DevTreks –social budgeting that improves lives and livelihoods

Earned Value Management 1

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A. Introduction

How much money has been lost throughout the world by badly managed public infrastructure investments or unaccountable public service improvements? The U.S. GAO (2009) provides evidence that the losses can be huge. They recommend using Earned Value Management (EVM) best practices to stem these losses and to achieve the public benefits needed from the investments. They define EVM as follows:

"Earned value management goes beyond simply comparing budgeted costs to actual costs. It measures the value of work accomplished in a given period and compares it with the planned value of work scheduled for that period and with the actual cost of work accomplished. … "(**1***).

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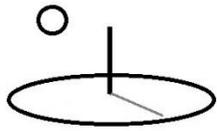
EVM best practices integrate budget, scheduling, and risk analyses. A key requirement of EVM is to measure budget variances and scheduling variances. Budget variances measure the costs [and benefits] of work planned versus actual work completed. Scheduling variances measure the amount, quality, and timeliness of work planned versus actual work completed. EVM measures variances in the value of work planned versus actual work completed.
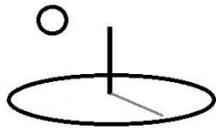
This reference provides examples of how DevTreks measures these variances using Life Cycle (LCA), Net Present Value (NPV), Resource Stock, and Monitoring and Evaluation (M&E) tools. DevTreks' best practices extend EVM to include Outputs (work progress), Outcomes (technical performance), Benefits (earned value), and Resource Stock/M&E indicators (performance effectiveness). The U.S. GAO (2009) reference should be read prior to this reference (**2***).

This reference also demonstrates that, in some instances, summary data can supply sufficient information to make informed decisions and increase the transparency of benefit cost data. This can be particularly helpful when the general public or busy executives are expected to be an important audience for the data.

B. Data URLs

The U.S. GAO (page 202, 2009) uses the following simple example to explain EVM:

"Assume, for example, that a contract calls for 4 miles of railroad track to be laid in 4 months at a cost of 4 million. After 3 months of work, only $2 million has been spent. An analysis of planned versus actual expenditures suggests that the project is underrunning its estimated costs. However, an earned value analysis reveals that the project is in trouble because even though only $2 million has been spent, only 1 mile of track has been laid and, therefore, the contract is only 25 percent complete. Given the value of work done, the project will cost the contractor $8 million ($2 million to complete each mile of track), and the 4 miles of track will take a total of 12 months to complete (3 months for each mile of track) instead of the originally estimated 4 months."

This example will be used to demonstrate how to measure EVM. The data can be examined at the following URIs (we recommend first going through some DevTreks introductory video tutorials). This data is owned by the Reconstruction Science club in the HomeTreks network group (if necessary, switch default clubs).

- **Inputs URI**:

https://www.devtreks.org/buildtreks/preview/commercial/inputgroup/Earned Value Management Examples/2126772316/none/

http://localhost:5000/buildtreks/preview/commercial/inputgroup/Earned Value Management Examples/2126772368/none

- **Outputs URI**:

https://www.devtreks.org/buildtreks/preview/commercial/outputgroup/Earned Value Management Examples/1936433723/none/

http://localhost:5000/buildtreks/preview/commercial/output/2013 RR Track/2141223455/none

- **Components URI**:

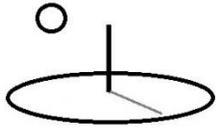https://www.devtreks.org/buildtreks/preview/commercial/componentgroup/Earned Value Management Examples/658/none/

http://localhost:5000/buildtreks/preview/commercial/componentgroup/Earned Value Management Examples/658/none

- **Operations URI:**

https://www.devtreks.org/buildtreks/preview/commercial/operationgroup/Earned Value Management Examples/755/none/

http://localhost:5000/buildtreks/preview/residential/operationgroup/Reconstruction Operation Group/759/none

- **Outcomes URI**:

https://www.devtreks.org/buildtreks/preview/commercial/outcomegroup/Earned Value Management Examples/37/none/

http://localhost:5000/buildtreks/preview/commercial/outcomegroup/Life Cycle Outcome Examples/33/none

- **Capital Budgets URI**:

https://www.devtreks.org/buildtreks/preview/commercial/investmentgroup/Earned Value Management Example/275505678/none/

http://localhost:5000/buildtreks/preview/commercial/investment/RR Track, 2 Time Periods/423/none

- **Operating Budgets URI**:

https://www.devtreks.org/buildtreks/preview/commercial/budgetgroup/Earned Value Management Examples/2140761974/none/

http://localhost:5000/buildtreks/preview/commercial/budgetgroup/Earned Value Management Examples/2140761972/none

- **Multimedia URI**:

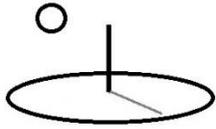https://www.devtreks.org/buildtreks/preview/commercial/resourcepack/Earned Value Management Media/505/none/

- **Story URI:**

https://www.devtreks.org/buildtreks/preview/commercial/linkedviewpack/Earned Value Management 01/151/none/

- **LCA Analyzers URI:**

https://www.devtreks.org/buildtreks/preview/commercial/linkedviewgroup/Life Cycle Cost and Benefit Analyzers/50/none/

- **Benefit Cost Analyzer URI:**

https://www.devtreks.org/agtreks/preview/crops/linkedviewgroup/Benefit Cost 1 Analyzers/60/none/

- **Monitoring and Evaluation Analyzer URIs:**

https://www.devtreks.org/hometreks/preview/farmworkers/linkedviewgroup/M and E 2 Analyzers/61/none/
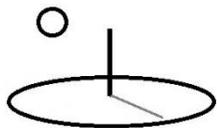
- **Resource Stock Analyzer URIs:**

https://www.devtreks.org/greentreks/select/carbon/linkedviewgroup/Stock Analyzers/64/none/

C. **Outputs, Outcomes, M&E Indicators, Resource Stock Indicators, Operating and Capital Budgets**

DevTreks measures the value of investments using Output and Outcome base elements. The U.S. GAO and cost estimators do not overtly use Outputs or Outcomes to measure EVM. Although their cost estimating and project scheduling techniques can be used in DevTreks to measure EVM, we recommend using Inputs to carry out cost estimating and Outputs to carry out benefit, and earned value, estimating. That aligns more closely with the "best practices" of the Economics profession and the Monitoring and Evaluation discipline (refer to the *Net Present Value 1* reference and the *Monitoring and Evaluation* references). It also makes EVM easier to understand –value comes from output, not from cost estimating schedules. This reference extends GAO's EVM "best practices" to include Outputs and Outcomes.

DevTreks also uses M&E and Resource Stock Indicators for tracking work progress and performance. They are commonly used to determine the effectiveness with which resources are expended (i.e. using Performance Measures such as Incremental Cost Effectiveness Ratios). This reference further extends GAO's EVM "best practices" to include M&E and Resource Stock Indicators.

GAO's reference primarily focuses on managing capital programs, which correspond to Capital Budgets in DevTreks. This reference extends GAO's best practices to include the management of operating programs, which correspond to Operating Budgets.

