When performance is measured ... performance improves

When performance is measured and reported ... the rate of performance improves

When performance is measured, reported, and compared ... the rate of performance continues to improve
Problem

• Sys Eng Scope is Huge, So …
  – What tenets should be measured?
  – What are the key characteristics?
  – How can it apply across different programs and organizations?

• Sys Eng Important, But …
  – No accepted, standard metrics
  – No measure of sys eng current status
  – No metrics for both PM and upper management
Sys Eng Metrics Key Characteristics

- Must Measure Major Components of Sys Eng
- Must Be Targeted for Management
- Must Be Few in Number
- Must Describe Current Status, Not Lagging
- Must Allow For Comparison Between Programs, Organizations, and Time
- Must Be Cumulative (Ability to Roll-Up)
- Must Avoid Extensive Data Collection Efforts
Solution: Sys Eng “Dashboard”

- Measure Five Key Areas of Sys Eng:
  - Requirements Management
  - Risk Management
  - Incentivizing Contractors
  - Robustness/LCC
  - Process Management
- Used on All Programs
- Regularly Shown at Organization Staff Meetings
1. Requirements Management Metric

- Most Important Area
- Quantify, quantify, quantify
- Level of Detail
  - Appropriate to Life Cycle
  - Examples
- Objective Review
- Agreement & Understanding
  - User
  - Contractor
  - Program Manager
- Sources
2. Risk Management Metric

- Proactive
- Dynamic
- Reviewed Regularly
- Tangible Reduction Plan
- Tracked
Basic Risk Rating Chart

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

**RISK ASSESSMENT**

- **HIGH** - Unacceptable. Major disruption likely. Different approach required.
- **MODERATE** - Some disruption. Different approach may be required.
- **LOW** - Minimum impact. Minimum oversight needed to ensure risk remains low.
## Risk Management Metric

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
<th>% With Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>2/4</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>1/2</td>
<td>30%</td>
</tr>
<tr>
<td>Med.</td>
<td>1/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0/1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/4</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1/3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2/4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2/3</td>
<td></td>
</tr>
</tbody>
</table>
3. Robustness/LCC Metric

- Hard to Measure
- Measures More the “Attempt” or Effort
- Can Include Underlying Processes
  - Example: Type of paint or the paint application process
- Need “Toolbox” Vice One Approved Way
  - Lean processes
  - Trade studies
  - Benchmarks
  - Combining components
  - COTS
  - Paredo Charts
  - Etc.
Robustness/LCC Metric

- Total Components
- Reviewed
- Changed

Goal
4. Incentivizing Contractors Metric

- Required for USAF by Policy
  - Policy Memo 03A-005, 9 Apr 03
  - Subject: “Incentivizing Contractors for Better Systems Engineering”
  - Signed by Marvin R. Sambour, Assistant Secretary of the Air Force (Acquisition)

- “A more robust SE environment can only be achieved through joint cooperative efforts with our contractors.”

- “…incentivize your contractors to perform robust SE…”
Incentivizing Contractors Metric

Goal

% of Contracts with Sys Eng Incentives

AIR FORCE MAT
5. Process Management Metric

- List Program’s Key Processes
  - Configuration Management
  - Waivers
  - Quality
  - Aircraft Structural Integrity Program
  - Deficiency Reviews
  - Etc.

- Each Program Does Own Processes
- For Each Process, 4 “Steps”
  - Define & Document
  - Lean, Improve or Refine
  - Keep Current by Periodic Reviews
  - Measure the Process
Developed Individual Metrics for the Five Key Areas of Systems Engineering:

- Requirements Management
- Risk Management
- Incentivizing Contractors
- Robustness/LCC
- Process Management

Now Put it All Together For the Proposed Program’s Sys Eng Dashboard...
How to Roll-Up from Program to Organization

- Requirements Management
  - Convert each program to a percentage
  - Display average (each program has equal weight)

