Army Software Operations, Maintenance and Sustainment Study Overview
"What Life Cycle Software Centers Do"

July 2011

Goals of Effort

- Determine whether budgets for software maintenance are sufficient to cover all of the work performed to keep systems operational

- If not, build a business case for increasing POM budgets to provide operations, maintenance and sustainment for warfighter

- Recommend policies and guidelines for ensuring budgets are sufficient once systems are fielded

Target Audience

- Target Audience
  - DoD finance staff
  - Army seniors
  - Army finance staff
  - Program managers
  - Estimators /model creators

- Benefits
  - Increased understanding of influence factors
  - More effective use of maintenance budgets
  - Increased maintenance budgets (POM)

Study Approach

- Investigate maintenance
  - What are the tasks?
  - Who does them?
  - What are the costs?
  - How they are estimated?
  - What impacts future costs?
- Understand
  - Current costs and risks
  - Current estimating practice
  - Current budgeting approach

On-Going Tasks

- Data collection
  - Questionnaire/instruments
  - Maintenance database
  - Data administration, protection & management
- Architecture development
  - Information needs
  - Data modeling
- Analysis
  - Gap analysis
  - Indicators

- Stakeholder Program
  "Working one-on-one "
  - Web site
  - Case studies
  - Outreach
    - Conferences
    - Presentations
  - Publications
  - Working groups
- Project management
  - Status and progress reviews/assessments

Products/Outcomes

- ## <u>Products</u>
  - Facts about actual work done for operations, maintenance and sustainment
  - Budget gaps based on actual work needs
  - Rationale why gaps should be filled (i.e., business case)
  - Presentations, publications and benchmarks
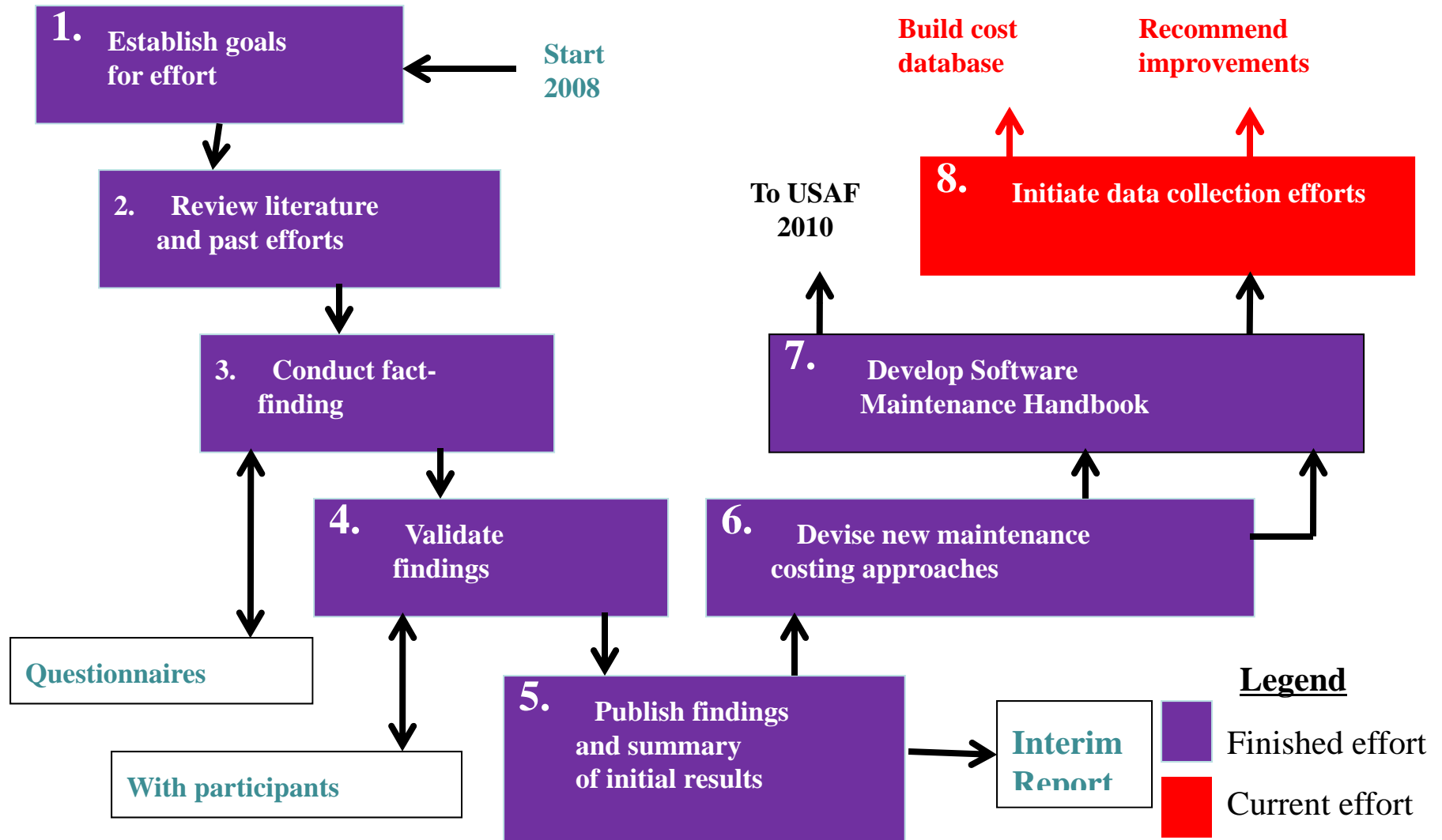   - For use in changing current business practices