D. Progress 1 Analysis Properties

A Progress 1 Analysis uses the Totals calculations generated by Life Cycle Analysis (LCA), Net Present Value (NPV), Monitoring and Evaluation (M&E), and Resource Stock, Analyzers to measure actual versus planned progress for aggregated base elements. Further documentation about Progress 1 Analyzers can be found in the *Life Cycle Analysis*, *Benefit Cost Analysis 1, Price Analysis 1, Monitoring and Evaluation, Resource Stock Analysis, and Performance Analysis,* references. Although all base elements can be analyzed using this technique, Operating Budgets and Capital Budgets allow the most straightforward EVM measurement because Outputs and Outcomes can be used to make the earned value measurements. Note that the GAO 2009 reference demonstrates that cost estimates alone can be used to measure EVM.

Two primary properties of base elements must be set correctly to carry out this analysis:

Date is the date of the base element, such as Input.Date, Outcome.Date, Operation.Date, TimePeriod.Date. For Inputs and Outputs, this is the date the Input has been fully expended, or the Output fully received. For the remaining base elements, this is the ending date of the Operation, Component, Outcome, or Time Period. Dates are used to order the planned and actual sequence of elements that will be compared.

Target Type supports setting goals and targets for base elements. The Benchmark option is used to define a baseline, or planned, base element. This element defines goals and targets. The Actual option is used to define the actual results for the same element. Both elements must have the same Label. Target Types are used to build the two collections of planned and actual elements that will be compared. The Target Type property can be can be set using LCA calculators for Inputs and Outputs and NPV calculators for other base elements (see the AlternativeType Change Analysis). **This property must be set for all**
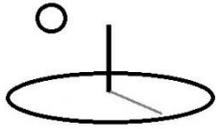
elements that are being compared. We might ease that requirement in future upgrades. Inputs and Outputs are only compared within Input or Output applications and don't need the property set when they are children of Operations, Components, or Outcomes. Operations, Components, and Outcomes need this property set when they are analyzed in budgets.

The Aggregate Using property can be used to first aggregate elements by Label, GroupId, or TypeId. Make sure to set this property to "none" when both Planned and Actual elements are siblings, otherwise both elements may be aggregated together into one element. Planned and actual element comparisons use WBS Labels to find the elements being compared. For example, a comparison of the planned and actual cost of a crop planting Operation uses WBS Labels to find the two Operations. The planned versus actual aggregated elements are compared using the following properties:

Actual Period Total (APTotal) is the actual total for the last period found in the actual budget or base elements. The last period is defined as the last date-ordered aggregated base element. For example, a crop budget may contain aggregated crop operations in the following date order: 1) tillage, 2) planting, 3) nutrient management, 4) cultivation, 5) pest management, and 6) harvest. The Actual Period Total is the last of these crop operations found in the current date-ordered actual element list. An actual crop budget completed through June may find that the Actual Period Total will be for 4) cultivation.

Actual Cumulative Total (ACTotal) is the cumulative total for all of the periods found in the actual budget or base elements. Using the crop budget example, the Actual Cumulative Total is the sum of 1) tillage, 2) planting, 3) nutrient management, and 4) cultivation in the actual budget.

Planned Full Total (PFTotal) is the planned total for the full planning budget or base elements. Using the crop budget example, the Planned Full Total is the sum of 1) tillage, 2) planting, 3) nutrient management, 4) cultivation, 5) pest management, and 6) harvest in the planned budget.

Planned Period Total (PPTotal) is the planned total for the period found in the planned budget or base elements that corresponds to the same period as the Actual Period Total. Using the crop budget example, if the Actual Period Total finds 4) cultivation as the last date-ordered element in the actual budget, the Planned Period Total will use the cultivation's WBS Label to find the corresponding element total in the planned budget (i.e. both might use the same WBS Label, A1010).

Planned Cumulative Total (PCTotal) is the cumulative total for the actual budget, or the actual base elements. The Actual Cumulative Total determines which element will be the last element to include in the cumulative totals. Using the crop budget example, the Planned Cumulative Total is the sum of 1) tillage, 2) planting, 3) nutrient management, and 4) cultivation in the planned budget. The Actual Cumulative Total stopped at 4) cultivation, so the Planned Cumulative Total will do the same.

**Actual Period Change (APChange)**: Actual Period Total – Planned Period Total

Actual Cumulative Change (ACTotal): Actual Cumulative Total – Planned Cumulative Total

Planned Period Percent (PPPercent): (Actual Period Total / Planned Period Total) * 100

Planned Cumulative Percent (PCPercent): (Actual Cumulative Total / Planned Cumulative Total) * 100

Planned Full Percent Percent (PFPercent): (Actual Cumulative Total / Planned Full Total) * 100

The planned budget or elements are sometimes referred to as the "comparator". That is, the actual budget is always being compared to the planned. The planned sequence and actual sequence of elements do not need to match perfectly. The planned sequence may have some elements that the actual found unnecessary, and the planned sequence may have overlooked
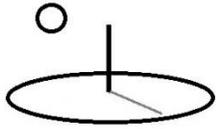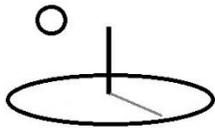
some actual elements that were needed. For example, if the element used to set the Actual Period Total does not find a corresponding planned element, the Planned Period Total will be zero and the Planned Cumulative Total will not change from the last planned totals. Elements in the planned budget that do not have corresponding elements in the actual budget will be added to the Planned Cumulative Total when a subsequent planned element matches an actual element. Dates are not used to make actual-planned element matches because actual dates differ from planned dates unpredictably.

Comparisons of actual and planned elements in Budgets use the same techniques as those explained in the Budget Change Analysis section found in the *Change Analysis 1* reference. For example, an Operation in an actual budget will use its WBS Label to look for a corresponding Operation in a planned budget.

The following Progress 1 Analysis is run at a Component Group level. The Component Group has four planned Components and three actual Components. The last actual Component (not shown) is a cumulative summation of three actual Components and their matched planned Components. The Component Group displays the same results as the last actual Component –a cumulative total of the "actuals versus planneds". The SubCosts are not summed cumulatively for each actual Component (i.e. Component 3 Materials = $66,700) but they are summed for the Component Group (i.e. Component Grup Materials = $200,100).

