Total Cost of Software Maintenance Workshop

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Purpose of Workshop

• Gain insight into total cost of software maintenance
  – What are the tasks done?
  – What are the costs?
  – How they are estimated?
• Understand
  – Industry viewpoints
  – Current best practices
• Recommend
  – Improvements in the practices and models
Agenda

• Setting the stage
• Maintenance WBS
• Three Wideband Delphi’s
  – What work is applicable?
  – What percentage of the effort is it?
  – How is it estimated?
  – Heuristics or rules of thumb?
• Establish a correspondence group
Setting the Stage

• During the past year, we have conducted a software maintenance study to determine:
  – What is the work performed by AF and Army life cycle support centers?
  – Who does it, where and at what costs?
  – How is it estimated and budgeted?
  – What are the factors that influence its cost most?

• We have conducted site visits, interviewed project leads and assembled a maintenance cost database

• We have developed conclusions and briefed seniors on our preliminary results

• We are now reaching out to industry to determine if our conclusions are valid for the work that they do
Study Approach

1. Establish goals for effort
2. Review literature and past efforts
3. Conduct fact-finding
4. Validate findings
5. Publish findings and summary of interim results
6. Devise new maintenance costing approaches
7. Develop Software Maintenance Handbook
8. Publish results and continue research into maintenance

Legend:
- Current effort
- Follow-on

Start
End of effort
To USC
Interim Report

Questionnaires
With participants
3/8/2010
Army Projects

• In progress

• Visited:
  – Ft. Monmouth, NJ
  – Picatinny Arsenal, NJ
  – Redstone Arsenal, AL

• Plans to visit:
  – Defense Industry

• Projects Interviewed
  – America’s Army
  – Apache AH-64A
  – Blackhawk UH-60
  – Bradley
  – Hellfire

• Kiowa
• JAMS
• JLENS
• Longbow
• Lower Tier
• MLRS
• NLOS
• NSITE
• Patriot
• SBX
• Shadow and Hunter UAS
• TACMS MCTD
• Others

3/8/2010
Air Force Projects

- In progress
- Visited:
  - Hanscom AFB, MA
  - Robins AFB, GA
- Plans to visit:
  - Hill AFB, UT
  - Oklahoma City, OK
  - Defense Industry

Findings to date are very similar to those we found in Army software life cycle support centers.

- Projects interviewed:
  - AWACS
  - C130J
  - MPS
  - MMP-U - JMPS
  - TACP-M
  - FAB-T
  - JSS
  - CITS
  - DASR
  - Electronics Warfare
  - SOF Aircraft
  - Joint STARS
  - JTIDS
  - F-15
  - MRT
  - MMRT

3/8/2010
Findings – Groups Do More Than Just Maintenance

Notes

• About seventy percent of their work involves:
  - Maintenance
  - Sustaining Engineering
  - Independent V&V

• The other thirty percent is devoted to other tasks:
  - Acquisition management
  - Software development (e.g., America’s Army)

• Maintenance staff includes both government and in-house contractor personnel
Work Done by Maintenance Organizations

• Software maintenance
  – Developing new releases
• Sustaining engineering
  – Sustaining existing releases
• Independent V&V
  – Acting as honest broker
• Acquisition management
  – Oversight and related support
• Software development
  – Product development (gaming systems, simulators, etc.)
• Emerging tasks
  – Interoperability engineering and testing
  – Information assurance and anti-tamper retrofits
Typical Release Contents

**LEGEND**

- **Enhancements** – incorporating new functions and features into the release based on approved change requests
- **Perfective changes** – making the software run more quicker or more efficiently.
- **Repairs** – fixes incorporated to address outstanding software trouble reports.
- **Patch Releases** – software releases sent to field to correct minor problems.
- **Major Releases** – software versions each released with different functionality.
Findings - Testing Is The Primary Maintenance Activity

Technical Workload

- **55%** Testing
- **20%** Design/Code
- **15%** Requirements
- **10%** Support

Notes

- As much as 60-70% of the technical work done during maintenance supports the retesting and qualifying the system.
- Testing is made harder when developers fail to transition and turnover the needed set of regression tests for use in revalidating the software once changes have been made.
- Support tasks are performed to maintain system integrity and support field operations.
Forecast Future Maintenance Effort Distributions

Notes

- Workload will rise as more and more systems are retrofit to support net-centric warfare concepts
- Total effort will not change, however, its distribution will
- Info Assurance work will continue to grow
- Net result will be that backlog of priority changes will take longer to process
### Other Aligned Study Efforts

