

Directing and Controlling Projects with EVM

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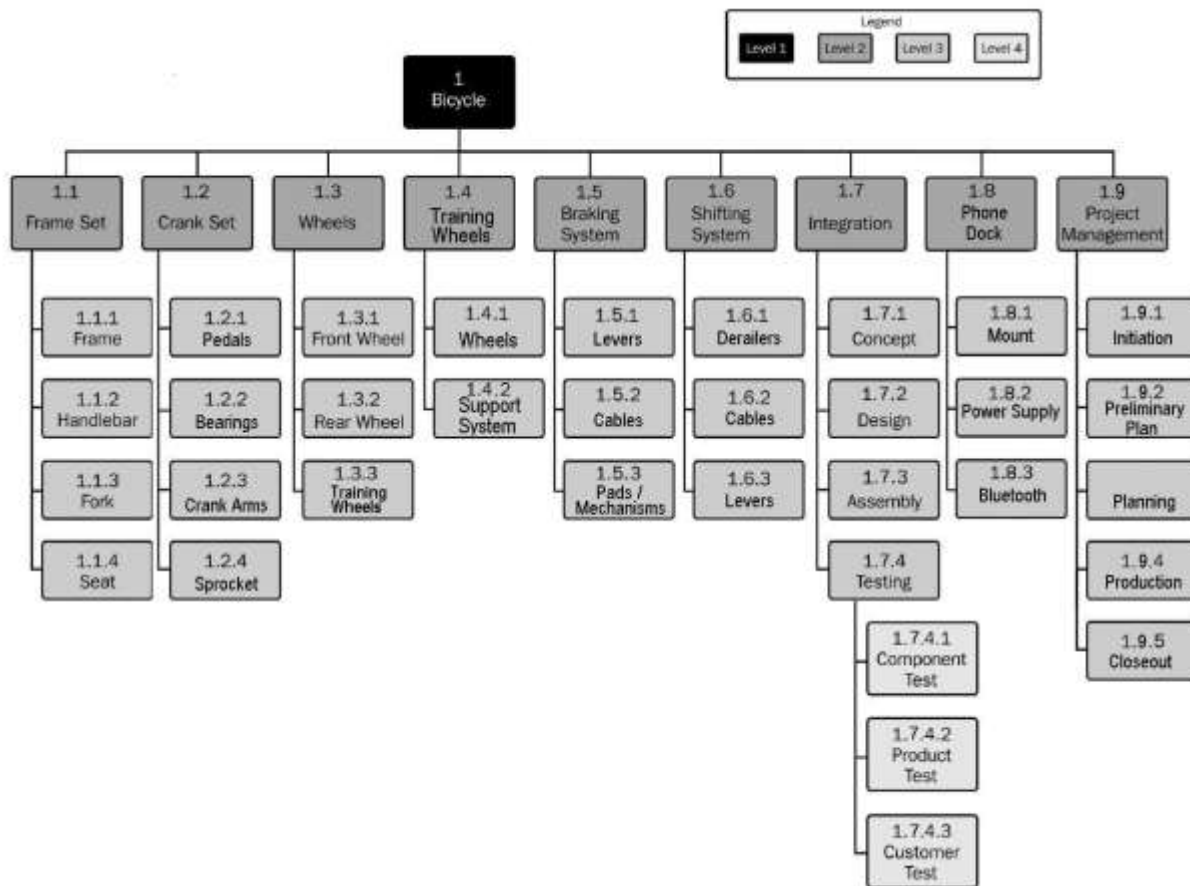
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## Directing and Controlling Projects with EVM

**Project Baseline**

Detailing and controlling projects with Earned Value Management (EVM) is a methodology that combines scope, schedule, and resource measurements to assess project performance and progress (PMI, 2013, p. 217). Utilizing the bicycle schedule in *Figure 1*, an Excel baseline was created using figure 8-3, from the Practice Standard for Earned Value Management (Second Ed.). For this baseline, only Level 2 items, of the Work Breakdown Structure (WBS), were utilized.