Change

CAP Actual Cumul Change	-133,200.00	0.00	-266,400.00	0.00	-399,600.00	0.00	0.00
CAP Plan P Percent	66.70	0.00	66.70	0.00	66.70	0.00	0.00
CAP Plan C Percent	66.70	0.00	66.70	0.00	66.70	0.00	0.00
CAP Plan Full Percent	16.68	0.00	33.35	0.00	50.03	0.00	0.00
LCC Plan Period	1,000,000.00	1,000,000.00	1,000,000.00	1,000,000.00	1,000,000.00	1,000,000.00	1,000,000.0
LCC Plan Full	4,000,000.00	4,000,000.00	4,000,000.00	4,000,000.00	4,000,000.00	4,000,000.00	4,000,000.0
LCC Plan Cumul	1,000,000.00	1,000,000.00	2,000,000.00	2,000,000.00	3,000,000.00	3,000,000.00	4,000,000.0
LCC Actual Period	667,000.00	0.00	667,000.00	0.00	667,000.00	0.00	0.00
LCC Actual Cumul	667,000.00	0.00	1,334,000.00	0.00	2,001,000.00	0.00	0.00
LCC Actual Period Change	-333,000.00	0.00	-333,000.00	0.00	-333,000.00	0.00	0.00
LCC Actual Cumul Change	-333,000.00	0.00	-666,000.00	0.00	-999,000.00	0.00	0.00
LCC Plan P Percent	66.70	0.00	66.70	0.00	66.70	0.00	0.00
LCC Plan C Percent	66.70	0.00	66.70	0.00	66.70	0.00	0.00
LCC Plan Full Percent	16.68	0.00	33.35	0.00	50.03	0.00	0.00

The following example of a simple Budget analysis compares a planned Budget for a railroad investment with the actual Budget (this comes from the GAO 2009 example of EVM analysis for 4 miles of railroad track). This Progress Analysis demonstrates that Benefits can be used to
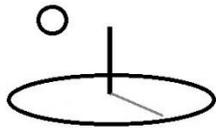
measure EVM variances, Costs can be used to measure cost variances, and both can be used to measure scheduling variances.

The following image, with the brown motif, reflects the Version 2.0.0 results. The remaining images, with the blue motif, reflect the 2014 results. Note the differences in details. Also note that the top image shows that 50% of the investment has been spent, while 25% of the value of the investment has been achieved. In other words, both results reach the same conclusion that the project is 100% over budget. Several tutorials point out that these calculations evolve over the years. Decisions may have been made, based on additional tests with additional datasets, that the 2016 results were the preferred way to conduct these analyses. They may also simply reflect running different datasets on localhost and azure, or displaying Operating Budget results versus Capital Budget results.

No attempt has been made to reconcile the difference for 3 reasons: 1. Closer examination of the complete datasets show consistent results –science-based clubs and networks are assumed to be able to go through the complete datasets and understand the reasons for the different displays of data, 2. The role of clubs and networks is to supply this type of technical documentation and communicate with their technologist about the preferred way to run the calculations and display the results, and 3. DevTreks is not perfect.
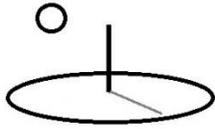
**Time Period : 2013 Time Period 01, ActualLabel: 2013**

Benefit Details

Date : 12/31/2013	Observations : 1; Target Type : actual
R Planned Period : 4,000,000.00	R Plan Full : 4,000,000.00
R Plan Cumul : 4,000,000.00	R Actual Period : 996,000.00
R Actual Cumul : 996,000.00	R Actual Period Change : -3,004,000.00
R Actual Cumul Change : -3,004,000.00	R Planned Period Percent : 24.90
R Planned Cumul Percent : 24.90	R Planned Full Percent : 24.90
LCB Planned Period : 4,000,000.00	LCB Plan Full : 4,000,000.00
LCB Plan Cumul : 4,000,000.00	LCB Actual Period : 996,000.00
LCB Actual Cumul : 996,000.00	LCB Actual Period Change : -3,004,000.00
LCB Actual Cumul Change : -3,004,000.00	LCB Planned Period Percent : 24.90
LCB Planned Cumul Percent : 24.90	LCB Planned Full Percent : 24.90
REAA Planned Period : 0.00	REAA Plan Full : 0.00
REAA Plan Cumul : 0.00	REAA Actual Period : 0.00
REAA Actual Cumul : 0.00	REAA Actual Period Change : 0.00
REAA Actual Cumul Change : 0.00	REAA Planned Period Percent : 0.00
REAA Planned Cumul Percent : 0.00	REAA Planned Full Percent : 0.00
RUnit Planned Period : 4,000,000.00	RUnit Plan Full : 4,000,000.00
RUnit Plan Cumul : 4,000,000.00	RUnit Actual Period : 996,000.00
RUnit Actual Cumul : 996,000.00	RUnit Actual Period Change : -3,004,000.00
RUnit Actual Cumul Change : -3,004,000.00	RUnit Planned Period Percent : 24.90
RUnit Planned Cumul Percent : 24.90	RUnit Planned Full Percent : 24.90

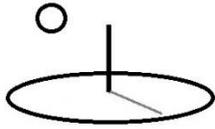## Cost Details

Date : 12/31/2013	Observations : 1; Target Type : actual
OC Planned Period : 1,800,000.00	OC Plan Full : 1,800,000.00
OC Plan Cumul : 1,800,000.00	OC Actual Period : 900,450.00
OC Actual Cumul : 900,450.00	OC Actual Period Change : -899,550.00
OC Actual Cumul Change : -899,550.00	OC Planned Period Percent : 50.03
OC Planned Cumul Percent : 50.03	OC Planned Full Percent : 50.03
AOH Planned Period : 600,000.00	AOH Plan Full : 600,000.00
AOH Plan Cumul : 600,000.00	AOH Actual Period : 300,150.00
AOH Actual Cumul : 300,150.00	AOH Actual Period Change : -299,850.00
AOH Actual Cumul Change : -299,850.00	AOH Planned Period Percent : 50.03
AOH Planned Cumul Percent : 50.03	AOH Planned Full Percent : 50.03
CAP Planned Period : 1,600,000.00	CAP Plan Full : 1,600,000.00
CAP Plan Cumul : 1,600,000.00	CAP Actual Period : 800,400.00
CAP Actual Cumul : 800,400.00	CAP Actual Period Change : -799,600.00
CAP Actual Cumul Change : -799,600.00	CAP Planned Period Percent : 50.03
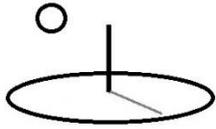
Additional testing of Operating and Capital Budget Progress Analysis for Version 1.9.4 revealed another factor influencing how elements line up in the final analysis. The order of the two Budgets matter. The benchmark has to appear in the search engine before the actual. This can be accomplished by simple naming conventions A. BM Investment and B. Act Investment. This convention may also be needed for the analysis of other elements, such as Time Periods. Additional testing with more datasets, which requires additional resources, can overcome some of the pedestrian, but at times frustrating, aspects of these analyses.

