WBS-Based Approach to Understanding and Predicting Program Risk

Presented By:

Bruce M. Heim
Program Integrator, DCMA
Agenda

- History
- Process Overview
- Data Analysis & Risk Inputs
- Documenting & Reporting
- Future Development
History
History

• Early 2003
  ➢ Concept / Goal: Assess risk in language meaningful to customer.
  ➢ Provide lower level visibility than Customer has into the program
  ➢ Researched various Risk methodologies

• Sept - Dec 2003
  ➢ Initial methodology presented to PST
  ➢ PST jointly refined the process/methodology
  ➢ Notional data used to test risk tool & determine feasibility of process

• Jan 2004 – Dec 2004
  ➢ January - Process baseline established
  ➢ Real data used
  ➢ Established process is viable
  ➢ Identified opportunities for improvement

• 2005
  ➢ Break Cost/Technical/Schedule risk out separately
  ➢ Incorporate consequence factor into ratings
Process Overview
Process Overview

- Work Scope Centric
  - WBS Element is evaluated
- Risk is assessed at Level 4
  - Performance Based Evaluation
  - Provides insight to lower level activity
  - Increases fidelity when rolled up to higher levels
- Common Categories & Criteria used
- Goal of process is to determine the likelihood of the WBS element work scope being successfully completed
  - On Schedule
  - On cost
  - Meets technical requirements
  - Predict future performance / risk
Process Overview

- Earned Value (EV) Cost
- Earned Value (EV) Schedule
- Risk Management
- IEAC
- Overtime Usage
- Staffing Levels
- Process Management (PM)
- TPM Management
- Critical Path Performance

Integrating data at the lower level
## Performance Factors / Criteria

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>DESCRIPTION</th>
<th>RATING CRITERIA</th>
</tr>
</thead>
</table>
| EVM-C        | CPI performance                                  | No variance = 1  
Variance < 3% = 2  
Variance 3 <7% = 3  
Variance 7< 10% = 4  
Variance > 10% = 5 |
| EVM-S        | SPI performance                                  | No variance = 1  
Variance < 3% = 2  
Variance 3 <7% = 3  
Variance 7 < 10% = 4  
Variance > 10% = 5 |
| EVM-EAC      | BAC vs. DCMA IEAC                                 | No variance = 1  
Variance < 5% = 2  
Variance 5 < 10% = 3  
Variance 10 < 15% = 4  
Variance > 15% = 5 |
| CP           | How well is the item performing relative to the Critical Path? | Not on Critical Path = 1  
On Critical Path, able to meet key milestones = 2  
Minor (< 1 wk) slip in key milestone = 3  
Major (> 1 wk or multiple minor) slip in key milestone = 4  
Cannot meet major milestone = 5 |
| RK           | How well is the contractor managing the identified risks? | All Mitigation events completed as planned = 1  
Minor slip (< 1 wk) in mitigation event completion = 2  
Major slip (> 1 wk) in mitigation event completion = 3  
Multiple Minor or Major slips in mitigation event completion = 4  
Risk events cannot be completed, or not planned = 5 |
<table>
<thead>
<tr>
<th>FACTOR</th>
<th>DESCRIPTION</th>
<th>RATING CRITERIA</th>
</tr>
</thead>
</table>
| PR     | How are the processes performing? | Continues improvement / analysis of metrics used = 1  
Processes are managed by metrics = 2  
Defined process / Documented standards used = 3  
Process management based on experience = 4  
Lack of processes/processes uncontrolled = 5 |
| TPM/PPM | How well are the measures performing relative to the Spec requirements or thresholds. ? | TPM will be met = 1  
Acceptable with some reduction in margin = 2  
Acceptable with significant reduction in margin = 3  
Acceptable, no remaining margin = 4  
Unacceptable = 5 |
| ST     | Staffing: Percent Under-manned | On plan = 1  
Total < 3% = 2  
Total 3 < 7% = 3  
Total 7 < 10% = 4  
Total > 10% = 5 |
| OT     | Amount of Overtime usage | No Overtime = 1  
Total < 3% = 2  
Total 3 < 7% = 3  
Total 7 < 10% = 4  
Total > 10% = 5 |
## Consequence Factors / Criteria