*Figure 1.* Group 4 Bicycle Work Breakdown Structure (WBS)

Combining the WBS with the bicycle budget in *Figure 2*, the Excel baseline provides the information needed for Project Management to monitor and control the bicycle project from initiation to completion.

| WBS    |                    | Before Crash Hours | After Crash Hours | Crashing Costs | Expenses  |             |           |              |                    | Totals      |
|--------|--------------------|--------------------|-------------------|----------------|-----------|-------------|-----------|--------------|--------------------|-------------|
| WBS No | WBS Element        |                    |                   |                | Labor     | Travel      | Materials | Subcontracts | Other Direct Costs |             |
| 1.1    | Frame Set          | 0.52               | 0.52              | \$ -           | \$ 3.77   | \$ -        | \$ 75.92  | \$ -         | \$ 5.00            | \$ 84.69    |
| 1.2    | Crank Set          | 0.18               | 0.18              | \$ -           | \$ 1.31   | \$ 439.00   | \$ 28.79  | \$ -         | \$ 15.00           | \$ 484.10   |
| 1.3    | Wheels             | 0.13               | 0.13              | \$ -           | \$ 0.94   | \$ 439.00   | \$ 38.79  | \$ -         | \$ 10.00           | \$ 488.73   |
| 1.4    | Training Wheels    | 0.00               | 0.50              | \$ -           | \$ 3.63   | \$ -        | \$ -      | \$ -         | \$ 117.00          | \$ 120.63   |
| 1.5    | Braking System     | 0.18               | 0.18              | \$ -           | \$ 1.31   | \$ 439.00   | \$ 16.98  | \$ -         | \$ 10.00           | \$ 467.29   |
| 1.6    | Shifting System    | 0.23               | 0.23              | \$ -           | \$ 1.67   | \$ 439.00   | \$ 17.11  | \$ -         | \$ -               | \$ 457.78   |
| 1.7    | Integration        | 18.25              | 14.25             | \$ 10.00       | \$ 71.25  | \$ 1,649.00 | \$ -      | \$ -         | \$ -               | \$ 1,720.25 |
| 1.8    | Phone Dock         | 9.65               | 2.00              | \$ 27.73       | \$ 14.50  | \$ 439.00   | \$ 6.16   | \$ 250.00    | \$ -               | \$ 709.66   |
| 1.9    | Project Management | 15.14              | 10.14             | \$ 12.50       | \$ 50.70  | \$ 1,649.00 | \$ -      | \$ -         | \$ -               | \$ 1,699.70 |
| Totals |                    | 44.28              | 28.13             | \$ 50.23       | \$ 149.08 | \$ 5,493.00 | \$ 183.75 | \$ 250.00    | \$ 157.00          | \$ 6,232.83 |

*Figure 2.* Group 4 Budget

*Figure 3* represents the Bicycle Project Baseline (PBB) and is the basis for all Planned Value (PV), Earned Value (EV), Cumulative Cost (CC), and Actual Cost (AC) calculations and graphs.

| Bicycle Project                              | Budget      | Duration | Start     | Finish          |                 |          |            |            |            |            |            |            |            |          |          |
|--|-------------|----------|-----------|-----------------|-----------------|----------|------------|------------|------------|------------|------------|------------|------------|----------|----------|
| Project/Contract Budget Base                 | \$10,000.00 |          |           |                 | Schedule (Days) |          |            |            |            |            |            |            |            |          |          |
| Management Reserve (MR)                      | \$2,000.00  |          |           |                 | 0               | 1        | 2          | 3          | 4          | 5          | 6          | 7          | 8          | 9        | 10       |
| Performance Measurement Baseline (PMB)       | \$8,000.00  | 10 days  | 6/15/2017 | 6/24/2017       |                 |          |            |            |            |            |            |            |            |          |          |
| WBS  | \$6,232.83  | 8 days   | 6/15/2017 | 6/22/2017       |                 |          |            |            |            |            |            |            |            |          |          |
| 1.1 Frame Set                                | \$84.69     | 1 day    | 6/16/2017 | 6/16/2017       |                 | \$84.69  |            |            |            |            |            |            |            |          |          |
| 1.2 Crank Set                                | \$484.10    | 1 day    | 6/17/2017 | 6/17/2017       |                 |          | \$484.10   |            |            |            |            |            |            |          |          |
| 1.3 Wheels                                   | \$488.73    | 1 day    | 6/18/2017 | 6/18/2017       |                 |          |            | \$488.73   |            |            |            |            |            |          |          |
| 1.4 Training Wheels                          | \$120.63    | 1 day    | 6/22/2017 | 6/22/2017       |                 |          |            |            |            |            |            |            | \$120.63   |          |          |
| 1.5 Braking System                           | \$467.29    | 1 day    | 6/19/2017 | 6/19/2017       |                 |          |            |            | \$467.29   |            |            |            |            |          |          |
| 1.6 Shifting System                          | \$457.78    | 1 day    | 6/20/2017 | 6/20/2017       |                 |          |            |            |            | \$457.78   |            |            |            |          |          |
| 1.7 Integration                              | \$1,720.25  | 8 days   | 6/15/2017 | 6/22/2017       |                 | \$215.03 | \$215.03   | \$215.03   | \$215.03   | \$215.03   | \$215.03   | \$215.03   | \$215.03   |          |          |
| 1.8 Phone Dock                               | \$709.66    | 1 day    | 6/21/2017 | 6/21/2017       |                 |          |            |            |            |            | \$709.66   |            |            |          |          |
| 1.9 Project Management                       | \$1,699.70  | 8 days   | 6/15/2017 | 6/22/2017       |                 | \$212.46 | \$212.46   | \$212.46   | \$212.46   | \$212.46   | \$212.46   | \$212.46   | \$212.46   |          |          |
| Contingency Reserve (CR) (Cost and Schedule) | \$1,767.17  | 2 days   | 6/23/2017 | 6/24/2017       |                 |          |            |            |            |            |            |            |            | \$883.59 | \$883.59 |
|  |             |          |           | Cumulative Cost |                 | \$512.18 | \$1,423.78 | \$2,340.00 | \$3,234.79 | \$4,120.06 | \$5,257.21 | \$5,805.34 | \$6,232.83 |          |          |