Investment : RR Track, 2 Time Periods

⊖ Benefit Details

Date : 12/19/2013
R Planned Period : 991,000.00
R Plan Cumul : 2,973,000.00
R Actual Cumul : 990,009.00
R Actual Cumul Change : -1,982,991.00
R Planned Cumul Percent : 33.30
LCB Planned Period : 991,000.00
LCB Plan Cumul : 2,973,000.00
LCB Actual Cumul : 990,009.00
LCB Actual Cumul Change : -1,982,991.00
LCB Planned Cumul Percent : 33.30
REAA Planned Period : 0.00
REAA Plan Cumul : 0.00
REAA Actual Cumul : 0.00
REAA Actual Cumul Change : 0.00
REAA Planned Cumul Percent : 0.00
RUnit Planned Period : 991,000.00
RUnit Plan Cumul : 2,973,000.00
RUnit Actual Cumul : 990,009.00
RUnit Actual Cumul Change : -1,982,991.00
RUnit Planned Cumul Percent : 33.30

Observations : 1; Target Type : actual
R Plan Full : 3,964,000.00
R Actual Period : 330,003.00
R Actual Period Change : -660,997.00
R Planned Period Percent : 33.30
R Planned Full Percent : 24.98
LCB Plan Full : 3,964,000.00
LCB Actual Period : 330,003.00
LCB Actual Period Change : -660,997.00
LCB Planned Period Percent : 33.30
LCB Planned Full Percent : 24.98
REAA Plan Full : 0.00
REAA Actual Period : 0.00
REAA Actual Period Change : 0.00
REAA Planned Period Percent : 0.00
REAA Planned Full Percent : 0.00
RUnit Plan Full : 3,964,000.00
RUnit Actual Period : 330,003.00
RUnit Actual Period Change : -660,997.00
RUnit Planned Period Percent : 33.30
RUnit Planned Full Percent : 24.98

⊖ Cost Details

Date : 12/19/2013
OC Planned Period : 450,000.00
OC Plan Cumul : 1,350,000.00
OC Actual Cumul : 900,450.00
OC Actual Cumul Change : -449,550.00
OC Planned Cumul Percent : 66.70
AOH Planned Period : 150,000.00
AOH Plan Cumul : 450,000.00
AOH Actual Cumul : 300,150.00
AOH Actual Cumul Change : -149,850.00
AOH Planned Cumul Percent : 66.70
CAP Planned Period : 400,000.00
CAP Plan Cumul : 1,200,000.00

Observations : 1; Target Type : actual
OC Plan Full : 1,800,000.00
OC Actual Period : 300,150.00
OC Actual Period Change : -149,850.00
OC Planned Period Percent : 66.70
OC Planned Full Percent : 50.03
AOH Plan Full : 600,000.00
AOH Actual Period : 100,050.00
AOH Actual Period Change : -49,950.00
AOH Planned Period Percent : 66.70
AOH Planned Full Percent : 50.03
CAP Plan Full : 1,600,000.00
CAP Actual Period : 266,800.00

E. EVM Performance Measures

GAO recommends using the following metrics (page 250 and table 36, page 253) to analyze EVM:

1. **BCWS (Budgeted cost for work scheduled):** How much work should have been completed by now—or what is the planned value?

2. **BCWP (Budgeted cost for work performed):** How much work has been done—or what is the earned value?
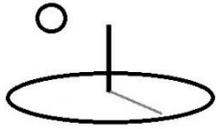
3. **ACWP (Actual cost of work performed):** How much has the completed work cost—or what is the actual cost?

4. **(PCWS (Planned cost of work scheduled):** What is the planned cost of the work that should have been completed?) This measure has been added by DevTreks to make our analyses consistent.

5. **BAC (Budget at completion):** What is the planned total program cost?

6. **EAC (Estimated cost at completion):** What is the program expected to cost, given what has been accomplished?

These metrics coincide with the results of a *Progress 1 Analysis* and will be used in the examples that follow to demonstrate how EVM is measured in DevTreks. The metrics can be used to evaluate EVM using the following types of Performance Measures:

Earned Value to Cost Percent = (Actual Cumulative Benefits (BCWP) / Actual Cumulative Costs (ACWP)) * 100

Estimated cost at completion = Actual Cumulative Total Cost (ACWP) / Planned Full Benefit Percent

Or: ACWP (cumulative) + (ACWP (cumulative) / Actual Output) * Remaining Outputs

Estimated Percent over (+) or under (-) Budget = ((Estimated Actual Cost to Complete Work - Planned Cost of Work Scheduled (PCWS)) / Planned Cost of Work Scheduled (PCWS)) * 100

F. **Planned versus Actual Budget, and Base Element, Preparation**

EVM measurements use the following general steps to analyze all base elements. The "budgets" mentioned in these steps can be full Operating or Capital Budgets, but, as many of the examples demonstrate sibling base elements can also be used.

1. Building a baseline performance budget that fully defines the planned work (BAC measured using Inputs and Components), and planned work results (BCWS measured
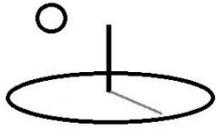
using Outputs and Outcomes). With the exception of Inputs and Outputs, the base elements in this budget must include a Benchmark Target Type property.

2. Progressively building an actual budget that fully accounts for the cost of the actual work completed (ACWP measured using Inputs and Components), and that fully accounts for the actual earned value of the work completed (BCWP measured using Outputs and Outcomes). With the exception of Inputs and Outputs, the base elements in this budget must include an Actual Target Type property.

3. Running an LCA, NPV, M&E, and/or Stock *Progress 1 Analysis* that generates the needed measurements (BAC, BCWS, ACWP, BCWP, EAC). Fixing any data discrepancies found in the data. Note that we have not fixed minor discrepancies in this example because we're a technology company rather than a content provider (and because, of course, we're not perfect).

4. Using Performance Measures to analyze the measurements and adding the results to a story that explains the status of the investment.

5. Taking pictures and videos of the investment that can be used to verify the status of the project and adding either their URLs to the Analyzer.MediaURL or to a separate story.

G. Example 1. EVM and Life Cycle Analysis (LCA)

Example 1 carries out EVM using LCA Analyzers. The *Life Cycle Analysis 1 and 2* references should be read prior to this reference. EVM analysis uses the following steps:

Step 1. Measure the actual cost of the work completed (ACWP), with the planned cost of the work scheduled (PCWS), by examining the results of a LCA Progress 1 *Cost* Analysis, as follows:

This analysis uses an actual year-to-date total cost of $2,000,000 and "unit cost" of $2,000,000/mile track. The planning budget uses a planned total cost of $4,000,000 for the entire project and "unit cost" of $1,000,000 mile/track. The analysis generates the following results:
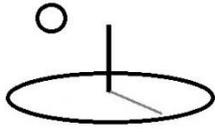
Investment : RR Track, 2 Time Periods

+ Benefit Details

– Cost Details

Date : 10/31/2013 12:00:00 AM
OC Planned Period : 450000.000
OC Plan Cumul : 1350000.000
OC Actual Cumul : 900450.000
OC Actual Cumul Change : -449550.000
OC Planned Cumul Percent : 66.700
AOH Planned Period : 150000.000
AOH Plan Cumul : 450000.000
AOH Actual Cumul : 300150.000
AOH Actual Cumul Change : -149850.000
AOH Planned Cumul Percent : 66.700
CAP Planned Period : 400000.000
CAP Plan Cumul : 1200000.000
CAP Actual Cumul : 800400.000
CAP Actual Cumul Change : -399600.000
CAP Planned Cumul Percent : 66.700
LCC Planned Period : 1000000.000
LCC Plan Cumul : 3000000.000
LCC Actual Cumul : 2001000.000
LCC Actual Cumul Change : -999000.000
LCC Planned Cumul Percent : 66.700
EAA Planned Period : 0.000
EAA Plan Cumul : 0.000
EAA Actual Cumul : 0.000
EAA Actual Cumul Change : 0.000
EAA Planned Cumul Percent : 0.000
Unit Planned Period : 1000000.000
Unit Plan Cumul : 3000000.000
Unit Actual Cumul : 2001000.000
Unit Actual Cumul Change : -999000.000
Unit Planned Cumul Percent : 66.700