<u>OUTCOME:</u> Maintaining and Sustaining Software in a Smarter, Quicker and More Effective Manner

Study Participants

- Study team
  - Joanne Arias, Army
  - Bob Charette, IEI
  - Cheryl Jones, Army+
  - Jack McGarry, Army
  - Dave Morris, IEI
  - Don Reifer, RCL+
- Sponsor
  - James Judy, ASA
  - Jeramia Poland, ASA

+ Co-Project Leads

- DOD collaborators
  - Ft. Monmouth
  - Ft. Sill
  - Picatinny Arsenal
  - Redstone Arsenal
  - USAF/ESC
  - Warner Robbins AFB, GA
- Industry collaborators
  - Lockheed Martin
  - Northrop Grumman
  - Raytheon
  - Others

Data Collection Focus

1. **Establish goals for effort**

Start 2008

2. **Review literature and past efforts**

3. **Conduct fact-finding**

4. **Validate findings**

Questionnaires

With participants

5. **Publish findings and summary of initial results**

Interim Report

6. **Devise new maintenance costing approaches**

7. **Develop Software Maintenance Handbook**

To USAF 2010

8. **Initiate data collection efforts**

Build cost database

Recommend improvements

Legend

Finished effort

Current effort

Results of Army Maintenance Study

- Over 200 projects surveyed
  - Six Army and AF Centers visited
  - Over 70 interviews
  - Industry consulted
  - Results viewed as universally true
- Findings
  - Maintenance centers do more than just updates and repairs

- Distribution of work much different than expected
- Testing is the major maintenance activity
- Transition and transfer is done poorly
- Estimates and budgets don't cover all the work
  - Sustaining engineering
  - Product field & user support
  - Regression testing
- Efficiencies are needed to cope with workload

Army Projects Interviewed

- ## Projects Interviewed
  - Adam Cell
  - Aerial Targets
  - AMPS
  - America's Army
  - AN/TPQ-37
  - Apache AH-64A
  - Blackhawk
  - Bradley
  - ESI DB
  - FOS
  - GFC
  - Hellfire
  - JAMS
  - JLENS
  - Kiowa & Kiowa CPT Trainer

  - LHMB
  - Longbow
  - Lower Tier
  - MLRS
  - MMS-P
  - NLOS
  - NSITE
  - Paladin
  - Patriot
  - SBX
  - Shadow & Hunter UAS
  - TACMS MCTD

Plus we validated findings with CECOM & Picatinny

Air Force Projects - 2009

- Visited:
  - Hanscom AFB, MA
  - Robins AFB, GA
- Findings were very similar to those found across Army centers
- AF is pursuing their own data collection activities
- Want to establish maintenance CERs

