Implementing EVM Data Analysis: Adding Value from a NASA Project Manager’s Perspective

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Outline

- Data Analysis Implementation
- Project Analysis Office Role
- HHR Project Overview
- Standard Report
- Benefits to Project
- Where to Next?
RS40 Project Analysis Office

Diverse, complimentary skill mix

- EVM Analysts
- Schedule Analysts
- Accountants & Auditors
- Data Administrators
- Software Developers
- Engineers
Why Implement Data Analysis?

- Cancelled Projects
- Cost Control Team Recommendations
  - Need for better analytical tools
  - Need for better project analysis and data analysis
- MSFC Center Director’s Cost Control White Paper
  - Better Data Analysis will enable MSFC Programs/Projects increased insight into performance
- COLSA Recommendations – Habitat Holding Racks (HHR) Specific
- Recent Documents Addressing NASA Project Management
  - NPG No. 7120.5A “NASA Program and Project Management Processes and Requirements”
  - Mars Program Independent Assessment Team summary Report – March 14, 2000
  - Mars Climate Orbiter Reports
  - NASA Integrated Action Team – December 21, 2000
- The President’s Management Agenda – Fiscal Year 2002
Biological Research Project (BRP)
Overview – Space Station Project

- Enabling project of NASA’s non-human life sciences research program managed by Ames Research Center.
- Consists of the:
  - Centrifuge
  - Life Sciences Glovebox
  - Habitat Holding Racks (HHR) (Located in US Lab or CAM)
  - Various animal and plant habitats as well as other life science experiments.
- ARC-BRP Mission Requirements Document specifies a high degree of commonality in the various hardware items to function efficiently as a fully integrated facility.
- ARC-BRP chose Boeing via MSFC to design, build, test, and integrate the BRP Habitat Holding Racks and supporting systems utilizing the EXPRESS Rack as the design basis.
- Much of the HHR hardware is common in function, fit, and form with other Biological Research Project hardware.
BRP - Habitat Holding Rack

NOTE: Items noted as (Reference) are not part of the HHR
Biological Research Project

Funding Profile

April 1996 Program Operating Plan (POP) Submit $45.7
April 1998 POP Submit $49.4
November 2000 $88
September 2001 $73
January 2002 $80
Present $88.5

($’s in Million)

Delivery Date Mar. 31, 2004

Why Data Analysis?
HHR Project Content History

**END ITEMS**

- Qualification Rack: 1
- Flight Racks: 2
- Suitcase Simulators: 2
- Habitat Fluid Transfer System: 3
- Closeout Covers: 3
- Habitat Functional Simulator Suite: 2 (one added in PCP 1186)
- Habitat Mass Simulator Complement: 1 set
- Transportation Racks: 2
- ARC Trainer: 1
- JSC Trainer: 1
- Habitat Checkout Units: 4
- Rack Interface Support Equipment: 1
- Spares: 2 sets
- Portable User Operations Station: 1
- Command/Telemetry Databases: 1

**TASKS**

- Habitat Physical Integration
- Analytical Integration
- Integrated Rack KSC Support
- Passive Damping/Rack Isolation Analysis
- User Operations Facility Display Development
- Centrifuge/Glovebox Developer Support
- User Operations Facility Console Operations

**Why Data Analysis?**

- Remains
- Deleted 1st Phase
- Deleted 2nd Phase
Implementation Approach

Two step approach

- Equip
  - Tools
  - System
  - Knowledge

- Support
  - Standard Reports
    - 5 Pager
  - Training
  - Hands-on

Products

- wInsight
- Schedules
- Filters
- Training - EV, wInsight, Schedule
- Policies, DRs, etc.
- Summary Reports
- CPRs
- Training - EV, wInsight, Schedule, Data analysis, etc.
- Schedule Support
SCHEDULE PERFORMANCE

COST PERFORMANCE

TO MEET BUDGET AT COMPLETION (BAC)

TO MEET CONTRACTOR'S LATEST REVISED ESTIMATE (LRE)