Observations : 1; Target Type : benchmark
OC Plan Full : 1800000.000
OC Actual Period : 300150.000
OC Actual Period Change : -149850.000
OC Planned Period Percent : 66.700
OC Planned Full Percent : 50.025
AOH Plan Full : 600000.000
AOH Actual Period : 100050.000
AOH Actual Period Change : -49950.000
AOH Planned Period Percent : 66.700
AOH Planned Full Percent : 50.025
CAP Plan Full : 1600000.000
CAP Actual Period : 266800.000
CAP Actual Period Change : -133200.000
CAP Planned Period Percent : 66.700
CAP Planned Full Percent : 50.025
LCC Plan Full : 4000000.000
LCC Actual Period : 667000.000
LCC Actual Period Change : -333000.000
LCC Planned Period Percent : 66.700
LCC Planned Full Percent : 50.025
EAA Plan Full : 0.000
EAA Actual Period : 0.000
EAA Actual Period Change : 0.000
EAA Planned Period Percent : 0.000
EAA Planned Full Percent : 0.000
Unit Plan Full : 4000000.000
Unit Actual Period : 667000.000
Unit Actual Period Change : -333000.000
Unit Planned Period Percent : 66.700
Unit Planned Full Percent : 50.025

– SubCosts

SubCost 1 Name : Materials
SubCost 1 Unit : mile
SubCost 1 Amount : 2.001
SubCost 1 Price : 300000.00

$667,000 **Actual Period Total**: Month 3 actual total capital cost (LCC Actual Period)

$2,000,000 **Actual Cumulative Total**: Cumulative 3 month actual total capital cost (LCC Actual Cumul)

$4,000,000 **Planned Full Total** = Full project planned total capital cost (LCC Total)
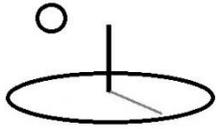
$1,000,000 **Planned Period Total:** Month 3 planned total capital cost (LCC Planned Period)

$3,000,000 **Planned Cumulative Total**: Cumulative 3 month planned total capital cost (LCC Planned Cumul)

-$333,000 **Actual Period Change**: $667,000 Actual Total – $1,000,000 Planned Total for the same ordinal Partial Period (LCC Actual Period Change)

-$1,000,000 **Actual Cumulative Change**: $2,000,000 Actual Cumulative Total – $3,000,000 Planned Cumulative Total for the cumulative Partial Periods (LCC Actual Cumulative Change)

67% **Planned Period Percent**: ($667,000 Actual Total / $1,000,000 Planned Total) * 100 (LCC Planned Period Percent)

67% **Planned Cumulative Percent**: $2,000,000 Actual Cumulative Total / $3,000,000 Planned Cumulative Total) * 100 (LCC Planned Cumul Percent)

50% **Planned Full Percent** = ($2,000,000 Actual Cumulative Total / $4,000,000 Planned Full Total) * 100 (LCC Planned Full Percent)
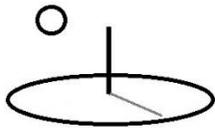
EVM Performance Measures: The actual cost of the work completed (ACWP) is $667,000 for the period and $2,000,000 cumulative total. The planned cost of the work schedules (PCWS) is $1,000.000 for the period and $3,000,000 cumulative total. The planned total cost (BAC) of the project is $4,000,000. This *Progress 1 Cost Analysis* supports GAO's contention that the analysis of budget costs is insufficient to determine investment status. The three performance measures suggest that the investment is doing well. Only 50% of the funds have been spent during the 75% scheduled investment period.
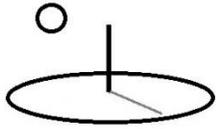
Step 2. Measure the actual value of the work completed (BCWP) and the planned value of the work (BCWS) by examining the results of a LCA Progress 1 *Benefit* Analysis, as follows:

This analysis uses a unit benefit (output price or "earned value") of $1,000,000/mile track. This is derived by taking the $4,000,000 projected project cost and dividing it by the 4 miles of total track needed. By pricing outputs in this manner, the resultant analysis measures Earned Value. The recommended "best practice" for pricing outputs is to use actual market, or opportunity cost, prices. This example does not use market prices because railroad tracks are not traded enough in markets to determine their market value. Although this type of pricing supports Earned Value Management analysis, it does not support typical economic analyses, such as Benefit Cost Analysis. The analysis generates the following results:

Investment Group : Earned Value Management Example

⊖ Benefit Details

Date : 11/7/2013 12:00:00 AM
R Planned Period : 1000000.000
R Plan Cumul : 3000000.000
R Actual Cumul : 996000.000
R Actual Cumul Change : -2004000.000
R Planned Cumul Percent : 33.200
LCB Planned Period : 1000000.000
LCB Plan Cumul : 3000000.000
LCB Actual Cumul : 996000.000
LCB Actual Cumul Change : -2004000.000
LCB Planned Cumul Percent : 33.200
REAA Planned Period : 0.000
REAA Plan Cumul : 0.000
REAA Actual Cumul : 0.000
REAA Actual Cumul Change : 0.000
REAA Planned Cumul Percent : 0.000
RUnit Planned Period : 1000000.000
RUnit Plan Cumul : 3000000.000
RUnit Actual Cumul : 996000.000
RUnit Actual Cumul Change : -2004000.000
RUnit Planned Cumul Percent : 33.200

Observations : 1; Target Type :
R Plan Full : 4000000.000
R Actual Period : 333000.000
R Actual Period Change : -667000.000
R Planned Period Percent : 33.300
R Planned Full Percent : 24.900
LCB Plan Full : 4000000.000
LCB Actual Period : 333000.000
LCB Actual Period Change : -667000.000
LCB Planned Period Percent : 33.300
LCB Planned Full Percent : 24.900
REAA Plan Full : 0.000
REAA Actual Period : 0.000
REAA Actual Period Change : 0.000
REAA Planned Period Percent : 0.000
REAA Planned Full Percent : 0.000
RUnit Plan Full : 4000000.000
RUnit Actual Period : 333000.000
RUnit Actual Period Change : -667000.000
RUnit Planned Period Percent : 33.300
RUnit Planned Full Percent : 24.900

⊕ Cost Details

⊕ SubCosts

⊕ SubBenefits

**Description :** Sample analysis used in a DevTreks tutorial. v141b

Investment : 01 RR Track, Planned

⊖ Benefit Details

Date : 11/7/2013 12:00:00 AM   Observations : 1; Target Type : benchmark

$333,000 **Actual Period Total**: Month 3 actual total benefit ($1,000,000/mile track * .33 miles) (LCB Actual Period)