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

Army Projects Analyzed - 2010-2011

Pilot Maintenance Database

Pilot Data Analysis Processes

Spreadsheet-Based Questionnaire

Data Protection Procedures

DID for data
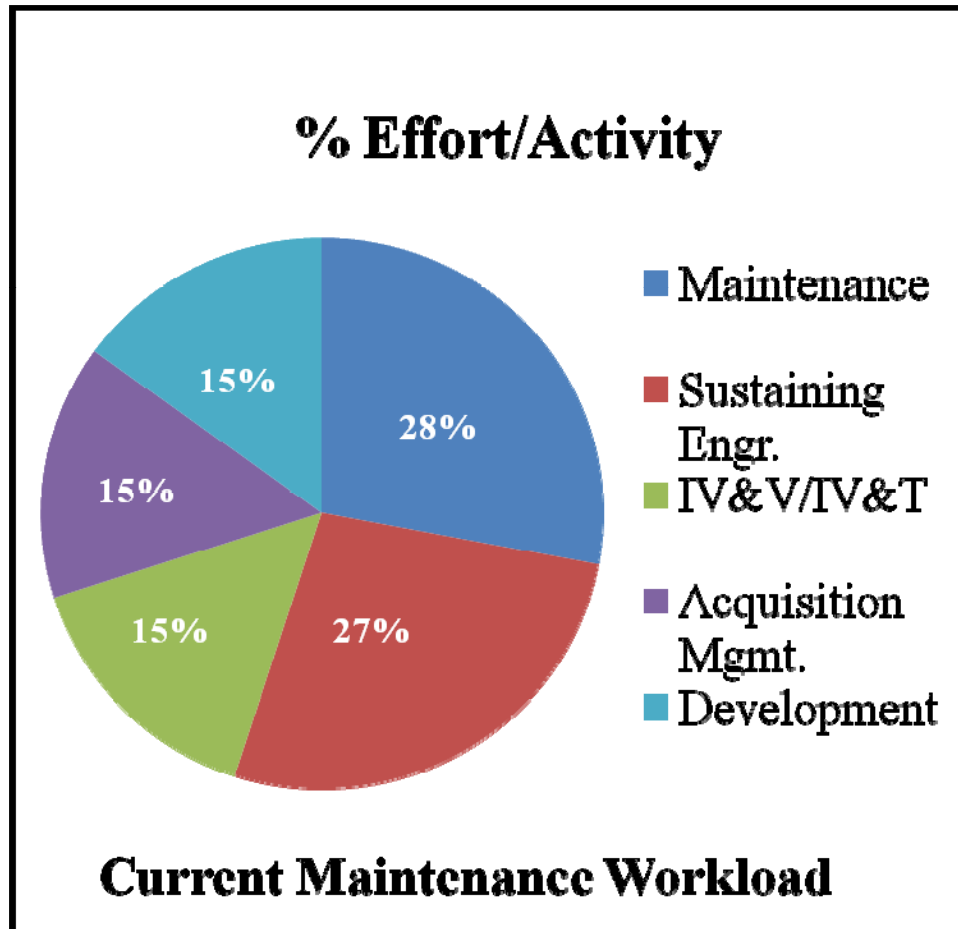
Glossary of Terms

Information Needs for Target Audiences

- **Picatinny Arsenal**
  - LHMBC
  - MFCS-H
  - Paladin
  - TAD

- **Data gathered and analyzed**
  - Processes to be used perfected
  - Analysis identified important trends
  - Hard data captured

Current Work Distribution

% Effort/Activity

- Maintenance — 28%
- Sustaining Engr. — 27%
- IV&V/IV&T — 15%
- Acquisition Mgmt. — 15%
- Development — 15%

Current Maintenance Workload

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

Maintenance Groups Support Up To Four Releases (in parallel)

