Software Development Challenges in AFMC (Agile Software Development and Data Rights)
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Breaking Barriers ... Since 1947
Outline

• Introduction (Dr. Marc Shaver)
• HQ AFMC/EN ASD Questionnaire Results (Mr. Andrew Jeselson)
• AFLCMC/EN-EZ Agile Software Development (ASD) Workshop (Mr. Curtis Jefferson)
• AFLCMC/EN-EZ SW Data Rights Strategy Process (Mr. Curtis Jefferson)
Introduction

- The Air Force Engineering Enterprise led efforts identifying knowledge, skills, and process gaps within the workforce
- Two software related topics were:
  - Awareness of Agile, Flexible SW Development & Sustainment Methodology to include Agile SW Development (ASD)
  - Software Data Rights Strategy process
- AF Life Cycle Management Center (AFLCMC), with AF Materiel Command (AFMC) support, leading efforts to address these topics
- A key initial outcome of these efforts is the requirement to develop education and training for the engineering workforce
  - Education will capitalize on existing DAU and other courses providing basic understanding of ASD and Data Rights
  - Focus on AF unique practices, processes, and tools
  - Initial concepts under development
Background

- ASD
  - Well understood and widely used commercially and, in DoD Information Technology (IT) and Business System applications
  - DoD weapon system acquisition now moving to apply ASD
    - No standard DoD weapon system specific ASD methodology or training
  - AFMC Engineering Council tasked AFMC/EN to study ASD to define scope and types of ASD employed and associated training
  - AFLCMC also interviewed programs to gather ASD lessons learned and best practices
- AF pursuing weapon system specific ASD education addressing:
  - Implementation approaches, barriers and enablers, weapon system specific ASD challenges/problems/successes, and other management considerations
Background (con’t)

• Software Data Rights Strategy
  • Data rights vital for life cycle management
  • Programs need to carefully consider appropriate Software Data Rights, especially related to sustainment, early in program’s lifecycle
  • AFLCMC/EN-EZ developed a standard process for producing an Intellectual Property (IP) Strategy for Weapon System Software
  • Repeatable process that produces SW Data Rights strategy
    • Provides consistent approach for identification, justification, and documentation of the program’s SW data rights; and assures persistence of the software data rights procured over program life cycle through early and continuous participation of government organic SW support agencies
  - AFLCMC has codified the SW Data Rights Strategy as a standard process
### Agile Software Development (ASD) Questionnaire

**Background**

- ASD has existed for decades for commercial and some DoD IT and Business System applications -- commercial training is available
- DoD weapon system acquisition and sustainment efforts are now applying ASD, however, there is no weapon system specific ASD training available to address unique DoD ASD applications

**Issues**

- ASD Training Action Item was assigned at 25 Feb 16 AFMC Engineering Council (EC) to:
  - ID programs/efforts that are using ASD Methodologies
  - ID ASD Training Needs & Gaps
  - Stood-up cross-Center ASD SME team: EC members assigned SMEs for their Center
  - ASD Questionnaire sent to cross-Center ASD SME team

**Bottom Line**

- 17 Nov 16 EC: Received ASD Training Questionnaire responses from cross-Center ASD SME team members. HQ AFMC/ENS and AFIT/LS personnel reviewed, consolidated, and analyzed the responses. The results indicate there is a pervasive need for ASD, and especially SCRUM training. The responses helped determine ASD Training Needs/Gaps and support development of Air Force ASD Training Plan.