### Performance Indicator Key

<table>
<thead>
<tr>
<th>Performance Indicator Key</th>
<th>At Completion Indicator Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worse than -10%</td>
<td>TCPI &gt; CPI by more than 5%</td>
</tr>
<tr>
<td>Between -10% and -5%</td>
<td>TCPI &gt; CPI by less than 5%</td>
</tr>
<tr>
<td>Better than -5%</td>
<td>TCPI &lt; CPI</td>
</tr>
<tr>
<td>Change Threshold = 5%</td>
<td></td>
</tr>
</tbody>
</table>

### At Completion Indicator Key

- **R** = Red
- **Y** = Yellow
- **G** = Green

HHR Worse than - 5% = Red
# EVM Quick-Look Report

## SAMPLE DATA

### Dollars in Thousands

<table>
<thead>
<tr>
<th></th>
<th>BCWS</th>
<th>BCWP</th>
<th>ACWP</th>
<th>Schedule Variance</th>
<th>Cost Variance</th>
<th>Funding Status</th>
<th>$\text{in Thousands}</th>
<th>$\text{in Millions}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Pd.</td>
<td>1,645</td>
<td>1,509</td>
<td>1,707</td>
<td>-136, -8.3%</td>
<td>-198, -13.1%</td>
<td>R ↓</td>
<td>1,509</td>
<td>1,645</td>
</tr>
<tr>
<td>Cumulative</td>
<td>7,279</td>
<td>6,851</td>
<td>7,350</td>
<td>-428, -5.9%</td>
<td>-499, -7.3%</td>
<td>Y ↓</td>
<td>7,279</td>
<td>7,279</td>
</tr>
</tbody>
</table>

### Variance Status Indicator Key

- **R**: Worse than -10%
- **G**: Better than -5%
- **Y**: Between -10% and -5%
- **Change Threshold = 5%**

### Additional Metrics

- **NASA**
  - BAC: 20,796
  - EAC: 22,480
  - VAC: 35

- **EAC Forecast**
  - Min.: 22,022
  - Max.: 23,385

- **Percent Scheduled**: 35.0%
- **Percent Complete**: 32.9%
- **Percent Spent**: 35.3%

- **3 Mo. Avg Spend Rate**: 1,441 (7%)
- **6 Mo. Avg Spend Rate**: 1,067 (5%)

- **SPI**
  - Current: 0.92 ↓
  - Cumulative: 0.94 ↓

- **CPI**
  - Current: 0.88 ↓
  - Cumulative: 0.93 ↓

- **3 Mo. Avg CPI**: 0.95
- **6 Mo. Avg CPI**: 0.92

- **To Compl Perf Index (TCPI) BAC**: 1.04 ↑
- **To Compl Perf Index (TCPI) LRE**: 1.04 ↓
## Top Issues Summary

### Top Schedule Variances

<table>
<thead>
<tr>
<th>WBS</th>
<th>Description</th>
<th>SV</th>
<th>CV</th>
<th>VAC</th>
<th>CPI</th>
<th>TCPI-LRE</th>
<th>CPI to LRE</th>
<th>SV</th>
<th>CV</th>
<th>BAC</th>
<th>LRE</th>
<th>% Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3200 COMMUNICATIONS</td>
<td>R</td>
<td>R</td>
<td>G</td>
<td>0.84</td>
<td>1.03</td>
<td>-0.19</td>
<td>(203)</td>
<td>(131)</td>
<td>2,043</td>
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<td>9.8%</td>
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<td>388</td>
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<tr>
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<td>3300 AUX EQUIP</td>
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<td>G</td>
<td>1.13</td>
<td>0.96</td>
<td>0.17</td>
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<tr>
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<td>G</td>
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<td>0.99</td>
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<td>(11)</td>
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<td>Y</td>
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<td>1.04</td>
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<td>(12 )</td>
<td>(17)</td>
<td>618</td>
<td>622</td>
<td>3.0%</td>
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### Top Cost Variances