*Figure 3.* Bicycle Project Baseline

To better illustrate cumulative cost, *figure 4* represents baseline cumulative cost in an easy to understand graphical image. Time and cost are directly proportional to one another, and as time increases so do cumulative cost.



Figure 4. Baseline Cumulative Cost

Given the cost variance of -15%, or 15% over budget, the actual cost exceeds that of the planned cumulative cost. Also, a given schedule variance of 5% ahead of schedule has been added and is an excellent indicator of task accomplishment and an earned value that exceeds that of the planned value. Figure 5 represents the percentage of each task accomplished, based on the 5% SV given.

| Bicycle Project                              | Budget      | Duration | Start     | Finish    | Schedule (Days) |            |            |            |            |            |            |            |          |          |          |
|--|-------------|----------|-----------|-----------|-----------------|------------|------------|------------|------------|------------|------------|------------|----------|----------|----------|
| Project/Contract Budget Base                 | \$10,000.00 |          |           |           |                 |            |            |            |            |            |            |            |          |          |          |
| Management Reserve (MR)                      | \$2,000.00  |          |           |           | 0               | 1          | 2          | 3          | 4          | 5          | 6          | 7          | 8        | 9        | 10       |
| Performance Measurement Baseline (PMB)       | \$8,000.00  | 10 days  | 6/15/2017 | 6/24/2017 |                 |            |            |            |            |            |            |            |          |          |          |
| WBS  | \$6,232.83  | 8 days   | 6/15/2017 | 6/22/2017 |                 |            |            |            |            |            |            |            |          |          |          |
| 1.1 Frame Set                                | \$84.69     | 1 day    | 6/16/2017 | 6/16/2017 |                 | \$84.69    |            |            |            |            |            |            |          |          |          |
| 1.2 Crank Set                                | \$484.10    | 1 day    | 6/17/2017 | 6/17/2017 |                 |            | \$484.10   |            |            |            |            |            |          |          |          |
| 1.3 Wheels                                   | \$488.73    | 1 day    | 6/18/2017 | 6/18/2017 |                 |            |            | \$488.73   |            |            |            |            |          |          |          |
| 1.4 Training Wheels                          | \$120.63    | 1 day    | 6/22/2017 | 6/22/2017 |                 |            |            |            |            |            |            | \$120.63   |          |          |          |
| 1.5 Braking System                           | \$467.29    | 1 day    | 6/19/2017 | 6/19/2017 |                 |            |            |            | \$467.29   |            |            |            |          |          |          |
| 1.6 Shifting System                          | \$457.78    | 1 day    | 6/20/2017 | 6/20/2017 |                 |            |            |            |            | \$457.78   |            |            |          |          |          |
| 1.7 Integration                              | \$1,720.25  | 8 days   | 6/15/2017 | 6/22/2017 |                 | \$215.03   | \$215.03   | \$215.03   | \$215.03   | \$215.03   | \$215.03   | \$215.03   | \$215.03 |          |          |
| 1.8 Phone Dock                               | \$709.66    | 1 day    | 6/21/2017 | 6/21/2017 |                 |            |            |            |            |            | \$709.66   |            |          |          |          |
| 1.9 Project Management                       | \$1,699.70  | 8 days   | 6/15/2017 | 6/22/2017 |                 | \$212.46   | \$212.46   | \$212.46   | \$212.46   | \$212.46   | \$212.46   | \$212.46   | \$212.46 |          |          |
| Contingency Reserve (CR) (Cost and Schedule) | \$1,767.17  | 2 days   | 6/23/2017 | 6/24/2017 |                 |            |            |            |            |            |            |            |          | \$883.59 | \$883.59 |
| Cumulative Cost                              |             |          |           |           | \$512.18        | \$1,423.78 | \$2,340.00 | \$3,234.79 | \$4,120.06 | \$5,257.21 | \$5,805.34 | \$6,232.83 |          |          |          |
| Given Data:                                  |             |          |           |           |                 |            |            |            |            |            |            |            |          |          |          |
| SV = 5%                                      |             |          |           |           |                 |            |            |            |            |            |            |            |          |          |          |
| CV = -15%                                    |             |          |           |           |                 |            |            |            |            |            |            |            |          |          |          |
| Earned Value (EV)                            |             |          |           |           | \$537.79        | \$1,494.97 | \$2,457.00 | \$3,396.52 |            |            |            |            |          |          |          |
| Actual Cost (AC)                             |             |          |           |           | \$589.01        | \$1,637.34 | \$2,691.00 | \$3,720.00 | \$4,738.07 | \$6,045.79 | \$6,676.14 | \$7,167.75 |          |          |          |