<table>
<thead>
<tr>
<th>Performance</th>
<th>Schedule</th>
<th>Cost</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal or No Impact</td>
<td>Minimal or No Impact</td>
<td>Minimal or No Impact</td>
<td>1</td>
</tr>
<tr>
<td>Acceptable with some reduction in margin</td>
<td>Able to meet key dates</td>
<td>Budget increase or unit cost increase &lt;5%</td>
<td>2</td>
</tr>
<tr>
<td>Acceptable with significant reduction in margin</td>
<td>Minor slip in key milestone; not able to meet key dates</td>
<td>Budget increase or unit cost increase 5-7%</td>
<td>3</td>
</tr>
<tr>
<td>Acceptable, no remaining margin</td>
<td>Major slip in key milestone or critical path impacted</td>
<td>Budget increase or unit cost increase &gt;7-10%</td>
<td>4</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>Cannot meet major milestone(s)</td>
<td>Budget increase or unit production cost increase &gt;10%</td>
<td>5</td>
</tr>
</tbody>
</table>
## Risk Level Definitions

<table>
<thead>
<tr>
<th>Risk Range</th>
<th>Risk of Failure</th>
<th>Definition</th>
</tr>
</thead>
</table>
| 21 - 25    | Near Certainty  |  WBS element will not be successfully completed.  
Severe Cost overruns: CV >1 0% and/or  
Severe Schedule slippage: SV >10%.  
Slip to Level I milestones  
Will not meet technical requirements (SOW)  
Completing QA Findings, Schedule & Corrective Actions > 60 days |
| 16 - 20    | Highly Likely   |  WBS element will probably not be successful.  
Cost overruns: 7% < CV > 10% and/or  
Schedule slippages: 7% < CV > 10%  
Slip to Level II Milestones  
May not meet all technical requirements (SOW).  
Completing QA Findings, Schedule & Corrective Actions Late < 60 days |
| 11 - 15    | Likely          |  WBS element may not be successful.  
Cost overruns: 3% < CV > 7% and/or  
Schedule slippages: 3% < CV > 7%  
Slip to Level III Milestones  
Will probably meet technical requirements. (SOW)  
Completing QA Findings, Schedule & Corrective Actions Late < 45 days |
| 6 - 10     | Unlikely        |  WBS element will probably be successful.  
Cost overruns: < 3% and/or  
Schedule slippages: < 3% CV  
Loss of more then one month schedule margin.  
Technical requirements met. (SOW)  
Completing QA Findings, Schedule & Corrective Actions Late < 30 days |
| 1 - 5      | Improbable      |  WBS element will be successful.  
On cost, on schedule (no variance)  
Meets all technical requirements. (SOW)  
Completing QA Findings, Schedule & Corrective Actions on time |
Data Analysis and Risk Inputs
PST Assessment

- Assessment is done monthly
  - Each PST member is assigned specific WBS elements
  - PST member use the factors as an outline when writing monthly inputs
  - Provide an integrated picture of element performance

- Continuously monitor all WBS elements
  - Provide early warning of changing risk
  - Risk metrics tracked over a period of time (better, worse, staying the same)

- Predictive Analysis
  - Predict factor ratings for next 3 months
  - Track element performance over period of time
    - Is performance/risk improving, getting worse, or staying the same?
    - Relative to Milestone events

- Discuss cross-IPT impacts in PST Meetings
PST Assessment

- Top 10 risk elements are tracked
  - These items will warrant closer and/or additional surveillance
    - Resource Focus
  - PST helps mitigate the risk and ensure the program office/end user is fully aware of the impacts to the program and make recommendations to the customer for options they may use.

