Systems Assurance in the Age of Open Source Technology

Edward Beck
Senior Manager

NDIA Conference    October 25-28, 2010
Mission Solutions Engineering

- Design, development, and integration of real-time software for the U.S. Navy’s Aegis weapons system, and its derivatives, since 1969

- Embraced an Open Technology Development paradigm to support Navy Open Architecture initiatives

- Decade of experience in the evaluation, selection, integration and maintenance of OSS for Mission Systems development.
Set of Activities

- Governance
  - Adherence to well-defined processes

- Acquisition
  - Matching requirements with best-of-breed components

- Legal
  - Review and approval of Open Source license types

- Security
  - Engineering analysis to mitigate vulnerability risk

- Integration
  - Full life-cycle engineering activities
Set of Activities

• **Governance**
  – Adherence to well-defined processes

• **Acquisition**
  – Matching requirements with best-of-breed components

• **Legal**
  – Review and approval of Open Source license types

• **Security**
  – Engineering analysis to mitigate vulnerability risk

• **Integration**
  – Full life-cycle engineering activities
Software Development Process


- **Operational Reqts Definition**
- **System Reqts Definition**
- **Element Reqts Definition**
- **CP Performance Reqts Definition**
- **Computer Program Design**
- **Comp Program Detailed Design**
- **Code**
- **Capture, Integration**
- **Investigation, Evaluation, Approval**

Governance of Open Source
- Investigation
- Evaluation
- Approval
- Capture
- Integration (modification)
- Delivery
- Upgrade

- **Operational Tests**
- **System Demo & System Qual Test**
- **System T&E, MEIT**

- **Engineering Test & Evaluation**
- **Element CP Integration & Test**
- **Unit Test**
- **Delivery, Upgrade**

Open Source Integration
Applying Open Source Technology is an Organizational Effort

• Our Engineering Organization is tasked with the investigation, evaluation, and integration of Open Source software according to a strict set of criteria

• The Contracts Organization provides authorization for the use of Open Source software based on the type of license associated with the component

• An Open Source Library is maintained by our Configuration Management Organization as a “trusted source” for officially sanctioned Open Source components
Adopting New Development Processes

• Investigation
  – Based on system requirements, a search of available Open Source repositories is made to determine if a component exists that meets system needs

• Evaluation
  – Candidate Open Source component is subjected to internal tests and reviews
  – Licensing agreement is reviewed

• Approval
  – Candidate Open Source component is recommended for inclusion into the system architecture

• Capture
  – Official Download and CM of Open Source Product
Adopting New Development Processes (cont.)

• Modification
  – Alterations to Open Source component due to locally encountered issues

• Delivery
  – Delivery of Open Source Product for use in the project

• Upgrade
  – Capture and subsequent re-delivery of the next generation of the Open Source component
Open Source Life Cycle

1. Internet
   - Evaluation Area
     - Controlled Directories
       - Open Source Library
         - Open Source Component
           - Build
           - Install
         - Load file
           - Build
           - Install
       - Library
         - Load file
           - Build
           - Install
       - Target Nodes
         - Open Source Executable
           - Data Access
           - Executable
         - Executable
           - Install

Download under CM/QA Log

Review and Approval Cycle
Set of Activities

• Governance
  – Adherence to well-defined processes

• Acquisition
  – Matching requirements with best-of-breed components

• Legal
  – Review and approval of Open Source license types

• Security
  – Engineering analysis to mitigate vulnerability risk

• Integration
  – Full life-cycle engineering activities
Satisfying Requirements with Open Source Components

Requirements

Investigation/Evaluation

Experience + Knowledge Base

Solution

Developed

COTS

Developed

Open Source Component

Open Source Component

Open Source Component
Where Does The Search Effort Begin?

- Thousands of Open Source projects are readily available for evaluation and use
  - Websites and projects are too numerous to mention

- Engineering expertise
  - Knowledge base within our center

- Leverage our Open Source Knowledge Community
  - Access to thousands of experienced employees worldwide

- Corporations are contributing to Open Source efforts
  - Open Source is no longer just the domain of hobbyists
Selection Criteria Guideline

• Established project?

• License type?

• Security concerns?

• Actively maintained?

• Adequate support?

• Supported platforms?
Set of Activities

• Governance
  – Adherence to well-defined processes

• Acquisition
  – Matching requirements with best-of-breed components

• Legal
  – Review and approval of Open Source license types

• Security
  – Engineering analysis to mitigate vulnerability risk

• Integration
  – Full life-cycle engineering activities
Beware: Open Source Licensing

• Although Open Source may be free, it is not completely free of restrictions
  – Unless the software has been placed in the public domain, access to Open Source software is subject to stated conditions of use, or license terms, determined by the owner

• Licensing is a complex issue
  – There are about 20 major license types in the Open Source community
  – Need to be aware of the restrictions associated with each

Open Source licenses must be carefully reviewed by area experts.
License Terms

The chart represents the primary license types: Commercial, GPL, BSD and public domain. GPL and commercial carry the most license obligations but are at opposite ends of the proprietary scale regarding source code ownership and availability.