Figure 5. Earned Value Chart (5% SV)

At the completion of week four and the beginning of week 5, *Figure 6* indicates that an overbudget condition is outpacing the fact that the project is ahead of schedule. This condition requires the completion of a variance report and change request to correct.



*Figure 6.* Cost Versus Value Graph

### Summary Table

The summary table serves as a tool for project management to identify a schedule of cost issues and to quickly move to correct. *Figure 7* represents the first four periods of the bicycle project. Each period reflects an overbudget condition relating to a negative cost variance. This variance supports the given condition of  $CV = -15\%$ .

|                | Period 1  | Period 2  | Period 3  | Period 4  |
|----------------|-----------|-----------|-----------|-----------|
| BAC            | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 |
| EAC            | 10,000.00 | 10,000.00 | 10,000.00 | 7,167.75  |
| PV             | 512.18    | 1,423.78  | 2,340.00  | 3,234.79  |
| EV             | 537.79    | 1,494.97  | 2,457.00  | 3,396.52  |
| AC             | 589.01    | 1,637.34  | 2,691.00  | 3,720.00  |
| CV Cum         | (51.22)   | (142.38)  | (234.00)  | (323.48)  |
| SV Cum         | 25.61     | 71.19     | 117.00    | 161.74    |
| VAC            | 0.00      | 0.00      | 0.00      | 2,832.25  |
| CPI Cum        | 0.91      | 0.91      | 0.91      | 0.91      |
| SPI Cum        | 1.05      | 1.05      | 1.05      | 1.05      |
| CPI Cur        | 0.91      | 0.91      | 0.91      | 0.91      |
| SPI Cur        | 1.05      | 1.05      | 1.05      | 1.05      |
| TCPI           | 1.01      | 1.02      | 1.03      | 1.05      |
| IEAC CPI Cum   | 10,980.43 | 11,030.35 | 11,080.52 | 11,129.52 |
| IEAC 80/20     | 11,437.95 | 11,489.95 | 11,542.21 | 11,593.25 |
| IEAC CPI X SPI | 17,710.37 | 17,790.89 | 17,871.81 | 17,950.84 |

*Figure 7.* Periods 1 thru 4 Summary Table

### Variance Report

Monitoring is a critical aspect of all project management. Once an issue is discovered, it must be reported and corrected as soon as possible. *Figure 8* represents one version of a variance report. This report is issued in support of the variance noted during the first half of the bicycle project.