- Tool provides a Quick Look
  - Where the risk is on the program.
  - What are the factors driving the risk
Old Process

- Process used up to May 2005.
- Consequence was not included in ratings. Consequence was interpreted via the PST members analysis.
- Attempted to incorporate Supplier Risk/Performance
  - Approach used (rating Suppliers separately) was not entirely successful.
- Roll up to program level done along WBS lines
  - Resulted in “masking” of lower level risks
  - Created a misconception of actual risk
Level 4 Risk Example (Old Process)

WBS Element: 1.1.2.4

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</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>
</tr>
</thead>
<tbody>
<tr>
<td>EVM-C</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVM-S</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RK</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPM</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OT</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVM-EAC</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WR</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Boeing  | 3.35 | 3.45 | 3.45 | 3.60 | 3.90 |     |     |     |     |     |     |     |
Supplier 1 | 5.00 | 5.00 | 5.00 | 5.00 | 3.00 |     |     |     |     |     |     |     |
Supplier 2 | 5.00 | 4.00 | 3.50 | 3.50 | 3.50 |     |     |     |     |     |     |     |
Supplier 3 | 5.00 | 5.00 | 4.50 | 4.50 | 4.50 |     |     |     |     |     |     |     |
Supplier 4 | 5.00 | 2.50 | 3.00 | 3.00 | 3.00 |     |     |     |     |     |     |     |
Supplier 5 | 4.00 | 3.00 | 2.50 | 2.50 | 2.50 |     |     |     |     |     |     |     |

Risk Factor | 4.06 | 3.73 | 3.60 | 3.67 | 3.41 |     |     |     |     |     |     |     |

Note: This is Notional data.
Risk Roll-up Example (old Process)

<table>
<thead>
<tr>
<th>WBS Element: 1.0</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</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>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>2.70</td>
<td>2.84</td>
<td>2.95</td>
<td>2.96</td>
<td>3.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>2.70</td>
<td>2.55</td>
<td>2.55</td>
<td>2.60</td>
<td>2.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>1.79</td>
<td>1.76</td>
<td>1.74</td>
<td>1.76</td>
<td>1.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>3.20</td>
<td>3.20</td>
<td>2.95</td>
<td>2.90</td>
<td>2.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.71</td>
<td>2.76</td>
<td>2.79</td>
<td>2.80</td>
<td>2.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This is Notional data.
New Process

• Tool calculates Risk based on Performance inputs and consequence inputs
  ➢ Cost is based on EVM-C, EVM-EAC and Staffing factors
  ➢ Schedule is based on EVM-S, Critical Path, and Overtime factors
  ➢ Technical is based on TPM, Risk Management, and Process Management

• Supplier performance is now assessed as an integral part of program level performance

• For each category, the tool takes the average of the 3 inputs and multiplies by the Consequence to arrive at the overall risk for each element.
  ➢ Overall risk factor is rated against the Risk Level Ratings/Definitions

• Roll-up of Risk to the Program Level is now done relative to the End Product delivered to the Customer
New Process (cont.)

- Roll-up is done relative to 8 groupings
  - Air Vehicle – Product
  - Air Vehicle – Non Product
  - Integration facilities
  - Program Management
  - Test & Eval
  - Production
  - Training
  - Logistics

- Each group has a Cost, Schedule & Technical Category
  - Each group is individually weighted (relative to 100%) in each category
# Level 4 Risk Example (New Process)