$1,000,000 **Actual Cumulative Total**: Cumulative 3 month actual total benefit ($1,000,000/mile track * 1 miles). You should be able to find the $4,000 discrepancy in the data. (LCB Actual Cumul)

$4,000,000 **Planned Full Total** = Full project planned total benefit (LCB Plan Full)
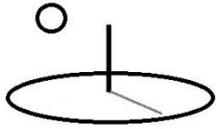
$1,000,000 **Planned Period Total:** Month 3 planned total benefit (LCB Planned Period)

$3,000,000 **Planned Cumulative Total**: Cumulative 3 month planned total benefit (LCB Plan Cumul)

-$667,000 **Actual Period Change**: $333,000 Actual Total – $1,000,000 Planned Total for the same ordinal Partial Period (LCB Actual Period Change)

-$2,000,000 **Actual Cumulative Change**: $1,000,000 Actual Cumulative Total – $3,000,000 Planned Cumulative Total for the cumulative Partial Periods (LCB Actual Cumul Change)
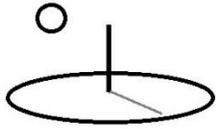
33% **Planned Period Percent**: ($333,000 Actual Total / $1,000,000 Planned Total) * 100 (LCB Planned Period Percent)

33% **Planned Cumulative Percent**: ($1,000,000 Actual Cumulative Total / $3,000,000 Planned Cumulative Total) * 100 (LCB Planned Cumul Percent)

25% **Planned Full Percent** = ($1,000,000 Actual Cumulative Total / $4,000,000 Planned Full Total) * 100 (LCB Planned Full Percent)

EVM Performance Measures: The actual earned value of the work completed (BCWP) is $333,000 for the period and $1,000,000 cumulative total. The budget cost for the work scheduled (BCWS), or planned earned value of the work completed, is $1,000,000 for the period and $3,000,000 cumulative total. In contrast to the cost numbers, all of the benefits performance measures raise red flags that the project is faltering. Only 25% of the benefits have been earned during the 75% scheduled investment period.

Step 3. Conduct a Performance Measure Analysis, as follows:

The results of the analysis can be combined in various ways to analyze EVM in greater depth. The GAO 2009 reference provides examples of various types of EVM reports that can be produced using these numbers. The following are examples:

50% **Earned Value to Cost Percent** = ($1,000,000 Actual Cumulative Total Benefit / $2,000,000 Actual Cumulative Total Cost) * 100. Note that the Actual Cumulative Total Benefit comes from the benefit calculations. The Actual Cumulative Total Cost comes from the cost calculations.

$8,000,000 **Estimated Cost at Completion** ($2,000,000 Actual Cumulative Total Cost / 25% Planned Full Benefit Percent)**.** Note that the Actual Cumulative Total Cost comes from the cost calculations. The 25% Planned Full Benefit Percent comes from the benefit calculations. This measure can also be calculated as follows: ($2,000,000 Actual Cumulative Total Cost) + ($2 million cost per mile of track * 3 remaining miles of track).

100% **Estimated Percent over (+) or under (-) Budget** (($8,000,000 Completion Estimated Amount - $4,000,000 Planned Full Cost Total) / $4,000,000 Planned Full Cost Total) * 100). The Planned Full Cost Total comes from the cost calculations.

A Performance Measurement report, or story, can then be added to the budget (see the *Story Telling 1* tutorial). The story uses these Performance Measures to explain that only 50% of the total money that has been spent on the project has been earned and that the project is estimated to overrun its budget by 100%. Since the data is online, complete with pictures and videos, concerned professionals might offer valuable advice about how to improve this project (or informed citizens may clamor to sack the perpetrators).

H. Example 2. EVM and Net Present Value (NPV) Analysis

Example 2 carries out EVM using NPV Analyzers. *The Net Present Value 1* and *Benefit Cost Analysis 1* references should be read prior to this reference. EVM analysis uses the same steps as LCA Analysis. The following two images demonstrate that the two results are similar (**3***):
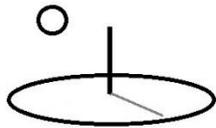
Cost Results

Total Plan Period	4,044,664.95	4,044,664.95
Total Plan Full	4,044,664.95	4,044,664.95
Total Plan Cumul	4,044,664.95	4,044,664.95
Total Actual Period	0.00	2,032,833.65
Total Actual Cumul	0.00	2,032,833.65
Total Actual Period Change	0.00	-2,011,831.30
Total Actual Cumul Change	0.00	-2,011,831.30
Total Plan P Percent	0.00	50.26
Total Plan C Percent	0.00	50.26
Total Plan Full Percent	0.00	50.26
Incent Plan Period	4,044,664.96	4,044,664.96
Incent Plan Full	4,044,664.96	4,044,664.96
Incent Plan Cumul	4,044,664.96	4,044,664.96
Incent Actual Period	0.00	2,032,833.65
Incent Actual Cumul	0.00	2,032,833.65
Incent Actual Period Change	0.00	-2,011,831.31
Incent Actual Cumul Change	0.00	-2,011,831.31
Incent Plan P Percent	0.00	50.26
Incent Plan C Percent	0.00	50.26
Incent Plan Full Percent	0.00	50.26
Net Plan Period	8,790.12	8,790.12
Net Plan Full	8,790.12	8,790.12
Net Plan Cumul	8,790.12	8,790.12

Benefit Results
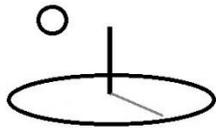
Investment Group : Earned Value Management Example ; 11/07/2013			
Investment	All	Alt. 0	Alt. 1
Name		01 RR Track, Planned	02 RR Track, Actual
Date		12/18/2013	12/18/2013
Label		RR01	RR01
Benefits	All	Alt. 0	Alt. 1
Observations		1	1
Target		benchmark	actual
R Plan Period		4,053,455.07	4,053,455.07
R Plan Full		4,053,455.07	4,053,455.07
R Plan Cumul		4,053,455.07	4,053,455.07
R Actual Period		0.00	1,013,069.13
R Actual Cumul		0.00	1,013,069.13
R Actual Period Change		0.00	-3,040,385.94
R Actual Cumul Change		0.00	-3,040,385.94
R Plan P Percent		0.00	24.99
R Plan C Percent		0.00	24.99
R Plan Full Percent		0.00	24.99
Output Q Plan Period		64.00	64.00
Output Q Plan Full		64.00	64.00
Output Q Plan Cumul		64.00	64.00
Output Q Actual Period		0.00	36.00
Output Q Actual Cumul		0.00	36.00

I. Example 3. EVM and Monitoring and Evaluation (M&E) Analysis

Example 3 carries out EVM using M&E 2 Analyzers. The *Monitoring and Evaluation* references should be read prior to this reference. EVM analysis uses the same steps as LCA and NPV Analysis. The following images demonstrate that the Indicator results can be generated for all base elements. The *Health Care Analysis* references demonstrate how to use these indicators in conjunction with benefit and cost data to support better decisions.
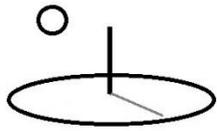
The following M&E Capital Budget Analysis compares a Benchmark Budget to an Actual Budget. Each Budget contained 2 Time Periods (2013 and 2014), and each Time Period contained 1 Outcome (with 1 Output) and 1 Component (with 1 Input). Each base element held 4 quarterly indicators. The Labels in the Benchmark base elements and indicators matched the Labels in the Actual. This image displays incorrect results for the Actual Budget, Time Period 2013, Outcome 2013. Although the displayed Time Period shows accurate results, the Outcomes and Components carry out independent searches for their benchmark comparators. That search returned Benchmark Budget, Time Period 2014. The comparator should have been Time Period 2013.

