



Test & Evaluation Methods

When to Automate in a Fiscally Constrained Environment

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Agenda

- Introduction/Biography
- Goals
- Automated Test System Design
 - Test Documentation
 - eTDR
 - Automation Architecture
- Return on Investment Calculation
- Applicability to Other Programs
- Summary & Recommendations



Biography

Amar Modi

Amar holds a B.S and a M.S in Electrical Engineering from UT Arlington. He has over 10 years of systems engineering experience by starting his career with Lockheed Martin – MFC in 2005 and transitioning to Raytheon in August 2008. His experience spans all the different areas of Systems Engineering from requirements development to production support. He has over 8 years of EO experience by supporting EO platforms on missiles, land combat vehicles, fixed & rotor wing crafts as well as ships.



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Joshua Strain

Josh started his career at Raytheon Space and Airborne Systems in May 2009. He holds a B.S. in Computer Engineering from the University of Oklahoma and is working towards a M.S. in Systems Engineering from Johns Hopkins University. He is a Certified Agile Product Owner and currently works as the Systems Software Architect in the Systems Verification Center. He specializes in database design and distributed architectures utilizing the Microsoft .NET platform.



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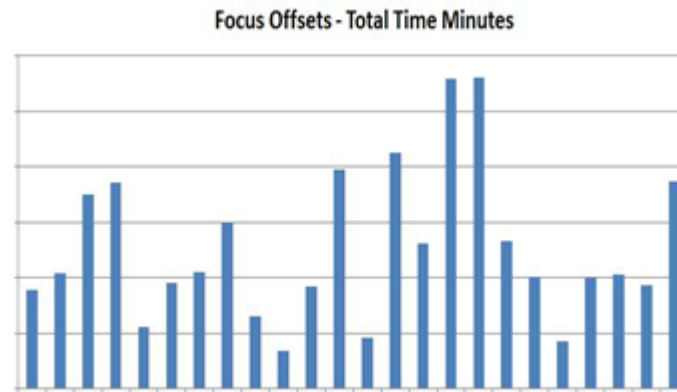
Goals

- **Goal of this presentation: Simplify the decision making process**
 - Show how it can improve the bottom line.
 - Show that a common automated system is a win-win for all involved.
 - Provide an agile implementation approach to start gaining benefits at the end of each phase.



The Manual Process

- Paper datasheets are easily misplaced/lost.
- Paper data sheets and notes could be illegible
- Test operators could make math/rounding errors
- Test operators could make data entry errors
- Very difficult to perform statistical analysis
- Could have significant variability between test operators
- Relies on human verification
- Manual process typically takes longer testing times



When to Automate

- The Timing:
 - Multiple variants of similar systems
 - Multiple different systems with similar test methodology
 - Use resources more efficiently
 - Improve test capability.

- Standardized IVV Process is Important
 - Reliable & repeatable results are needed.
 - When test process are mature enough that human oversight is not necessary.

- Reduce Cost:
 - Reduce per unit cost by reducing cycle time.
 - Reduce cost related to operator training, line startup costs, test execution, rework, etc



Software Automation Overview

Needs met by development of two Raytheon software platforms:



Electronic Test Data Records Software

- Software displays test procedure to operator
- Calls into AA DLLs to run a test
- Records data electronically
- Automatically determines pass / fail against limits
- Allows for mix of manual and automated test paragraphs
- Controls calling into automated software



Automation Architecture Software

- Runs automation that controls unit under test and test equipment
- Returns test results back to eTDR
- Flexible plug and play automation software



Incremental Approach

- Phase I: Implement Test Procedures in DOORs
 - Portability
 - Consistency
 - Standardization

- Phase II: Integrate eTDR Software
 - Analyze Test Variations
 - Analyze station to station or technician to technician variations
 - Analyze Test Repeatability

- Phase III: Integrate Automation Software
 - Reduces Cycle Time
 - Flexible Architecture



Rol – Test Procedure Parameters

- Total number of test procedures
- Manual Setup Teardown Time Per Procedure
- Total # entries/test per procedure:
 - Percent of entries in automation format
 - Percent of new entries not requiring automation
 - Percent of new entries requiring automation
 - Percent of old entries adding automation
- Hours Required:
 - Update a similar eTDR test entry (no automation)
 - Update a unique or new eTDR test entry (no automation)
 - Update a unique or new eTDR test entry (with automation)
 - Add automation to a pre-existing eTDR entry.
 - Hours required to sustain/maintain/update a test procedure manually
 - Hours required to sustain/maintain/update a test procedure in a database such as DOORs



Rol – Test Equipment Parameters

- % Test Equipment Already Support by Automation
- % Test Equipment Cannot Be Automated
- % Test Equipment Can Be Automated but have not yet
- SW Hours Required to establish C2 with non-supported (but automatable TE) based on the following:
 - # of functions the test equipment has to perform.
 - Complexity in the SW interface, vendor provided DLL, vs a complete custom design
- HW hours required to establish C2 with non-supported (but automatable TE) based on the following:
 - TE HW Design, Development, Integration & Maintenance Cost
 - Actual TE Purchase Cost
- Hours Required to bring non-supported (but automatable TE) added to the AA
- Hours Required to sustain AA & eTDR SW



Rol – System Software Interface Parameters

- % of systems commands that exits on GUI's/Soft Panels/etc. which needs testing/verification
- SW interface (in hours) for system message/command requiring testing/verification based on
 - Number of system message/command requiring testing/verification.
 - Complexity in UUT HW/SW interface, standard interface such as GPIB, Ethernet, etc or a custom interface
- Average # of steps required until value displayed on screen per system message requiring testing/verification



RoI Summary & Results

- Other Considerations:

- Number of firm units
- Number of units in potential award (non-firm)
- Currently producing plus forecasted number of units of other similar programs (similarity $\geq 75\%$ in the next 5 years)

- Summary/Totals:

- Hours required to automate assuming new additions are automated?
- Hours required to develop assuming new additions are manual?
- Percentage of Automation achieved
- Total Hours to run all procedures (Automated)
- Total Hours to run all procedures (Manually)
- Break Even (in # of units) from automating
- Profitability from automation



SUMMARY

- **Programs with greatest benefits :**
 - Hardware centric programs are more beneficial but process/tools apply to SW centric programs as well.
 - Programs with similar/common sub-systems.
 - Programs whose roadmap (from R&D to production) spans a decade or longer.
 - Programs with high volume of delivered hardware .



SUMMARY (cont...)

- Provided a mechanism to calculate if automation is worthwhile:
 - Answers whether it is right for your program?
 - The development hours it would take to automate?
 - Break even point?
 - Percentage of Automation achieved?
- Provided a phased approach to get there



Questions

