$15,000.00	1.014	
3.3	Manfr. & Install PC Bridge Deck	02-Jan-22	25-Jul-22	$3,900,000.00	20-Dec-21		$600,000.00	$190,000.00	$790,000.00	20.00%	$955,882.35	$780,000.00	-$175,882.35	0.816	-$10,000.00	0.987	
3.4	Concrete piers & walls	01-Mar-22	30-May-22	$2,900,000.00	15-Feb-22		$8,000.00	$45,000.00	$53,000.00	2.00%		$58,000.00	$58,000.00	N/A	$5,000.00	1.094	
3.5	Embankment works	30-May-22	10-Jul-22	$1,200,000.00													
3.6	Track works	26-Jul-22	30-Aug-22	$1,700,000.00													
3.7	Clear Site & Make Good	30-Aug-22	15-Sep-22	$500,000.00													

The instructions for using the spreadsheet are:

1. The spreadsheet is designed to process the data for a single update. After each update is complete, save a copy of the spreadsheet ready for the next update and then edit / add the new information.

2. The spreadsheet is protected, data can only be entered in the cells shaded light green.

3. Work package numbers and descriptions are free-form and can be edited to suit the needs of the project. Once created, these should not change.

4. It is recommended a schedule be set up for the project with the following characteristics:

    a. The schedule contains a summary activity for each work package with detail tasks below

    b. The summary activity be set to roll up 'physical percent complete' from the activities

    c. Baseline start and end dates are obtained from the schedule and transcribed into the relevant fields. Once entered, these should not be changed.

    d. Progress dates and percent complete are transcribed from the schedule at each update

5. Baseline budget values are obtained from the project budget. Once entered these values should not be changed. The total budget (BAC) is summed at the top of the table for verification.

6. Any change to the baseline values should be approved and fully documented. See: *Easy EVM, Section 4.2.4*.

7. The update date is entered at the top of the table, this should be the same date as used to update the schedule.

8. The actual start date for the work package is obtained from the schedule. Once entered, this should not be changed.

9. The worksheet assumes progress within the work package is uniform, therefore once started, an actual cost value and a percent complete value must be entered. $1 and 1% are acceptable.

10. The actual finish date for the work package is obtained from the schedule. Once entered, this should not be changed.

11. The Actual Cost (AC) comprises two values, the actual costs for the work package recorded in the project accounting system, plus an accrual value to cover the cost of work performed, but not yet recorded in the project accounts, the accrual will typically be an estimate revised at each update.

12. The physical percent complete (%) is either derived from the schedule (preferred) or estimated.

13. The calculated variance for each work package in progress should be reviewed and actioned. See: *Easy EVM Section 4.4*.

14. Trend information is valuable, reviewing changes in a work package over several updates (saved worksheets) will indicate if the project situation is improving or deteriorating.

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In this example, the baseline values were entered when the project was set up in the spreadsheet and are shown in the **Baseline Values** columns. Progress data was entered as at the 21st February 2022 is in the **Actual This Update** columns. The data entry fields are shaded green; at each update, most of the data should be transcribed from the schedule or carried forward from the previous update.