- Risk Management
  - Convert each program “square” to percentage
  - Display average “square’s” percentage (equal weight)

- Incentivizing Contractors
  - Bottom number equals sum of contracts
  - Depict percentage of contracts (program independent)

- Robustness/LCC
  - Calculate reviewed/changed as a percentage
  - Display avg percentage (equal weight)

- Process Management
  - Depict overall percentage for each category (process/program independent)
<table>
<thead>
<tr>
<th>Organization Requirements Metric (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Requirements</td>
</tr>
<tr>
<td>Requirements Reviewed</td>
</tr>
<tr>
<td>Requirements Quantified</td>
</tr>
<tr>
<td>Requirements Changed</td>
</tr>
</tbody>
</table>

Goal
Organization Risk Metric (%)

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>10</td>
</tr>
<tr>
<td>Med.</td>
<td>5</td>
</tr>
<tr>
<td>High</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>5</td>
</tr>
<tr>
<td>Med.</td>
<td>50</td>
</tr>
<tr>
<td>High</td>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>10</td>
</tr>
<tr>
<td>Med.</td>
<td>60</td>
</tr>
<tr>
<td>High</td>
<td>80</td>
</tr>
</tbody>
</table>

% w/ Plan:
- Low: 7%
- Med.: 36%
- High: 60%
Organization Requirements Metric (%)
Organization Incentivizing Contractors Metric

Goal

% of Contracts with Sys Eng Incentives

56
Summary

- Sys Eng Important, but No Consistent Way to Measure…Until Now
- Need Concurrent Metrics…Not Lagging
- Metrics For Management…Essential to Drive Action
- What to Measure…Sys Eng “Dashboard”
- Means To Use…Regular Part of an Organization’s Overall Management Indicators

- Allows Comparison…Drives Improvement
Questions?
Sample: 5-Level Risk Rating Chart

**Likelihood:**

<table>
<thead>
<tr>
<th>Level</th>
<th>What Is The Likelihood The Risk Will Happen?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Remote</td>
</tr>
<tr>
<td>b</td>
<td>Unlikely</td>
</tr>
<tr>
<td>c</td>
<td>Likely</td>
</tr>
<tr>
<td>d</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>e</td>
<td>Near Certainty</td>
</tr>
</tbody>
</table>

**Consequence:**

Given The Risk Event is Realized, What is the Magnitude of the Impact?

<table>
<thead>
<tr>
<th>Level</th>
<th>Technical Performance</th>
<th>Schedule</th>
<th>Cost</th>
<th>Impact on Other Teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimal or no impact</td>
<td>Minimal or no impact</td>
<td>Minimal or no impact</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Acceptable with some reduction in margin</td>
<td>Additional resources required; able to meet need dates</td>
<td>&lt; 5%</td>
<td>Some impact</td>
</tr>
<tr>
<td>3</td>
<td>Acceptable with significant reduction in margin</td>
<td>Minor slip in key milestone; not able to meet need dates</td>
<td>5 - 7%</td>
<td>Moderate impact</td>
</tr>
<tr>
<td>4</td>
<td>Acceptable, no remaining margin</td>
<td>Major slip in key milestone or critical path impacted</td>
<td>&gt; 7 - 10%</td>
<td>Major impact</td>
</tr>
<tr>
<td>5</td>
<td>Unacceptable</td>
<td>Can’t achieve key team or major program milestone</td>
<td>&gt; 10%</td>
<td>Unacceptable</td>
</tr>
</tbody>
</table>

**Risk Assessment:**

- **High:** Unacceptable. Major disruption likely. Different approach required. Priority management attention required.
- **Moderate:** Some disruption. Different approach may be required. Additional management attention may be needed.
- **Low:** Minimum impact. Minimum oversight needed to ensure risk remains low.
Risk Handling Plan - “Waterfall”

Risk Rating

- High
- Medium
- Low

Time

EVENT

EVENT

EVENT