<table>
<thead>
<tr>
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<th>Description</th>
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<th>CV</th>
<th>VAC</th>
<th>CPI</th>
<th>TCPI-LRE</th>
<th>CPI to LRE</th>
<th>SV</th>
<th>CV</th>
<th>BAC</th>
<th>LRE</th>
<th>% Budget</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>3600 PCC</td>
<td>G</td>
<td>R</td>
<td>G</td>
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<td>(11 )</td>
<td>(296)</td>
<td>5,801</td>
<td>5,988</td>
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<tr>
<td>2</td>
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<td>R</td>
<td>R</td>
<td>G</td>
<td>0.84</td>
<td>1.03</td>
<td>-0.19</td>
<td>(203)</td>
<td>(131)</td>
<td>2,043</td>
<td>2,130</td>
<td>9.8%</td>
</tr>
<tr>
<td>3</td>
<td>2200 SYS ENGINEERING</td>
<td>G</td>
<td>R</td>
<td>G</td>
<td>0.90</td>
<td>2.65</td>
<td>-1.75</td>
<td>6</td>
<td>(26)</td>
<td>283</td>
<td>283</td>
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<tr>
<td>4</td>
<td>I &amp; A</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>0.96</td>
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<td>-0.05</td>
<td>83</td>
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<td>G</td>
<td>Y</td>
<td>G</td>
<td>0.94</td>
<td>1.04</td>
<td>-0.10</td>
<td>(12 )</td>
<td>(17)</td>
<td>618</td>
<td>622</td>
<td>3.0%</td>
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</table>

### Top LRE Issues

<table>
<thead>
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<th>WBS</th>
<th>Description</th>
<th>SV</th>
<th>CV</th>
<th>VAC</th>
<th>CPI</th>
<th>TCPI-LRE</th>
<th>CPI to LRE</th>
<th>SV</th>
<th>CV</th>
<th>BAC</th>
<th>LRE</th>
<th>% Budget</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>3600 PCC</td>
<td>G</td>
<td>R</td>
<td>G</td>
<td>0.85</td>
<td>1.03</td>
<td>-0.18</td>
<td>(11 )</td>
<td>(296)</td>
<td>5,801</td>
<td>5,988</td>
<td>27.9%</td>
</tr>
<tr>
<td>2</td>
<td>3200 COMMUNICATIONS</td>
<td>R</td>
<td>R</td>
<td>G</td>
<td>0.84</td>
<td>1.03</td>
<td>-0.19</td>
<td>(203)</td>
<td>(131)</td>
<td>2,043</td>
<td>2,130</td>
<td>9.8%</td>
</tr>
<tr>
<td>3</td>
<td>4000 SPARES</td>
<td>G</td>
<td>Y</td>
<td>G</td>
<td>0.95</td>
<td>1.00</td>
<td>-0.06</td>
<td>1</td>
<td>(8 )</td>
<td>756</td>
<td>762</td>
<td>3.6%</td>
</tr>
<tr>
<td>4</td>
<td>2100 PROJ MANAGEMENT</td>
<td>G</td>
<td>Y</td>
<td>G</td>
<td>0.94</td>
<td>1.04</td>
<td>-0.10</td>
<td>(12 )</td>
<td>(17)</td>
<td>618</td>
<td>622</td>
<td>3.0%</td>
</tr>
<tr>
<td>5</td>
<td>2200 SYS ENGINEERING</td>
<td>G</td>
<td>R</td>
<td>G</td>
<td>0.90</td>
<td>2.65</td>
<td>-1.75</td>
<td>6</td>
<td>(26)</td>
<td>283</td>
<td>283</td>
<td>1.4%</td>
</tr>
</tbody>
</table>
• The Bulls-Eye Chart provides overall status at a glance. The point labeled '0' represents the status for the current month. The point labeled '1' represents the status one month ago.
• The project is currently behind schedule.
• The project is currently over cost.
• Normally, a negative schedule variance will have a negative impact on cost by program completion. Special attention should be paid to cost for behind-schedule elements as the contract approaches completion.

