2021 ICEAA Workshop

Business Transformation of Life Cycle Cost Estimating at PEO STRI

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Agenda

• Problem
• Goals
• Lean Six Sigma (LSS) Overview
• PEO STRI Specific Goals & Scope
• SIPOC
• Voice of the Customer
• Measure - Data Collection Plan
• Analyze
• Improve
• Lessons Learned
Problem

- Life Cycle Cost Estimates for software-intensive programs have a potential to overstate costs
  - Potential negative impact to acquiring funding
  - Potential negative impact to acquisition of timely and affordable training capabilities
- Systemic across all software-intensive Program Office Estimates
  - Lack of software development engineering data
  - Heavily reliant on Subject Matter Expert Opinions
  - No clear methods to Acquire, Analyze, and Use SDE Data to Predict Future Costs/Hours
- Unable to Defend Software Cost Estimates to Independent Reviewers
  - DASA-CE requires a data-driven basis of estimate
  - Cost Estimating Relationships cannot be established by domain
- Inability to estimate more closely the actual costs associated with software-intensive programs
  - Potential to request not enough funding or too much funding for programs
Goals

- Earlier and Faster Production of Life Cycle Cost Estimates
  - Credible
  - Comprehensive
  - Data-Driven
  - Reliable

- Increased Confidence in Program Office Estimates
  - Standalone Estimates
  - Informed by Prime Mission Product (PMP)
  - Compliance with U.S. Army DASA-CE Guidance
  - Repeatable Method to Acquire, Analyze, and Use SDE Data to Predict Future Costs/Hours

- Improved Organizational Ability to Defend Software Cost Estimates.
  - Relies on Organizational Historical Software Development Engineering (SDE) Data
  - Less reliance on Subject Matter Expert (SME) Opinion
  - Independent Review of Software Cost Estimates and Cross-checks
  - Database of Historical SDE Data
U.S. Army Lean Six Sigma (LSS)

• Continuous Process Improvement (CPI)
  – Improve existing processes
  – Increase funding available for mission critical functions by gaining savings and efficiencies
  – Achieve transformational results
  – Consistently tackle enterprise level projects
  – Maximize return on investment

• Lean Six Sigma (Background)
  – Established in the Army in 2006
    – Cadre of Certified LSS practitioners (Green, Black, and Master Black Belts)
    – Work on high priority, core projects
      – Steering group typically determines priorities
    – Individual Belts and their Team use LSS methods to understand the problem, gather data
      – Use as a basis of analysis to gather more data, analyze, and improve the process
    – DMAIC (Define – Measure – Analyze – Improve – Control) methodology

• The Army’s LSS Program
  – Under the purview of the Director, Office of Business Transformation
  – Integrate and exploit CPI/LSS capabilities
  – Institutionalized across the Army
  – Successful projects at enterprise, organizational, and tactical unit/installation levels.
Example LSS Organizational Structure

Source: Army Lean Six Sigma Deployment Guidebook, V5.2
PEO STRI Specific LSS Scope & Outcomes

- Significantly reduce growth factors in software cost estimates to:
  - Achieve more training capabilities for the Warfighter for the funding received.
  - Reduce contractor and cost estimator data collection costs.
  - Reduce cost associated with development of software cost estimates.
  - Decrease cycle time to gather data, perform software cost estimates.
  - Improve affordability of PEO STRI software-intensive programs.
  - Standardize estimating software costs across domains.

- Improve future pricing/cost estimates by determining a more accurate measure of contractors’ software development efforts.

- Improve the contractor software data collection process.

- PEO STRI ACAT I, II and III programs with a software development requirement, including: All appropriations; All software development effort (e.g., P3I, PPSS, PDSS); Contractor software data; PM software data; PEO STRI software data collection process.
## SIPOC

**Suppliers**
- PMO
- Contractor (Software Developer)

**Inputs**
- Software Data (Code / Manhours)

**Process**
1. Software Cost Estimate Required
2. SDE Data Gathering
3. SDE Analysis
4. Estimate Software Effort
5. Apply Growth Factor

**Outputs**
- SDE Report
- Database
- Valid POE

**Customers**
- MDA
- PM
- DASA-CE
- G8
- G3
- G5

### VO/C/VOB

<table>
<thead>
<tr>
<th>VOC/VOB</th>
<th>Input Metrics</th>
<th>Process Metrics</th>
<th>Output Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOB</td>
<td>Historical database of domain-relevant software development efforts.</td>
<td>Operate on data and apply analysis techniques to determine effort in terms of manhours and cost.</td>
<td>Software cost estimates based on domain-relevant, actual coding effort.</td>
</tr>
<tr>
<td>VOC</td>
<td>SW developer data.</td>
<td>SW data analyze to estimate SW Dev manyears.</td>
<td>Domain-relevant software development efforts.</td>
</tr>
<tr>
<td>VOB</td>
<td>Cost estimating models and tools.</td>
<td>Analyze productivity.</td>
<td>Estimates of contractor productivity</td>
</tr>
</tbody>
</table>

**Input Metrics**
- Software development data to include contractor code data and manhours.
- Cost estimating models and tools.
- Software development data. 
- Cost estimating models and tools.
- Cost Analyst manhours to build estimate.
- SW dev manhours / tools to get data.