Easy EVM Workbook

Sample Rail Bridge EVM — Update Date: 21-Feb-22

WP #	WP Description	Baseline Values			Actual This Update					
		Start	End	$ Budget	Start	End	Account Costs	Acrual Costs	AC	%*
	Project totals =	15-Nov-21	15-Sep-22	$15,000,000.00	15-Nov-21	-	$3,669,000.00	$522,500.00	$4,191,500.00	-
1.1	Project management and overheads	15-Nov-21	15-Sep-22	$850,000.00	15-Nov-21		$266,000.00	$8,000.00	$274,000.00	32.00%
1.2	Site management and services	02-Jan-22	15-Sep-22	$600,000.00	10-Jan-22		$82,000.00	$9,500.00	$91,500.00	15.00%
2	Design & Approvals	15-Nov-21	31-Jan-22	$1,550,000.00	15-Nov-21	20-Jan-22	$1,558,000.00		$1,558,000.00	100.00%
3.1	Site set up	02-Jan-22	31-Jan-22	$300,000.00	15-Jan-22	10-Feb-22	$255,000.00	$60,000.00	$315,000.00	100.00%
3.2	Earth works	20-Jan-22	20-Mar-22	$1,500,000.00	25-Jan-22		$900,000.00	$210,000.00	$1,110,000.00	75.00%
3.3	Manfr. & Install PC Bridge Deck	02-Jan-22	25-Jul-22	$3,900,000.00	20-Dec-21		$600,000.00	$190,000.00	$790,000.00	20.00%
3.4	Concrete piers & walls	01-Mar-22	30-May-22	$2,900,000.00	15-Feb-22		$8,000.00	$45,000.00	$53,000.00	2.00%
3.5	Embankment works	30-May-22	10-Jul-22	$1,200,000.00						
3.6	Track works	26-Jul-22	30-Aug-22	$1,700,000.00						
3.7	Clear Site & Make Good	30-Aug-22	15-Sep-22	$500,000.00						

The objective measure of performance in the spreadsheet is set as physical percent complete which is an option in most scheduling tools, the percent complete as at the data date entered is in the % column above. Based on this information, the spreadsheet then calculates the status of the work packages and the overall project:

Update Date: 21-Feb-22				ETC: $10,867,781.44	EAC: $15,059,281.44	VAC: -$59,281.44			

AC	%*	Planned Value	Earned Value	SV	SPI	CV	CPI	Errors
$4,191,500.00	-	$4,010,642.33	$4,175,000.00	$164,357.67	1.041	-$16,500.00	0.996	
$274,000.00	32.00%	$274,013.16	$272,000.00	-$2,013.16	0.993	-$2,000.00	0.993	
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$1,558,000.00	100.00%	$1,550,000.00	$1,550,000.00	$0.00	1.000	-$8,000.00	0.995	
$315,000.00	100.00%	$300,000.00	$300,000.00	$0.00	1.000	-$15,000.00	0.952	
$1,110,000.00	75.00%	$813,559.32	$1,125,000.00	$311,440.68	1.383	$15,000.00	1.014	
$790,000.00	20.00%	$955,882.35	$780,000.00	-$175,882.35	0.816	-$10,000.00	0.987	
$53,000.00	2.00%		$58,000.00	$58,000.00	N/A	$5,000.00	1.094	

The calculations are standard EVM[6] formula and immediately highlight the opportunities for improvement. By keeping a copy of each month's update, changes over time and trends are also easy to see. Overall, this

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[6] For a brief overview of the **EVM calculations** see:
https://mosaicprojects.com.au/WhitePapers/WP1081_Earned_Value.pdf

project is ahead of time (there is a positive Total SV) a with a relatively small negative cost variance, but if something does not happen to improve the production of the bridge deck units (SV -$175,882,35) the current gains will be lost.

A functioning EVMS will include processes that require the responsible Cost Account Manager (CAM) to explain what has caused the negative SV, and more important, what is being done to resolve the problem before it becomes a major issue. Similar questions should be asked of the CAMs responsible for the other significant negative variances in open work packages.

Conclusion

Earned Value Management (EVM) is a powerful tool designed to focus management effort onto significant issues and opportunities. It works in conjunction with, but is separate to, the schedule and the project cost reports.

This practical spreadsheet is designed as a low-cost stepping stone towards the implementation of a fully functional EVMS. A fully functional system will automate many of the manual transcriptions required in the spreadsheet and provide better trend analysis and reporting options. However, a sophisticated EVMS will only be as good as the underlaying design of the project WBS and management systems, these aspects can be learned and the organizational culture change needed to embrace EVM begun using this practical tool on a few smaller projects.

The message in our two books, *Easy EVM* and *Easy CPM* is that good project controls are robust, simple and provide management with information they can action. Both books and the *Easy EVM Workbook* are available from the Mosaic website: https://mosaicprojects.com.au/shop-Easy_e-Books.php. For a limited time, you can buy both books and the spreadsheet as a bundle for $60.00.

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