- Upon your request, the ASD Questionnaire can be delivered to you
  - Contact Mr. Andrew Jeselson, HQ AFMC/ENS, andrew.jeselson@us.af.mil
## HQ AFMC/EN ASD Questionnaire

### Samples of Data Collected

<table>
<thead>
<tr>
<th>Center</th>
<th>Program Name</th>
<th>Kind of Program</th>
<th>Program Phase using ASD</th>
<th>Type of ASD</th>
<th>Total # Personnel</th>
<th>Training Offered</th>
<th>Training Needed</th>
<th>Current Expenditures</th>
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<tbody>
<tr>
<td>JWS F-22</td>
<td>Business/IT</td>
<td>X</td>
<td>Scrum</td>
<td>0</td>
<td>N</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
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<tr>
<td>CRH</td>
<td>Weapon System</td>
<td>X</td>
<td>Scrum, C4I</td>
<td>2</td>
<td>Y</td>
<td>Y</td>
<td></td>
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<tr>
<td>AFSC 76</td>
<td>Mission Planning</td>
<td>X</td>
<td>Scrum</td>
<td>12</td>
<td>Y</td>
<td>N</td>
<td>$5,000</td>
<td></td>
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<tr>
<td>AFTR/PA</td>
<td>Business/IT application program</td>
<td>X</td>
<td>SCRUM</td>
<td>4</td>
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<tr>
<td></td>
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<td></td>
<td>SCRUM</td>
<td>4</td>
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<tr>
<td></td>
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<td></td>
<td>SCRUM</td>
<td>3</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SCRUM, RUP, Kanban, Extreme Programming</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Data Collected**

- Program identification data
- Type of ASD employed
- Current training expenditures
- Future training requirements
HQ AFMC/EN ASD Questionnaire
Results

Personnel and Programs

- 97 Programs
- 900 Personnel (Est)

<table>
<thead>
<tr>
<th>Programs</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>509</td>
</tr>
<tr>
<td>34</td>
<td>436</td>
</tr>
</tbody>
</table>

Sustainment
Acquisition

Agile Training Reported Funding

Current Expenditures
$74,000
$13,000

Estimated Need
$258,000
$63,000

Acquisition Prog Phase
MSA: 19
TD: 27
EMD: 24
PD: 25
OS: 47

Sustainment Prog Phase
MSA: 0
TD: 2
EMD: 6
PD: 11
OS: 29

H/Q AFMC/EN ASD Questionnaire Results

19
27
24
25
47
29

Current Expenditures
$74,000
$13,000

Estimated Need
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13,000
258,000
63,000

$13,000
$258,000
$63,000

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HQ AFMC/EN ASD Questionnaire Results (con’t)

**ASD Techniques in Use**

- **Scrum**: 68%
- **Kanban**: 7%
- **Extreme**: 2%
- **SAFe**: 4%
- **Other**: 19%

**Assessment:**

- Many Air Force organizations are pursuing their own education
- AFMC has a need for enterprise level agile education
- AFIT/LS assisted with gap analysis and ASD course development
- More educational gap analysis is required; however, some tailored courses are likely to be needed
  - SMC/EN funds a Software Engineering Institute (SEI) ASD for Government programs course for SMC ASD training
  - AFLCMC/EN-EZ is developing an ASD workshop

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AFLCMC/EN-EZ Agile Software Development (ASD) Workshop
Guidance For Agile Avionics SW Development
How can I track development progress in terms of functionality (Value)?

How do I apply software engineering in an ASD environment?

How can I track development progress in terms of SWE (e.g., moving data throughout the SW system)?

How can I handle early discovery of issue?

Metrics!

How should I communicate with the contractor?

How can I include the customer (e.g., war fighter, flight test, operational test, etc.)?
Guidance For Agile Avionics SW Development

**Issue**

- Lack of guidance to help AF POs incorporate/transition agile SW procedures into the acquisition process
  - How to meet the intent of the of AFI 63-101
  - How to satisfy requirements of other processes (i.e., EVM)
- Industry has pushed agile based SW development processes

**Goal**

- Establish agile aircraft systems SW development guidance & training focused on needs of the PO personnel
- Establish best practices
- Guidance on technical reviews
- Understanding elements that impact cost, schedule, & performance
- Etc.
Agile Avionics SW Development