**Process Metrics**
- Data gathering operations by Contractor and PMOs. Production of cost estimates by PMO analyst.

**Output Metrics**
- Faster cycle time for data gathering effort.
- Faster cycle time for cost estimate development.
<table>
<thead>
<tr>
<th>Voice of the Customer</th>
<th>Key Customer Issue(s)</th>
<th>Critical Customer Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timely, accurate, and reliable software cost estimates.</td>
<td>Software cost estimates may be misstated due to application of a non-relevant growth factor.</td>
<td>Valid, accurate, and compliant software cost estimates that justify funding requests (POM) and the APB.</td>
</tr>
<tr>
<td>Acquire actual software development engineering data (coding effort descriptive data and effort manhours data).</td>
<td>No standard collection process for obtaining accurate software development effort data.</td>
<td>Reliable, standardized software coding effort data (coding data and manhour data).</td>
</tr>
<tr>
<td>Ability to adjust software cost estimates quickly to respond to budget drills, cuts, changes.</td>
<td>Cycle time to complete software cost estimates needs to be reduced.</td>
<td>Timely completion of software cost estimates to support POM and APB adjustments.</td>
</tr>
</tbody>
</table>
## Data Collection Plan

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Operational Definition</th>
<th>Data Source and Location</th>
<th>How Will Data Be Collected</th>
<th>Who Will Collect Data</th>
<th>When Will Data Be Collected</th>
<th>Sample Size</th>
<th>Stratification Factors</th>
<th>How Will Data Be Used?</th>
</tr>
</thead>
</table>
| Identification of discrete steps in the software development process | The lowest level of steps, and who performs them in the software development process, along with identifying where they receive information from. | PM and Contractor software development labor data and interviews with practitioners. | Interviews will be conducted to gather how the process is presently conducted. | LSS Team | March 1, 2012 to April 30, 2017 | 20 development SMEs both Federal and Contractor, which occurred from 2012 to present. | An assessment of each step taken from end to end in the software development process. | - To check for Special Cause variation  
- To evaluate the correlation between steps among various software development actions. |
| Accuracy and consistency of discrete steps in the software estimating process | The lowest level of steps, and who performs them in the software estimating process. | PM and Contractor software cost estimates and actual contractor cost data. | Interviews will be conducted to gather how the process is presently conducted. | LSS Team | March 1, 2012 to April 30, 2017 | 20 Fed and Contractor development SMEs which occurred from 2012 to present. | Examination of each step used by each Cost Estimator from end to end in the hiring process. | - To check for Special Cause variation  
- To investigate correlation between poor projections and execution |
| Comparison of Actuals hours to estimated hours in software development | Evaluation of time (in hours) it takes to accomplish each step of software development process. | PM and Contractor software cost estimates and actual contractor cost data. | Interviews will be conducted to gather how the process is presently conducted. | LSS Team | March 1, 2012 to April 30, 2017 | 20 development actions, and the correlating estimates | Hours to accomplish each step in the process. | - To check for Special Cause variation  
- To investigate correlation between poor projections and execution  
- To check for normality |
| Validity of estimates | Evaluation of time (in hours) it takes between each step of the software development process. | PM and Contractor software cost estimates and actual contractor cost data. | Interviews will be conducted to gather how the process is presently conducted. | LSS Team | March 1, 2012 to April 30, 2017 | 20 development actions, and the correlating estimates | Hours of wait time in-between step in the process. | - To check for Special Cause variation  
- To investigate correlation between poor projections and execution  
- To check for normality |
### Analyze Summary

**Current State Process Map**

- **Estimate Software Effort**
- **Apply Growth Factor**
- **Software Cost Estimate Complete**

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**Critical X/Root Cause Analysis**

- **Process Step / Input**
- **Potential Failure Mode**
- **Potential Failure Effects**
- **Potential Causes**
- **Current Controls**
- **Actions Recommended**
- **Corrective Action Assessment**