<table>
<thead>
<tr>
<th>Effort</th>
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</thead>
<tbody>
<tr>
<td><strong>Maintenance WBS</strong></td>
</tr>
<tr>
<td>- Developed aligned activity</td>
</tr>
<tr>
<td>&amp; task structure</td>
</tr>
<tr>
<td>- Validated it with several defense</td>
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<tr>
<td>contractors</td>
</tr>
<tr>
<td>- Running this workshop for</td>
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<tr>
<td>broader outreach</td>
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<tr>
<td><strong>Estimation models</strong></td>
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<tr>
<td>- Assessed capabilities of</td>
</tr>
<tr>
<td>COCOMO II, SLIM, SEER and True S</td>
</tr>
<tr>
<td>- Validated findings with developers</td>
</tr>
<tr>
<td>- Developing cost database</td>
</tr>
<tr>
<td>to calibrate the models</td>
</tr>
<tr>
<td><strong>Metrics</strong></td>
</tr>
<tr>
<td>- Developed recommended set at both the</td>
</tr>
<tr>
<td>enterprise and project levels</td>
</tr>
<tr>
<td>- Running pilot project to validate</td>
</tr>
<tr>
<td>metrics</td>
</tr>
<tr>
<td>- Will run workshop on these</td>
</tr>
<tr>
<td>at PSSM 2010</td>
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<tr>
<td><strong>Load Balancing Model</strong></td>
</tr>
<tr>
<td>- Developed cost model to</td>
</tr>
<tr>
<td>balance maintenance labor load across</td>
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<tr>
<td>maintenance phases</td>
</tr>
<tr>
<td>- Running pilot project at AF/ESC to</td>
</tr>
<tr>
<td>validate model</td>
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</table>
Maintenance Model Assessment

- **COCOMO II**
  - Drives estimate using code fragment change
  - COPLIMO extends model to take into account life cycle impact of investments

- **SEER-SEM**
  - Drives estimate using size and years to be covered
  - Estimate allocated to four types of changes
  - SEER-IT used to estimate sustaining activities

- **SLIM**
  - Derives maintenance prediction from base estimate using SLIM MasterPlan
  - Views estimate in terms of:
    - Major & minor enhancements
    - Baseline support

- **True S**
  - Maintenance determined by the number of latent defects in a release
  - Assumes maintenance can involve more than just a release
Other Aligned Study Efforts

- Developing maintenance chapter for AFCAA cost handbook
  - Materials discussed so far will be included
  - Looking for several exemplar maintenance projects
    - Best practices-oriented
  - Looking for heuristics and rules of thumb used to estimate maintenance
  - Soliciting help with review
## 2010 Schedule

<table>
<thead>
<tr>
<th>Tasks</th>
<th>1st Quarter</th>
<th>2nd Quarter</th>
<th>3rd Quarter</th>
<th>4th Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Provide improvement inputs for estimating models and techniques for maintenance</td>
<td>Suggestions</td>
<td>Consensus</td>
<td>Pilot Results</td>
<td></td>
</tr>
<tr>
<td>2. New metrics for software maintenance</td>
<td>Suggestions</td>
<td>Pilot Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Continue data collection effort</td>
<td>Collection Complete</td>
<td>Database Finished</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Meetings and conferences</td>
<td>Models WS</td>
<td>PSM WS</td>
<td>ISPA</td>
<td>Brief to Seniors</td>
</tr>
<tr>
<td>6. Project management</td>
<td>Progress</td>
<td>Progress</td>
<td>Progress</td>
<td>Final</td>
</tr>
<tr>
<td>7. New concepts and next proposals for maintenance studies</td>
<td></td>
<td></td>
<td>Suggestions</td>
<td></td>
</tr>
</tbody>
</table>

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Total Cost of Software Maintenance Workshop

PROCESS

• **Step 1**
  – Circulate Software Maintenance WBS
  – Mark what activities and tasks are applicable
    • Government and contractor
  – Identify applicable activities and tasks that we did not include
  – Estimate the percentage of effort allocated to each activity in WBS
    • Total must equal 100%

• **Step 2**
  – For each activity, we will identify how estimated
    • Heuristic, Cost Model, Level of Effort, Other
  – We will next identify how maintenance activities are budgeted
    • Level of Effort, project directed, Other

• **Step 3**
  – Summarize results and prepare outbrief for tomorrow’s presentation

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Total Cost of Software Maintenance Workshop (Continued)

- **Workshop Products**
  - Updated Software Maintenance WBS
  - WBS Dictionary
  - Percentage effort
    - Government
    - Contractor
  - Manner estimated
    - Heuristic, LOE, model and/or other
  - How activities are budgeted
  - Correspondence group

- **Resources**
  - Draft Software Maintenance WBS
  - Worksheets
  - Project Reports
    - Myths of Maintenance
    - Comparison of COCOMO, SLIM, SEER and True S Maintenance Cost Models
    - Metrics for Maintenance
    - An Innovative Load Balancing Parametric Software Maintenance Model

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Let’s Get On With The Show

• First order of business, sign-in on the sign-up sheet
• Worksheet
  – **Activities/tasks** – add if incomplete
    • Define your activities/tasks on added sheet as identified
  – **Column 1** – applicable activities/tasks
    • Mark government or contractor
  – **Column 2** – percentage effort for activities (total = 100%)
  – **Column 3** – manner in which activities estimated
    • Mark heuristics, LOE, model, or identify other method
  – **Column 4** – manner in which activities budgeted
    • Mark LOE, negotiated or identify other method
  – **Column 5** – notes to add any thoughts you might have

3/8/2010
Summary and Conclusions

• Summary
  – Communicated study findings to defense community
  – Gathered feedback and identified differences between how maintenance is done by government and contractors

• Conclusions
  – Lots of interest in topic and lots to learn
  – Study is on the right track
Acknowledgements

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  – Susan Davis, USA/RDECOM
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• Study team
  – Jill Allen, USA/RDECOM
  – Brian Fersch, USAF/ESC
  – Barbara Hitchings, SAIC
  – Don Reifer, RCI
  – Denise Saltojanes, USAF/ESC

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