| Variance Analysis Report |             |            |            |               |                    |                   |      |
|--------------------------|-------------|------------|------------|---------------|--------------------|-------------------|------|
| Project                  | Bicycle     |            |            | Report Period | Period 4           |                   |      |
| Date                     | 9-Jul-17    |            |            | WBS Element   | 1.5 Braking System |                   |      |
|                          | PV          | EV         | AC         | Cost Variance |                    | Schedule Variance |      |
|                          |             |            |            | CV            | CV%                | SV                | SV % |
| Current Period           | \$3,234.79  | \$3,396.52 | \$3,720.00 | -\$323.48     | -15%               | \$161.74          | 5%   |
| Cumulative               | \$3,234.79  | \$3,396.52 | \$3,720.00 | -\$323.48     | -15%               | \$161.74          | 5%   |
| At Completion            | BAC         | EAC        | VAC        |               |                    |                   |      |
|                          | \$10,000.00 | \$7,167.75 | \$2,832.25 |               |                    |                   |      |

**SCHEDULE VARIANCE**

**Program/Task Impact:** Currently, the project is on schedule to complete five percent ahead of schedule. As a result, the earned value is outpacing the planned value.

**Corrective Action Plan:** The source of the variance does not rest with the schedule. Since the bicycle project is being tracked as a 0 / 100 type of completion, the schedule will continue to be monitored for any slip. Currently, the project is ahead of schedule. No action necessary.

| COST VARIANCE                   |  |
|---------------------------------|--|
| <b>Problem Analysis - Cause</b> | \$323.48 of the cost variance is in direct relation to a failed vendor delivery.   |
| <b>Program Impact</b>           | The additional cost of \$323.48 is directly related to parts procurement. No impact to labor is anticipated.   |
| <b>Corrective Action Plan</b>   | All procurement contracts will be visited and a claim laid against the original vendor for the overage experienced. All other contracts and vendors will be reviewed for potential savings. In addition, labor will be visited to offset the additional cost with labor savings. |

*Figure 8.* Period 4 Variance Analysis Report

### Change Request

Monitoring and controlling is a formal process where issues discovered, recorded, reported, and corrected. During the monitoring process, a cost variance was discovered and

reported on the variance analysis report presented in *figure 8*. To correct the issue noted, the report must be converted into a change request with formal instructions to resolve the issue.

*Figure 9* represents the change request form issued to correct the cost variance.

| <b>Project Change Request Form</b>   |  |  |
|--|--|--|
| <b>Name of Project:</b> BICYCLE  | <b>Project Manager:</b> Benjamin Srock |  |
| <b>Change Request #:</b> 2.0   | <b>Change Request Date:</b> 9-Jul-17   |  |
| <b>Change Requested by Name:</b> Project Manager   | <b>Current Project Phase:</b> Period 4 |  |
| <b>Description of Change:</b> Project manager reports period 4 WBS 1.5 Braking System with a cost variance of -15%. Requests reduction in procurement costs. The project team recommends: <ol style="list-style-type: none"><li>1. Resourcing reducing costs associated with WBS 1.6 and 1.8 parts. Particular attention to be paid to the \$709.66 scheduled for the training wheels and labor.</li><li>2. Crashing the time to assemble and install the training wheels (WBS 1.8) from 1 day to 1 hour.</li><li>3. Crashing the time to install the shifting system (WBS 1.6) from 1 day to 3 hours.</li></ol> |  |  |
| <div style="display: flex; justify-content: space-between;"><span>Original completion date: 23-Jun-17</span><span>Revised completion date: 23-Jun-17</span></div>  |  |  |
| <b>Scope Impact:</b> The scope will remain unchanged. Additional changes to the project documents will be necessary.   |  |  |
| <b>Cost Impact:</b> The total cost of crashing labor and changing procurement sources, leads to a reduction in the overall cost of \$323.48  |  |  |
| <b>Quality Impact:</b> The quality level of the product will remain unchanged.   |  |  |
| <b>Possible Risks:</b> The possibility of failing locate alternate sources for parts procurement. Crash costs exceed the estimated costs causing new delays or change of scope. Outside vendor delays getting materials, which can cause additional delays to the schedule.  |  |  |
| <div style="display: flex; justify-content: space-between;"><span><b>Reviewed by:</b> Benjamin Srock</span><span><b>Position:</b> Project Manager</span><span><b>Date:</b> 9-Jul-17</span></div>   |  |  |
| <b>Recommended Action:</b> APPROVE   |  |  |

**Figure 9. Change Request Form**



References

*A Guide to the Project Management Body of Knowledge (PMBOK Guide)* (Fifth ed.). (2013).

Newton Square, Pennsylvania: Project Management Institute, Inc.