Space Systems Engineering Professional Development & Certification

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Background

• The space race created a surge in scientists and engineers
• Aerospace workforce reduced in 1990s
  – Collapse of the Soviet Union – military cutbacks
  – Rise of the “dot-coms”
  – Acquisition Reform
• Government hiring of engineers was significantly reduced
• Today, the government workforce is short of engineers and scientists
  – Reduces the government’s ability to assess the quality of contractor efforts
Today’s Situation

• Need for technical competence is high
• Space systems are much more complex than in the past
• Systems must perform in concert with many other systems, instead of as independent systems
  – No control over legacy system interfaces
  – Evolving requirements
• Demand for perfection, the first time
## NRO Risk Over Time

<table>
<thead>
<tr>
<th>Era</th>
<th>Time Frame</th>
<th>NRO Willingness To Take Risks</th>
<th>Oversight Tolerance for Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence Imperative</td>
<td>1960-1970</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Technology Driven</td>
<td>1970-1990</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Peace Dividend</td>
<td>1990-2002</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>War on Terrorism</td>
<td>2002-?</td>
<td>Medium</td>
<td>None</td>
</tr>
</tbody>
</table>
What is different about Aerospace?

- High risk environment
- Complex systems
  - Launch
  - Space
  - Ground
- Much longer timeline for development
  - Causes designers to “push” the technology envelope
- Significant increase in failure of satellites and launches in late 1990s
Greybeard Findings

- National security space acquisition process is seriously flawed
- The government had moved away from the application of rigorous proven engineering practices
- Cost estimates should be based on 80% confidence vs. 50%
- The government must retain adequate talent to be a “smart buyer”
- Requirements growth is a major cause of cost growth and schedule delays
- Many problems caused by failure to conduct adequate systems engineering studies
- Previous attempts at acquisition reform had the unintended consequence of focusing on cost versus mission success
Response

• DoD Policy for:
  – Robust systems engineering
  – Systems Engineering Plan (SEP)

• Call for “Systems Engineering Revitalization” by many government organizations
NRO Approach

- Develop a basic systems engineering training program
- Follow up with a certification program for systems engineers
  - Training program based on our specific needs
  - Minimize business impact
  - Training needs to be practical with frequent student participation
• Eight class days, each separated by two weeks
• Threaded exercise throughout course
  – Team project with assigned responsibilities
  – Required deliverables and presentations each day
• Response very positive
• Evolution of course design:
  – Course changed to five days in a single week and three days a month later
  – Class taught by cleared instructors so that real program problems could be discussed
  – Added Best Practices day with program Chief Systems Engineers sharing their experiences
SE Career Path

Gain PM Experience

Identify PM Candidates

SE Graduate Training

SE Mentoring

Gain SE Experience

SE Certification Training

Identify SE Candidates

Gain Domain Experience

Recruit New Engineer
NROI 65-4

- NRO Instruction signed 9 June 2004
- Implements 3-level SE certification
- Requirements are a combination of experience and training
- DDSE is certifying authority
- NRO Joint Systems Engineering Team (JSET) Representatives are responsible for review and assessment of directorate personnel applications
## SE Certification Requirements

<table>
<thead>
<tr>
<th>Level</th>
<th>Experience</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2 yrs. SE</td>
<td>SE-501 Acquisition Systems Engineering and SE-502 Designing Space Missions or 6 SE-related graduate credits</td>
</tr>
<tr>
<td>II</td>
<td>4 yrs. SE</td>
<td>Complete 4 from below: Requirements Development/Management, Risk Management, Measurement &amp; Analysis, Concept &amp; Architecture Development, Formal Decision Making, Integration, Verification &amp; Validation or 12 SE-related graduate credits or 6 after Level 1</td>
</tr>
<tr>
<td>III</td>
<td>7 yrs. SE</td>
<td>INCOSE Certification or 18 total SE-related graduate credits or 6 after Level 2</td>
</tr>
</tbody>
</table>

• All levels require a baccalaureate degree in engineering, physics, chemistry, mathematics, computer science or a related field.
Legacy

• Legacy certification offered for those who have been in systems engineering positions for a significant time
• Twelve-month application period after rollout or first assignment to NRO
• Recommended experience requirements:
  – Level I – 4 years
  – Level II – 8 years
  – Level III – 12 years plus
  – Attendance at an SE Executive Overview Course (3 days)
FY05 Results

Cumulative Systems Engineers Certified by Level

Month

Cumulative Number Certified

Oct-04 Nov-04 Dec-04 Jan-05 Feb-05 Mar-05 Apr-05 May-05 Jun-05 Jul-05 Aug-05 Sep-05

Level I Level II Level III
Other Initiatives

• Increase awareness of systems engineering tools and their applicability to NRO systems engineering activities
• Acquaint NRO SEs with the SE graduate school programs available in Washington Metropolitan Area
• Develop a joint SE-PM course
  – Detail the duties of each
  – Develop the partnership essential to program success