### Cost/Schedule Variance

<table>
<thead>
<tr>
<th>Percent of Dollars</th>
<th>1992</th>
<th>1993</th>
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<tbody>
<tr>
<td>BCWS</td>
<td>0.3</td>
<td>20.8</td>
</tr>
<tr>
<td>BCWP</td>
<td>0.2</td>
<td>20.8</td>
</tr>
<tr>
<td>ACWP</td>
<td>0.2</td>
<td>23.0</td>
</tr>
<tr>
<td>SV</td>
<td>-0.1</td>
<td>-2.2</td>
</tr>
</tbody>
</table>

At Completion

<table>
<thead>
<tr>
<th></th>
<th>KTR</th>
<th>PDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCWS</td>
<td>20.8</td>
<td>20.8</td>
</tr>
<tr>
<td>BCWP</td>
<td>20.8</td>
<td>20.8</td>
</tr>
<tr>
<td>ACWP</td>
<td>23.0</td>
<td>23.0</td>
</tr>
<tr>
<td>SV</td>
<td>-2.2</td>
<td>-2.2</td>
</tr>
</tbody>
</table>

Dollars in Millions

<table>
<thead>
<tr>
<th></th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCWS</td>
<td>0.3</td>
<td>0.6</td>
<td>1.0</td>
<td>1.4</td>
<td>2.2</td>
<td>2.5</td>
<td>3.5</td>
<td>4.2</td>
<td>5.6</td>
</tr>
<tr>
<td>BCWP</td>
<td>0.2</td>
<td>0.5</td>
<td>0.9</td>
<td>1.4</td>
<td>2.2</td>
<td>2.7</td>
<td>3.8</td>
<td>5.3</td>
<td>6.9</td>
</tr>
<tr>
<td>ACWP</td>
<td>0.2</td>
<td>0.5</td>
<td>0.9</td>
<td>1.5</td>
<td>2.2</td>
<td>3.0</td>
<td>4.2</td>
<td>5.6</td>
<td>7.3</td>
</tr>
<tr>
<td>SV</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.0</td>
<td>-0.0</td>
<td>-0.2</td>
<td>-0.4</td>
<td>-0.3</td>
<td>-0.4</td>
</tr>
</tbody>
</table>

- The Cost/Schedule Variance Chart graphically depicts the cost and schedule variances in percentages, and provides the associated values in dollars (in thousands).
- Currently, the contractor has an unfavorable schedule variance of -428 (-6%) and an unfavorable cost variance of -499 (-7%).
- The Budget at Completion (BAC) is 20,796 and the effort is 33% complete.
- The contractor’s Latest Revised Estimate (LRE), which depicts their Estimate at Completion (EAC), is 20,761, which is 35 less than the BAC.
Estimate at Completion Validity

- The LRE Validity Chart compares the contractor's Latest Revised Estimate (LRE) to several statistically derived values for the Estimate at Completion (EAC). The LRE and EAC are terms that are often used interchangeably, representing the estimate of the total direct charges against the contract. The LRE should be somewhere within the range of the calculated values.

- Currently, MEGA HERZ ELEC & VEN LRE of 20,761 is 35 less than the BAC.

- The LRE appears to be below the range of the statistically derived values.

- "Since the LRE falls outside the range of calculated values, the contractor should re-evaluate the LRE as soon as possible."

To Complete Performance Index (TCPI)

- The To Complete Performance Index (TCPI) chart illustrates the efficiency rate that the contractor must accomplish to meet the BAC or LRE, based on the contractor's performance to date.

- To date, the cost performance efficiency has been 0.932. In other words, for each dollar spent, the contractor has accomplished $0.93 worth of the work budgeted.

- To meet the BAC, the contractor must accomplish $1.04 of work for each dollar spent.

- Given the performance to date, it does not seem likely that the contractor will be able to meet the BAC.