Status

- Commenced active participation in the Software Engineering Institute Agile Collaboration
- Active membership in the NDIA Agile Working Group
- Continuous involvement in the F-22 implementation of Scaled Agile Framework
- Working with AFMC/ENS, SEI, and AFIT to establish training focused on the needs of the personnel in the imbedded avionics systems programs
  - Material based on best practices and lessons learned from participation in the above working groups and observations from F-22, B-2, F-15, and other programs
  - Including updated materiel in existing focus week training
Develop Training Tailored for DoD Aircraft Programs

- Illustration of agile tents aligned with DoD System Engineering
- Sample metrics to track SW development progress
- Approach to satisfy earned value management requirements
- Subset of documents generated for government accountability
- Early sustainment posture
- Etc.

Illustration of Outcomes

- A
- B
- C

Target Audience

- Traditional Agile SW Dev Training
  - Commercial World
  - Federal Government
  - Etc.

- Tailored Agile SW Dev Training
  - Program Office
  - War Fighter
  - Flight Test

— Expected role, availability . . .
— Etc.

— Examples of impacts to flight testing
— Etc.
AFLCMC/EN-EZ SW Data Rights Strategy Process
Improve Acquisition of SW Data Rights

Issue

- Non-availability of program SW data rights for sustainment – assertion supported by:
  - 2011 AF Studies Board & Scientific Advisory Board reports
  - Table top discussions with 10 plus AFLCMC programs
  - No analysis executed to ID appropriate SW data rights

Goal

- Develop standard engineering analysis framework designed to ID, acquire, document, & retain appropriate SW data rights
  - Framework to include provisions for timely acquisition of government subject matter expertise congruent with utilization of acquired SW data rights
  - Cross organizational involvement (LCMC & AFSC) critical
  - Framework tenets included as part of core competency
SW Data Rights Analysis Example: Isolate Mission Thread

Software Architecture

- Sensor Fusion Device
- Gigahertz Bus
- COTS Host
- 1553 Comm Bus 1
- Mission Computer
- UHF
- Com 1 - n
- Device 2 - n
- FCC 1..4
- ADC 1..4

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## SW Data Rights Analysis Example: Analyze Thread Elements

<table>
<thead>
<tr>
<th>LRU/ICD</th>
<th>Sensor Fusion Device</th>
<th>ICD</th>
<th>COTS Host</th>
<th>ICD</th>
<th>Mission Computer</th>
<th>ICD</th>
<th>PVI</th>
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<tbody>
<tr>
<td><strong>Expected Change Rate</strong></td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Mod</td>
<td>High</td>
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<tr>
<td><strong>Gov’t Development Funded</strong></td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>SW Type</strong></td>
<td>Complex Algorithm</td>
<td>N/A</td>
<td>COTS SW</td>
<td>N/A</td>
<td>OFP</td>
<td>N/A</td>
<td>OFP</td>
</tr>
<tr>
<td><strong>Expected Rights</strong></td>
<td>Restricted</td>
<td>Unlimited</td>
<td>COTS SW</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
</tr>
<tr>
<td><strong>Needed Rights</strong></td>
<td>TBD</td>
<td>GPR</td>
<td>COTS SW</td>
<td>GPR</td>
<td>GPR</td>
<td>GPR</td>
<td>GPR</td>
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<tr>
<td><strong>Current Rights</strong></td>
<td>Restricted</td>
<td>GPR</td>
<td>COTS SW</td>
<td>GPR</td>
<td>GPR</td>
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<tr>
<td><strong>Comments</strong></td>
<td>Needed rights pending analysis of winning bid</td>
<td>See fusion device</td>
<td>Organic Support</td>
<td>Organic Support</td>
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</table>

Comments: Needed rights pending analysis of winning bid; See fusion device; Organic Support; Organic Support; Organic Support.
Acquisition/Sustainment of Software Data Rights

Acquisition/Sustainment of SW System Subject Matter Expertise

Life Cycle SW Data Rights Analysis Framework

Includes
- Focus Week course
- Course material developed via SEI
- AFIT course in works
Questions?

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