Time Period : 2013 Actual Food Security TP122 12/31/2013									

Target Type: **actual**

Indicator Property	Plan Period	Plan Full	Plan Cumul	Actual Period	Actual Cumul	Actual Period Progress	Actual Cumul Progress	Plan P Percent ; Plan C Percent	Plan Full Percent
Q1 Food Security TP122									
Date: 03/15/2013; Observations: 4									
Total Unit: percent hh secure; Q1 Unit: hhs secure; Q2 Unit: hh population									
Total	118.000	218.00	118.00	240.91	240.91	122.91	122.91	204.16 ; 204.16	110.51
Q1	118,000.000	218,000.00	118,000.00	265,000.00	265,000.00	147,000.00	147,000.00	224.58 ; 224.58	121.56
Q2	400,000.000	800,000.00	400,000.00	440,000.00	440,000.00	40,000.00	40,000.00	110.00 ; 110.00	55.00

This indicator measures the proportion of households that receive adequate food each quarter.

Outcome: 2013 Act Food Consumed OC122 12/31/2013

Target Type: **actual**

| Indicator Property	Plan Period	Plan Full	Plan Cumul	Actual Period	Actual Cumul	Actual Period Progress	Actual Cumul Progress	Plan P Percent ; Plan C Percent	Plan Full Percent
Q1 Food Consumed OC122									
Date: 03/15/2013; Observations: 4									
Total Unit: dollar cost; Q1 Unit: tons; Q2 Unit: dollar price									
Total	7,211,000.000	7,211,000.00	7,211,000.00	8,001,000.00	8,001,000.00	790,000.00	790,000.00	110.96 ; 110.96	110.96
Q1	13,700.000	13,700.00	13,700.00	15,300.00	15,300.00	1,600.00	1,600.00	111.68 ; 111.68	111.68
Q2	2,120.000	2,120.00	2,120.00	2,120.00	2,120.00	0.00	0.00	100.00 ;	100.00

The following image displays correct results for the same Actual Budget, Time Period 2013, Outcome 2013. The Outcomes and Operations in the Actual Budget found their correct benchmark comparators because Benchmark Time Period 2013's Label was set equal to Actual Time Period's 2013 Label. A different Label was used to set Benchmark Time Period 2014's Label equal to Actual Time Period's 2014 Label. The take home lesson is that data conventions play very important roles in these types of analyses.

	Time Period : 2013 Actual Food Security TP122 12/31/2013								

Target Type: **actual**

Indicator Property	Plan Period	Plan Full	Plan Cumul	Actual Period	Actual Cumul	Actual Period Progress	Actual Cumul Progress	Plan P Percent ; Plan C Percent	Plan Full Percent
Q1 Food Security TP122									
Date: 03/15/2013; Observations: 4									
Total Unit: percent hh secure; Q1 Unit: hhs secure; Q2 Unit: hh population									
Total	118.000	218.00	118.00	240.91	240.91	122.91	122.91	204.16 ; 204.16	110.51
Q1	118,000.000	218,000.00	118,000.00	265,000.00	265,000.00	147,000.00	147,000.00	224.58 ; 224.58	121.56
Q2	400,000.000	800,000.00	400,000.00	440,000.00	440,000.00	40,000.00	40,000.00	110.00 ; 110.00	55.00

This indicator measures the proportion of households that receive adequate food each quarter.

Outcome: 2013 Act Food Consumed OC122 12/31/2013

Target Type: **actual**

Indicator Property	Plan Period	Plan Full	Plan Cumul	Actual Period	Actual Cumul	Actual Period Progress	Actual Cumul Progress	Plan P Percent ; Plan C Percent	Plan Full Percent
Q1 Food Consumed OC122									
Date: 03/15/2013; Observations: 4									
Total Unit: dollar cost; Q1 Unit: tons; Q2 Unit: dollar price									
Total	6,772,000.000	6,772,000.00	6,772,000.00	8,001,000.00	8,001,000.00	1,229,000.00	1,229,000.00	118.15 ; 118.15	118.15
Q1	14,000.000	14,000.00	14,000.00	15,300.00	15,300.00	1,300.00	1,300.00	109.29 ; 109.29	109.29
Q2	1.960.000	1.960.00	1.960.00	2.120.00	2.120.00	160.00	160.00	108.16 :	108.16

## J. Example 4. EVM and Resource Stock Analysis

Example 4 carries out EVM using Resource Stock Analyzers. The *Resource Stock Analysis* tutorial should be completed prior to this reference. EVM analysis uses the same steps as LCA and NPV Analysis. The following image is a representative example from the referenced tutorial. The *Stock* references demonstrate how to use these indicators in conjunction with benefit and cost data to support decisions related to climate change mitigation technologies.
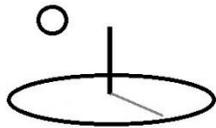
DevTreks –social budgeting that improves lives and livelihoods

Budget Group : LCA Organic Orange Crops ; 12/31/2014			
Budget	**All**	**Alt. 0**	**Alt. 1**
Name		Conventional Orange Budget	Organic Orange Budget
Date		07/15/2014	07/15/2014
Label		A100C	A100O
Stock Details	**All**	**Alt. 0**	**Alt. 1**
Target		benchmark	actual
Observations		1	1
Name		Nitrate Loss	Nitrate Loss
Label		NO3E	NO3E
Plan Period		-91.233	-226.253
Unit		kg N03-N / ha	kg N03-N / ha
Plan Full		-91.233	0.000
Plan Cumul		-91.233	0.000
Actual Period		0.000	-226.253
Actual Cumul		0.000	-226.253
Actual Period Change		0.000	0.000
Actual Cumul Change		0.000	-226.253
Plan P Percent		0.000	-100.000
Plan C Percent		0.000	0.000
Plan Full Percent		0.000	0.000
Observations		1	1
Name		Ammonia Loss	Ammonia Loss
Label		NH3E	NH3E
Plan Period		-19.387	-29.343
Unit		kg NH3-N / ha	kg NH3-N / ha
Plan Full		-19.387	0.000
Plan Cumul		-19.387	0.000
Actual Period		0.000	-29.343
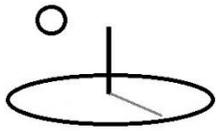
K. **Multimedia**

The following image (USGAO 2009) demonstrates how graphics can help to interpret complex data.