- To meet the LRE, the contractor must accomplish $1.04 of work for each dollar spent.

- Given the performance to date, it does not seem likely that the contractor will be able to meet the LRE.
EVM Definitions

**TERMINOLOGY**

- **ACWP** ACTUAL COST OF WORK PERFORMED (ACTUAL COST)
- **BAC** BUDGET AT COMPLETION (ALLOCATED BUDGETS)
- **BCWP** BUDGETED COST OF WORK PERFORMED (EARNED VALUE)
- **BCWR** BUDGETED COST OF WORK REMAINING
- **BCWS** BUDGETED COST OF WORK SCHEDULED (PLANNED VALUE)
- **CBB** CONTRACT BUDGET BASELINE (TOTAL AUTHORIZED WORK)
- **CPI** COST PERFORMANCE INDEX
- **CV** COST VARIANCE (BCWP-ACWP)
- **EAC** ESTIMATE AT COMPLETION (GOVERNMENT’S EAC)
- **ETC** ESTIMATE TO COMPLETE
- **LRE** LATEST REVISED ESTIMATE (CONTRACTOR’S EAC)
- **MR** MANAGEMENT RESERVE
- **PMB** PERFORMANCE MEASUREMENT BASELINE
- **SPI** SCHEDULE PERFORMANCE INDEX
- **SV** SCHEDULE VARIANCE (BCWP-BCWS)
- **UB** UNDISTRIBUTED BUDGET

**COMMON CAUSES FOR VARIANCE**

**FAVORABLE**

- POOR INITIAL PLANNING OR ESTIMATING
- TECHNICAL BREAK THROUGH
- COST OF LABOR AND MATERIAL LOWER THAN PLAN
- FRONT END LOADING
- METHOD OF EARNING BCWP

**UNFAVORABLE**

- POOR INITIAL PLANNING OR ESTIMATING
- TECHNICAL PROBLEM
- COST OF LABOR OR MATERIAL HIGHER THAN PLAN
- INFLATION
- NEW LABOR CONTRACTS
- WORK STOPPAGE

**USE OF CONTRACTOR PERFORMANCE MEASUREMENT DATA**

- **CPR** COST PERFORMANCE REPORT
- **C/SSR** COST/SCHEDULE STATUS REPORT

PURPOSE: TO OBTAIN CONTRACT COST AND SCHEDULE STATUS INFORMATION ON WHICH TO BASE PROGRAM MANAGEMENT DECISIONS
Benefits of EVM Data Analysis

- **NO SUPRISES!**
- EVM provides a more realistic approach to cost planning based on statistical data
- EVM provides a tool for Project Managers to utilize in reviewing Contractor data
  - Direct comparisons between contractor data and wInsight data is very beneficial
- Provides a solid means to forecast future cost requirements based on previous contractor performance
- Shows Valid History
  - Looks at both total contract and new baseline performance
- Provides estimate of required contractor performance to maintain budget within project schedule
  - Provides projections/justifications for future budgets
  - Provides good Estimates at Completion (EAC)
- Provides trends analysis to reflect whether contractor performance is decreasing or increasing
- Identifies Cost/Schedule drivers
- Helps determine risks to project
- Information to support hunches
Progress to Date

- Hardware/Software setup
  - wInsight Implemented
  - CPRs Loaded

- Training
  - wInsight/Administrator
  - Basic EVM
  - Basic hands-on EVM training for analysts
  - Basic, Intermediate, and Advanced Scheduling techniques
  - Immediate Data Analysis

- CPR analysis support to Projects
- Integrated Baseline Review (IBR) support
- Developed Standard EVM Report (5 pager)
- Schedule Working Group
Where to Next?

- Rollout NASA-wide System for all NASA Projects
- Implement Data analysis tool NASA-wide
- Provide More Advanced EV and Analysis Training
- Establish Standard for Schedule Competencies
- Train, Train, Train, …
- Coordinate with NASA HQ to conduct pilot test implementation of winsight at selected NASA Centers