<table>
<thead>
<tr>
<th>Process Step / Input</th>
<th>Potential Failure Mode</th>
<th>Potential Failure Effects</th>
<th>Potential Causes</th>
<th>Current Controls</th>
<th>Actions Recommended</th>
<th>Corrective Action Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate Software Effort</td>
<td>Inadequate data available</td>
<td>No Baseline Estimate</td>
<td>9 no data</td>
<td>Supervisory Direction</td>
<td>3 14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Competing workload for Cost Estimator</td>
<td>No Baseline Estimate</td>
<td>9 no data</td>
<td>Supervisory Direction</td>
<td>3 12</td>
<td></td>
</tr>
<tr>
<td>Apply Growth Factor</td>
<td>Inaccurate Factor applied</td>
<td>Poorly Estimated cost</td>
<td>10 Poorly developed factor</td>
<td>Use of Army Factor</td>
<td>4 280</td>
<td></td>
</tr>
<tr>
<td>Complete Software Estimate</td>
<td>No Basis for Factor</td>
<td>Poorly Estimated cost</td>
<td>10 Poorly developed factor</td>
<td>Use of Army Factor</td>
<td>4 280</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prepare documentation not available</td>
<td>Final estimate not complete</td>
<td>6 Final estimate not complete</td>
<td>Supervisory Direction</td>
<td>3 26</td>
<td></td>
</tr>
</tbody>
</table>

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**Root Cause Analysis**

**Cause and Effect Matrix**

<table>
<thead>
<tr>
<th>Customer Rank Importance</th>
<th>Finalize Cost</th>
<th>Process Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth Factor</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Step</th>
<th>KPIV</th>
<th>Correlation of Input to Output</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate Software Effort</td>
<td>Development of Software Estimate</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Apply Growth Factor</td>
<td>Employ Army Directed Cost Estimating Relationship (CER) Factor</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Complete Software Estimate</td>
<td>Document the Estimate</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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**Prioritized Root Causes / Effects**

<table>
<thead>
<tr>
<th>Effect (Y)</th>
<th>Root Cause (X)</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Rationale CER Factor</td>
<td>Army Directed Factor without sufficient basis</td>
<td>1</td>
</tr>
<tr>
<td>Inaccurate cost Estimate</td>
<td>Army Directed Factor without sufficient basis</td>
<td>2</td>
</tr>
</tbody>
</table>

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## Improve - Solutions

### Prioritized List of Solutions

<table>
<thead>
<tr>
<th>PRIORITY</th>
<th>SOLUTIONS</th>
</tr>
</thead>
</table>
| 1        | **Solution 1A:**  
From analysis of data, develop Cost Estimating Relationships (CER) for Software Cost Estimating based on historical data from existing programs. New CER will be loaded into parametric estimating tool (PRICE TruePlanning). |
| 2        | **Solution 1B:**  
Continuous collection of data will be accomplished for additional programs from contract CLIN’s directing reporting of actual Software Development costs and loaded into parametric estimating tool (PRICE TruePlanning). |
| 3        |           |
| 4        |           |
Improve - “To-Be” Process Map

Current Process

- Estimate Software Effort
- Apply Growth Factor
- Software Cost Estimate Complete

Future State Process

- Identify Software (S/W) Development Requirement
- Enter Program data into TruePlanning
- Generate S/W development cost in TruePlanning
- Generate S/W development cost in TruePlanning
- Apply new S/W Growth factor to Program Office Estimate (POE)
Improve - Pilot Plan

- Identify a program that can include (or has included) contract language in a CLIN to collect software development data (hours and cost).
- Work with Program Management Office to incorporate the CLIN and identify POC’s in the PMO, Contracting Office, and their POC’s at the contractor to ensure data is appropriately collected.
- Gather data, and develop a Cost Estimating Relationship (CER) for use in the parametric estimating tool (PRICE TruePlanning) to assess the cost of Software Development based on actual historical costs.
- Develop a database to utilize that data.
- Run the parametric estimating tool for a new program to estimate data.
Lessons Learned

▪ Flat rates used to estimate costs that are not based on recent historical data may grossly overstate or understate costs.
▪ Future contracts should include CLINs to collect software development costs.
▪ PM’s and the Army Contracting Command are key participants in ensuring new data is continually collected.
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Today’s Presenter

Jim Golden
Solutions Consultant

- Jim is the U.S. Army lead for the Government Division and is responsible for supporting all U.S. Army organizations in cost estimating and analysis.

- Over 30 years of experience in cost estimating and financial analysis with the U.S. Air Force and the U.S. Army.

- Level 3 Certified Acquisition Professional in both Cost Estimating and Financial Management; and is Level 3 certified under the DoD Financial Management Certification program.

- Retired U.S. Air Force Financial Analyst
  - Former Cost Chief of the U.S. Army’s PEO STRI
  - U.S. Army Lean Six Sigma Black Belt.