Source: CSC Open Source: Open for Business
Established Procedures

• Our process engages the Contracts organization for review and approval of each license
  – Also leverage the MSE Knowledge Community for guidance

• Additional steps
  – Create guidance document on license evaluation
  – Provide knowledge training on the various OSS license types
  – Create automated workflow for the review and approval process of OSS licenses
  – Establish a well-known list of OSS license types that are acceptable for organizational use
Set of Activities

- Governance
  - Adherence to well-defined processes

- Acquisition
  - Matching requirements with best-of-breed components

- Legal
  - Review and approval of Open Source license types

- Security
  - Engineering analysis to mitigate vulnerability risk

- Integration
  - Full life-cycle engineering activities
Systems Assurance

• Ensure Security
  – Mitigate vulnerabilities

• Maintain Quality
  – Software stability

• Eliminate Fear Uncertainty Doubt
  – Embrace use of Open Source
Security: Safety in Numbers

- Open Source and Security appear to be an oxymoron, but in fact are highly compatible
  - The very openness of the software ensure rigorous reviews and testing, bolstering security

- In practice, source code availability allows a large community of developers to inspect and review the code for security flaws

- Developers are driven by fame: finding a security weakness in a complex system is a challenging task that is recognized and lauded by peers.
Security and Safety Measures

• Virus Scans

• Backdoor checks

• Code Inspections

• Performance Tests
  – Memory consumption
  – CPU utilization
  – Process/Thread allocation
Multiple Testing Levels

- System Definition & Design
- Computer Program Definition & Design
- Computer Program Implementation
- Computer Program Testing
- System Integration Testing

Governance of Open Source
- Investigation
- Evaluation
- Approval
- Capture
- Integration (modification)
- Delivery
- Upgrade

Operational Tests
System Demo & System Qual Test
System T&E, MEIT
Engineering Test & Evaluation
Element CP Integration & Test
Unit Test
Code

Open Source Integration
Initial Test and Performance Measurement
CP Performance Reqts Definition
Element Reqts Definition
System Reqts Definition
Operational Reqts Definition

Computer Program Design
Comp Program Detailed Design
Set of Activities

- Governance
  - Adherence to well-defined processes

- Acquisition
  - Matching requirements with best-of-breed components

- Legal
  - Review and approval of Open Source license types

- Security
  - Engineering analysis to mitigate vulnerability risk

- Integration
  - Full life-cycle engineering activities
Open Source Case Studies

- MSE has successfully leveraged Open Source technology in the development and support of the AEGIS weapons system.
Open Source Allocation in Product Area Domains

- Integrated 90+ Open Source components on the Aegis program
  - 30% are deployed within the certified real-time weapons system
  - 40% are used on IR&D projects in support of future programs
  - 30% are used as development tools and IT support programs
Sampling of Integrated Open Source Components

- **CLIENTWARE**: Mozilla, Eclipse, TCPDUMP, LSOF, Expect VIM
- **MIDDLEWARE**: Hibernate, JSPWiki, Devilspie, TCL, TK, XPM, DBG, Bwidget, TCLLIB, iText, ACE+TAO, Pidgin
- **PLATFORMS**: Linux, KNOPPIX, CENTOS
- **MANAGEWARE**: Mantis, Doxygen, GNU Tools, CVS
- **SERVERWARE**: Ingres, Apache, Jabberd
Insight: Distributed Systems Management Toolset

Integration
A Migration to Open Architecture

Proprietary Systems
Manufactured hardware and developed software

Open Technology
Emphasis on COTS hardware and software integration

Computing System Management functions have become more complex with the adoption of COTS technology.
Application Management

• Manage where applications are running
• Manage runtime state of the applications
• Manage recovery and reconfiguration
• Assess health status of the applications

Equipment Management

• Node/Server Management
  – Diagnostics
  – Performance Monitoring
• Network Management
• Asset Management
  – Validation and Verification
  – Software Distribution

Fault Detection / Fault Isolation
Root Cause Analysis
Open Technology

• An Aegis ship not much different from a large-scale commercial data center.

• The weapons system is comprised of a standard operating environment with unique components not seen in commercial architectures.
Insight: Distributed Systems Management Toolset

• Highly configurable suite of open source, commercially available, and developed tools that perform system management functions across the enterprise

Development Site
Validation of the build environment

Test Facility
System validation, diagnostics, operability tests

Shipyard Integration

Deployed Systems
Runtime status monitoring, operability tests, diagnostics
Extensive Use Of Open Source Technology

- Over 40% of Insight is comprised of Open Source software
  - Permits selection of cost effective, best-of-breed solutions
  - Reduces development time
  - Allows for extensible functionality

Open Source is incorporated within every functional component of Insight.
The Open Source Benefits For Insight

Sample cost and schedule

<table>
<thead>
<tr>
<th></th>
<th>Open Source</th>
<th>MSE Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expect/TCL, XPM, DBG</td>
<td>Framework</td>
</tr>
<tr>
<td>Source Lines</td>
<td>102,266</td>
<td>10,238</td>
</tr>
<tr>
<td></td>
<td>38,417</td>
<td>8,812</td>
</tr>
<tr>
<td>Development Cost</td>
<td>$2,676,404*</td>
<td>$267,938*</td>
</tr>
<tr>
<td></td>
<td>$1,005,372*</td>
<td>$230,610*</td>
</tr>
<tr>
<td>Effort - Staff Months</td>
<td>227</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>85</td>
<td>19</td>
</tr>
</tbody>
</table>

*Costing number derived from industry standard numbers as determined by the SLOCCount estimation tool. Refer to [http://www.dwheeler.com/sloccount](http://www.dwheeler.com/sloccount) for details.*
Edward Beck
MSE
304 W. Rt 38
Mooresstown, New Jersey 08057
Phone: (856) 252-2055
Email: edward.beck@missionse.com