Figure 34: Overall Program View of EVM Data

Source: © 2003 SCEA, "Earned Value Management Systems."
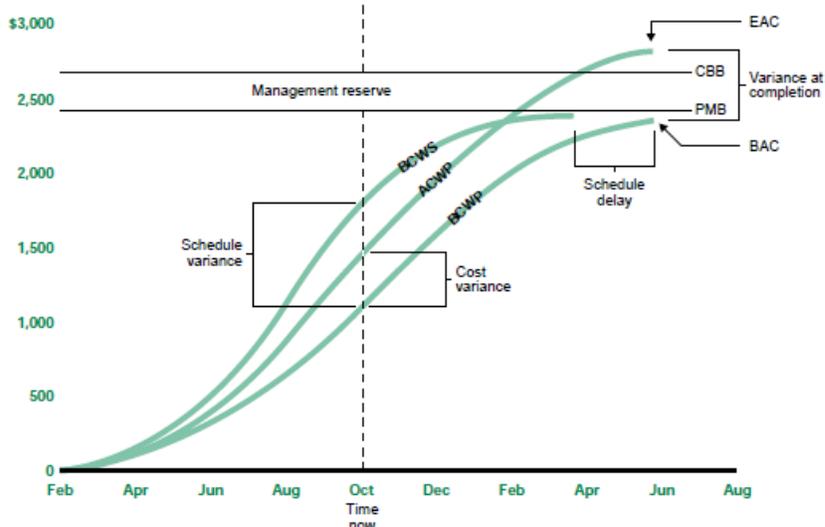
Note: ACWP = actual cost of work performed; BAC = budget at completion; BCWP = budgeted cost for work performed; BCWS = budgeted cost for work scheduled; CBB = contract budget baseline; EAC = estimate at completion; PMB = performance measurement baseline.

L. Stories

Not everyone can quickly grasp the meaning or significance of EVM data. Make sure to include graphics, videos, photos, images, and stories that explain each analysis.
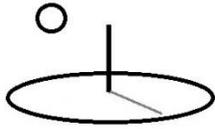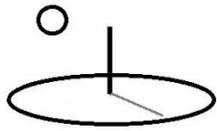
Earned Value Management 1: Last Updated August 07,2018 -Version 2-1-4a

How much money has been lost throughout the world by badly managed public infrastructure investments? The U.S. GAO (2009) provides evidence that the losses can be huge. They recommend using Earned Value Management (EVM) best practices to stem these losses and to achieve the public benefits needed from the investments. They define EVM as follows: "Earned value management goes beyond simply comparing budgeted costs to actual costs. It measures the value of work accomplished in a given period and compares it with the planned value of work scheduled for that period and with the actual cost of work accomplished. ... "

EVM best practices integrate budget, scheduling, and risk analyses. A key requirement of EVM is to measure budget variances and scheduling variances. Budget variances measure the costs (and benefits) of work planned versus actual work completed. Scheduling variances measure the amount, quality, and timeliness of

M. Knowledge Bank Standards

All EVM analyses should be entered into online knowledge banks (i.e. production servers as contrasted to development servers) that can be used to track work progress and performance in projects, programs, and technologies. That structured evidence must be passed down to future generations. These knowledge banks aggregate and analyze all of the data in a network. Future references will demonstrate how these knowledge banks will evolve (i.e. semantic data, forecasts) to support future decision making needs. The flexibility offered by DevTreks in documenting EVM means that networks need to develop "rules" explaining the "standards" that should be followed by clubs in their network. The "standards" make it possible to build knowledge banks.

Summary and Conclusions

Clubs using DevTreks can start to use basic Earned Value Management to save their communities money and ensure the public gets the benefits they pay for. Clubs can solicit help when projects falter, programs fail, or technology fumbles. They can share structured evidence explaining how to increase accountability, stay on budget, improve performance, and eliminate waste. Networks can build knowledge banks that explain why projects, programs, and technologies, succeed or fail and pass that knowledge down to future generations. The result may be government software projects that work as expected and on time, agricultural development programs that reduce farmers' risks, factory safety programs that save factory workers' lives, hospitals that treat patients more affordably, governments that mitigate climate change more convincingly, country safety ministries that improve the efficacy of their safety programs (**4***), and people who improve their lives and livelihoods.

Footnotes

1. This definition has implications beyond what the GAO, 2009 reference covers. For example, some health care analysts believe that USA hospitals routinely overcharge for medical services. The excess costs are possible because health care delivery in the USA is seldom based on efficient markets. An *EVM Analysis* can be used to make these types of "overcharges" more transparent by allowing objective, third party, health care
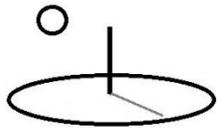
professionals to define the value of the work being performed. Clear, objective, metrics can be defined to measure "best practice" medical service delivery and service outcome value. The transparency allows patients to shop around better, tarnish or burnish institutional reputations and brands, and provide the evidence needed to change health care policies. The accompanying video explains why the current institutions in these types of industries may not be capable of serious reform and why the alternative institutions implied by the Social Performance Analysis tutorial may make appropriate replacements. If current institutions are stacked against efficient public service delivery, replace them.

2. The US GAO (2009) reference makes it clear that EVM can be analyzed using a comprehensive set of techniques. This reference only covers basic EVM. Additional ways to balance value received with resources expended are introduced in the Performance and Social Performance tutorials.

3. Close examination of the results of an LCA and NPV Progress Analysis completed for the same data sets will reveal some ostensible differences. The major difference is that at the Budget and Time Period element levels, an LCA Progress Analysis uses the results from the *last of its children components and outcomes*. Those two results have correct full, cumulative, and period totals through those last "periods". In contrast, NPV Progress Analysis runs a new analysis that compares *sibling Time Periods and Budgets* –it ignores the results of its children components and outcomes. Look closely at the Actual Time Period in these data sets and verify that the Period totals in the LCA Analysis reflect the last component and outcome, while the NPV Analysis reflects the last time period. Also note that an analysis completed for a single Budget displays marked differences –the NPV Analysis can't find a sibling Budget element and so displays mostly zeros for that element. With the exception of the Period properties, both aggregations generate the same Performance Measures, but analysts should be aware of the differences.

4. Safety programs are included because they make up relatively large proportions of government budgets and the evidence (GAO 2009) suggests they are seldom transparent but particularly prone to waste.
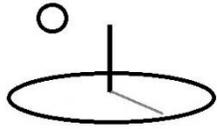
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References

United States Government Accountability Office. Applied Research and Methods. GAO Cost Estimating and Assessment Guide. Best Practices for Developing and Managing Capital Program Costs. March, 2009.

Additional information about EVM can be found in the LCA, NPV, M&E, and Resource Stock references in the tutorial library.

References Note

We try to use references that are open access or that do not charge fees.

Improvements, Errors, and New Features

Please notify DevTreks (devtrekkers@gmail.com) if you find errors or can recommend improvements.

Video tutorials explaining this reference can be found at:

https://www.devtreks.org/commontreks/preview/commons/resourcepack/Earned Value Management 1/504/none/