- Confusion often reigns because maintenance staff at centers are working on multiple releases in parallel using funds available
  - "Development" version working enhancements, repairs and perfective updates to current baseline
    - Often done iteratively with multiple releases
  - "Fielded" and "to be fielded" releases
  - Requirements release (included because takes staff resources and may pursue prototyping)
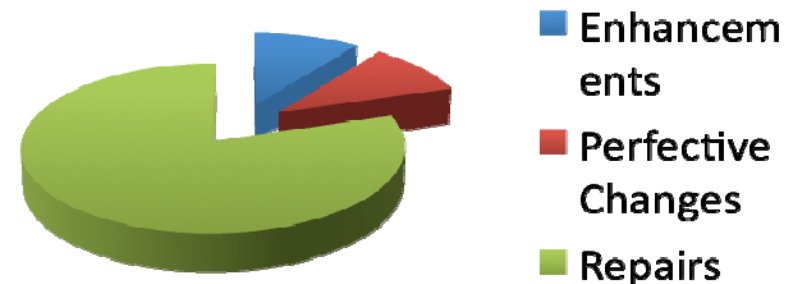- Budgets taken from several sources
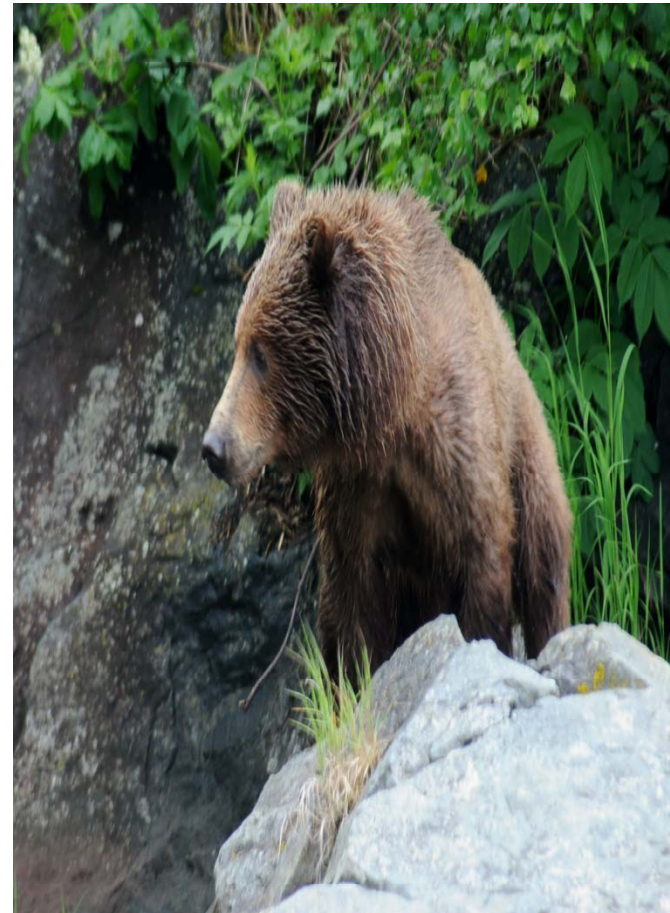
Typical Release Contents
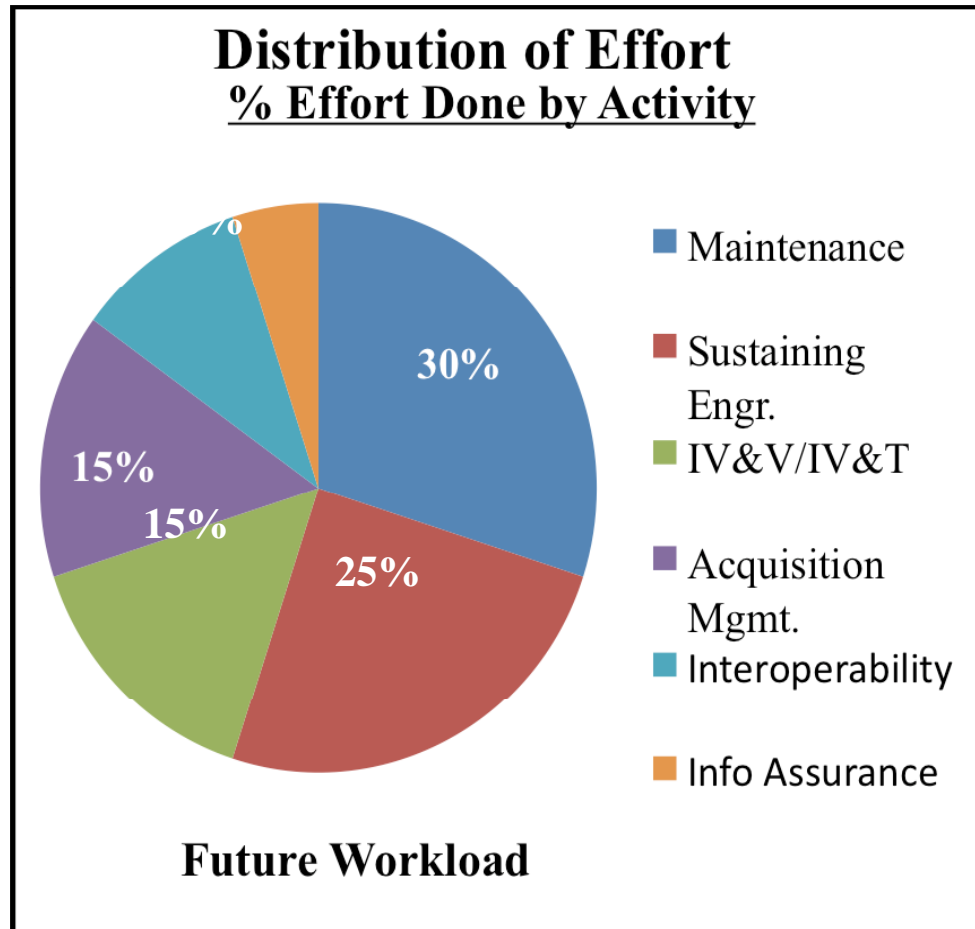