**Note:** This is Notional data.

## WBS Element: 1.2.3.4

|        | 2005 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|--------|------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|        | Jan  | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      | Jan      | Feb      | Mar      | Apr      |
| EVM-C  | 3    | 3        | 3        | 3        | 4        | 4        | 4        | 5        |          |          |          |          |          |          |          |          |          |
| EVM-EAC| 4    | 4        | 4        | 4        | 4        | 4        | 5        |          |          |          |          |          |          |          |          |          |          |
| OT     | 2    | 2        | 3        | 4        | 4        | 4        | 4        | 4        |          |          |          |          |          |          |          |          |          |
| Consequence | 4  | 4        | 4        | 4        | 4        | 4        | 4        | 4        |          |          |          |          |          |          |          |          |          |
| Cost Risk | 12.0 | 12.0     | 13.3     | 13.3     | 16.0     | 17.3     | 18.7     |          |          |          |          |          |          |          |          |          |          |
| EVM-S  | 4    | 4        | 4        | 4        | 4        | 4        | 4        |          |          |          |          |          |          |          |          |          |          |
| CP     | 3    | 3        | 3        | 3        | 3        | 3        | 3        |          |          |          |          |          |          |          |          |          |          |
| ST     | 3    | 3        | 3        | 3        | 3        | 3        | 3        |          |          |          |          |          |          |          |          |          |          |
| Schedule Risk | 10.0 | 10.0     | 10.0     | 10.0     | 10.0     | 10.0     | 10.0     |          |          |          |          |          |          |          |          |          |          |
| RK     | 2    | 2        | 2        | 2        | 2        | 2        | 2        |          |          |          |          |          |          |          |          |          |          |
| PR     | 3    | 3        | 3        | 3        | 3        | 3        | 3        |          |          |          |          |          |          |          |          |          |          |
| TPM    | 1    | 1        | 1        | 1        | 1        | 1        | 1        |          |          |          |          |          |          |          |          |          |          |
| Consequence | 5  | 5        | 5        | 5        | 5        | 5        | 5        |          |          |          |          |          |          |          |          |          |          |
| Technical Risk | 10.0 | 10.0     | 10.0     | 10.0     | 10.0     | 10.0     | 10.0     |          |          |          |          |          |          |          |          |          |          |

![Cost Risk Schedule Risk Technical Risk Graph](image)

Note: This is Notional data.
Risk Roll-up Example (New Process)

Note: This is Notional data.

Program "X"

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Cost Risk</th>
<th>Schedule Risk</th>
<th>Technical Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Jan</td>
<td>15.5</td>
<td>11.0</td>
<td>16.2</td>
</tr>
<tr>
<td></td>
<td>Feb</td>
<td>15.9</td>
<td>11.3</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>Mar</td>
<td>15.9</td>
<td>12.6</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td>Apr</td>
<td>16.0</td>
<td>14.3</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>16.2</td>
<td>16.8</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>Jun</td>
<td>18.9</td>
<td>17.3</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>Jul</td>
<td>19.0</td>
<td>17.9</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>Aug</td>
<td>19.7</td>
<td>18.1</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Note: This is Notional data.
Documenting & Reporting
Documenting & Reporting

- Risk Tool provides a running metric on element risk

- Monthly Report
  - Narrative provided in Monthly Report to the customer
    - What are the factors driving risk in the WBS element
    - DCMA independent assessment of program performance
    - What are the real/potential impacts to the element
    - What actions are DCMA taking?

- DCMA Program Review (DPR)
  - WebEx session with all customers
  - Supporting DCMA offices/PSTs are tied in as well
  - Provide DCMA's independent assessment of program performance / risk
  - Forum for customer to ask questions pertaining to our assessment
Future Development
Future Development

• Other factors under consideration
  ➢ Technology Maturity Level
  ➢ Complexity Factors
  ➢ CMMI
  ➢ Other Earned Value Metrics
  ➢ Quality Measurements
Future Development (cont.)

• Alternative Risk Tool Formula
  ➢ Are other calculations more appropriate?
    ☐ Cost & Schedule relationship
    ☐ Staffing & Overtime relationship
    ☐ Example: \((EVC \times EVS) + CP + RK + PBM + TPM + (OT/ST)\)

• Develop additional risk metrics
• Continuously Refine Risk Definitions
• Convert Tool to Database Design