Major Maintenance Release Contents (%)
- Enhancements
- Perfective changes
- Repairs
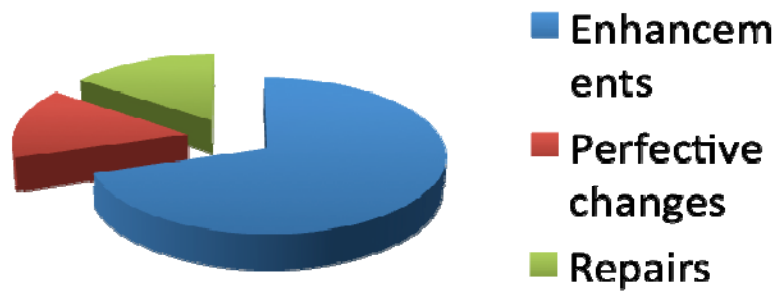
Patch Release Contents (%)
- Enhancements
- Perfective Changes
- Repairs

- **Enhancements** - incorporating new features and functions into released based on approved change requests.

- **Perfective changes** - making the software run more quickly or efficiently.

- **Repairs** - fixes incorporated to address outstanding software trouble reports.

- **Patch release** - software sent to the field that corrects minor problems.

- **Major release** - software versions each released with different functionality

Future Work Projections

Distribution of Effort
% Effort Done by Activity

- Maintenance — 30%
- Sustaining Engr. — 25%
- IV&V/IV&T — 15%
- Acquisition Mgmt. — 15%
- Interoperability
- Info Assurance

Future Workload

- Workload will rise as more and more systems are retrofit to support net-centric warfare concepts
- Total effort may increase as it gets better aligned with the work than needs to be done
- Info Assurance work will continue to grow
- Net result will be that backlog of priority changes will take longer to process

Testing is Primary Maintenance Activity

Maintenance
% Work Done by Technical Task

- 20%
- 15%
- 55%

Requirements
Design/Code
Testing
Support
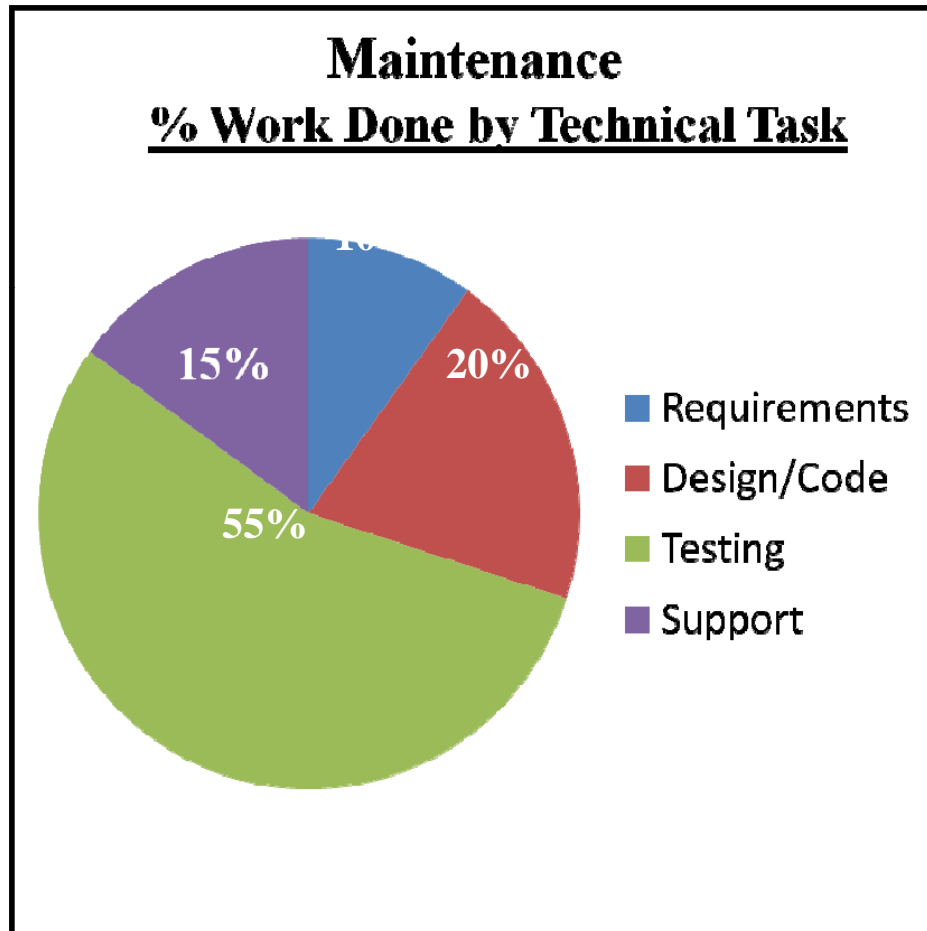
- As much as 55-70% of the technical work done during maintenance supports retesting and qualifying the system
- Testing is much harder when developers fail to transition and turnover the needed set of regression tests for use in revalidating the software once changes have been made
- Support tasks are performed to maintain system integrity and support field operations

Transition and Turnover Done Poorly

- Transition requirements often waived, avoided or delayed
  - Consequences dire
    - Delivery not ready for maintenance
    - Facilities, tactical equipment and tools often not available when needed for testing block releases
  - Prime wants to retain responsibility
    - Ownership rights to tools and special test equipment often an issue
- Budgetary guidelines needed
  - Emphasize Program Office accountability/responsibility
  - Provide transition budget line as review item in prime item contract
- Development SIL seldom transitioned for maintenance

Not All Of The Work Funded

- Estimates formulated based on effort needed to make updates and repairs
- Other activities like sustaining engineering and testing not covered
- Unfunded mandates like Info Assurance not adequately covered
- Small projects done on LOE basis

- Resulting budgets force maintenance staff to play backlog reduction games
- They do what they can with resources allocated
- Cost models & heuristics used perpetuate status quo
    - Study done that verifies this finding
- Shortfalls in funding need to be corrected

Future Plans

- Collect O&M cost and quality data and build the software maintenance database

- Analyze these data to better understand the maintenance workload and the factors that drive cost, risk and schedule

- Understand how big our O&M workload truly is

- Develop measures and indicators that provide us insight into this workload

- Identify best practices and put them to work to improve O&M affordability

What We Want From You

- Query
  - Ask questions to gain insight into how you run your business

- Gather
  - As much "hard data" on your software cost, quality and productivity as we can
  - Your opinions about what factors drive these costs and impacts your quality

- Understand
  - What it truly takes to get the maintenance job done cost-effectively

- Act
  - Use the "hard data" to help build a business case for change
  - Focus initially on the low hanging fruit
  - Then, move on to the more difficult changes

Want to Participate?

Fact-Finding

- Become a collaborator and provide maintenance data under MOA or NDA agreement
- Collaborators will have early access to results via private web site
  - Typically, six months to a year before others
- Data will be protected

Frame Recommendations

- Collaborators will help shape recommendations for seniors

Become More Effective

- Results will make it possible to improve how we do business overall

End-Game: Win the Tough Battles of the Budget in Leaner Times

Benefits of Participation

Industry Groups

- Hard data will help you to improve the way you maintain software

- Results will help you define and defend reasonable budgets for maintenance activities

- Benchmarks will help you to more effectively do the job and manage the work involved

Government Groups

- Hard data will help us to convince seniors that POM budgets need to be increased

- Business cases will help us to educate management about the work that needs to done during O&M phase of the life cycle

- Data will help everyone to more effectively use the sparse resources allocated to do the job

Data Protection Scheme

- All data provided will be protected
  - Projects will be code named
  - Files will be encrypted and placed on a machine with restricted access
  - Limited access to data will be enforced via terms of MOA or NDA
- Only generalized results will be reported
  - Traceable to application domains, not specific projects
- Custodian will administer database

Process Used

- **Process**
  - Teleconference held to explain goals
  - Questionnaire distributed to participant along with glossary and other aides
  - Questionnaire completed by participant(s)
  - Questionnaire reviewed and finalized by our team
  - Initial findings provided at out-brief
  - Follow-up after-the-fact to clarify items and gather more data

- **What we expect**
  - Openness - we are here to help you
  - Candor
  - Responses

- **What you should expect**
  - Openness
  - Candor
  - Honesty

Next Steps

- Meet with Projects
  - Review the questionnaires (or fill them out if necessary)
  - Review whatever "hard data" that you provide to understand it fully
  - Gather worksheets with the detailed estimates/actuals so we can work our magic
  - Have a tour of the facilities if time permits
  - Develop insights into ways we can help you get your job done

Summary and Conclusions
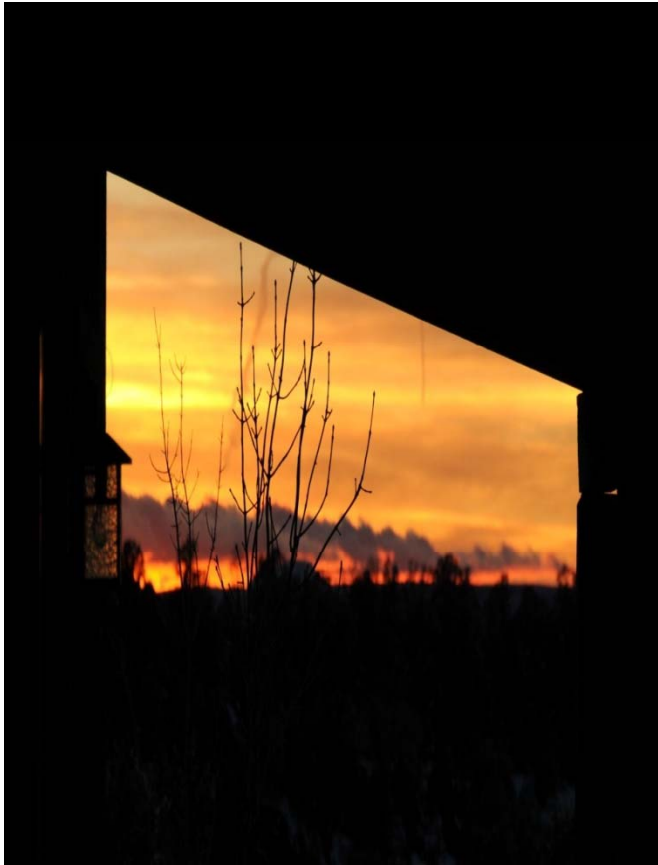
- Summarized past efforts and accomplishments
- Highlighted issues and suggested future paths
- Discussed our fact-finding process
- We hope that you are ready to take the next step

Back-Up Charts

Ten Myths of Maintenance

- **<u>Myth 1</u>** - PDSS workload is aimed at satisfying requirements
  - Goal is getting rid of high priority ECPs (backlog reduction)
- **<u>Myth 2</u>** - PDSS is funded based on requirements
  - Mostly funded LOE using available funds
- **<u>Myth 3</u>** - In general, maintenance schedules are based on user need dates
  - Actually, based on calendar release dates

Ten Myths of Maintenance

- **Myth 4** - Sustaining engineering effort is separately estimated and managed
  - Most of funding for this effort is taken out of hide
- **Myth 5** - IV&V uses separate processes, people and tools to assess capability of the code to perform
  - Often projects must share people and tools because of lack of funds
  - Tactical equipment and resource availability often constrain options

Ten Myths of Maintenance

- **<u>Myth 6</u>** - Maintenance personnel are for the most part junior
  - Actually senior people with skills not readily available on active marketplace (Ada, VAX, etc.)
- **<u>Myth 7</u>** - Motivating maintenance personnel is difficult
  - Interesting work, educational opportunities, etc. do the job
- **<u>Myth 8</u>** - Process improvement efforts address maintenance
  - Address only a subset of the work

Ten Myths of Maintenance

- **Myth 9** - All maintenance groups do is maintenance
  - The Center has the flexibility to enter the software business
  - It also has the ability to use new paradigms and embrace commercial best practices

- **Myth 10** –The maintenance Group's focus is software
  - They also fix hardware and work lots of contract issues
  - Some perform field engineering and other forms of support