Achieving Acquisition Excellence via Improving the Systems-Engineering Workforce

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Overview

• Is your organization working towards achieving acquisition excellence?
  – The application of systems-engineering to improve the workforce may be part of the answer!
• What are the rate-limiting variables/drivers that limit success?
• How can the CMMI® - ACQ model be used?
Increasing # of Procurements & Complex Systems Coupled With Huge Decrease In Acquisition Workforce
Recapture Acquisition Excellence: Revitalize The Acquisition Workforce

Problem

- Acquisition capability has slowly atrophied
- Organic Workforce reductions - 23% since 1999
  - Force shaping, reduced training, retirements of critical cost estimators, price analysts, experienced system engineers, contracting officers

Initiatives

- Recapitalize the Acquisition Corps/Training
- OSD Funding Increased Numbers and Training of Organic Acquisition Personnel

It Is All About the Acquisition Workforce
Project Purpose

Use a systems engineering approach to assess acquisition training and organizational training processes for improving acquisition excellence

Experience

Workforce Attributes – Training Easiest to Manage

Training Ability
Summary of Systems Engineering Drivers

External Forces
• Increasing size of untrained defense acquisition workforce
• Retiring of experienced and capable workforce

Technological
• Accelerating technological changes makes systems specific acquisition training difficult at best
• Identifying future competencies to ensure most relevant training content

Human Capital
• Changing workforce demographics requiring newer methods of training and management

Client Business Environment
• Achieving acquisition excellence in a fiscally constrained environment
External Forces

Rebalanced Workforce

AT&L Civilians – Risk of Losing

Level 4 - Systems Engineer (Expert) (minimum 6 years of SE experience)

Level 3 - Systems Engineer (Expert) (minimum 6 years of SE experience)

Level 2 - Acquisition Engineer (Journeyman) (minimum 2 years of experience)

Level 1 - Acquisition Engineer (Entry) (minimum 1 year of experience)

Bimodal Demographics (Space Industry)

Source: DAU

Professional Growth vs. Time

Source: LMSC

Source: DAU

SPRDE/Systems Engineering Career Field

Source: DAU

External Forces

Rebalanced Workforce

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Professional Growth vs. Time

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Source: DAU

SPRDE/Systems Engineering Career Field

Source: DAU
Technological: Acceleration of Innovation in the 21st Century - Facilitating Our Ability to Build Move Complex Systems

The Amount of New Technological Innovation is Doubling Every Two Years - Requires More Upfront SE/SW Engineering to Leverage Trends
Technological: Augustine’s Law Holding - Growth of Software is an Order of Magnitude Every 10 Years

In The Beginning

1960’s
F-4A
1000 LOC

1970’s
F-15A
50,000 LOC

1980’s
F-16C
300K LOC

1990’s
F-22
1.7M LOC

2000+
F-35
>6M LOC
Technological: Moore's Law Holding - The Number of Transistors That Can be Placed on an Integrated Circuit is Doubling Approximately Every Two Years
Technological: Increasing Rate of Adoption

- Automobile (1926) = 56 years
- Telephone (1876) = 36 years
- Television (1926) = 26 years
- Cell Phone (1983) = 14 years
- PC (1975)
- VCR (1952)
- Microwave (1953)
- Radio (1905)
- Electricity (1873)

No. of Years Since Invention

Source: Rich Kaplan, Microsoft
Human Capital: Refocusing University Curriculums -
Alignment of Software Systems Engineering

OSD Initiatives: Graduate Software Engineering Reference Curriculum (GSwERC)
& Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE)

SW = Software
Human Capital: Using Core Competencies

Accurate identification of required competencies are important to support the curriculum review and development effort needed to ensure the best and most relevant training.

<table>
<thead>
<tr>
<th>Competency Family</th>
<th>Software Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Application domain</td>
</tr>
<tr>
<td></td>
<td>Procedural design</td>
</tr>
<tr>
<td></td>
<td>Cobol &amp; Assembler</td>
</tr>
<tr>
<td></td>
<td>Numerical analysis</td>
</tr>
<tr>
<td>Skills</td>
<td>Requirements analysis</td>
</tr>
<tr>
<td></td>
<td>System design</td>
</tr>
<tr>
<td></td>
<td>Project management</td>
</tr>
<tr>
<td></td>
<td>Debugging</td>
</tr>
<tr>
<td>Process Abilities</td>
<td>Integrated team design</td>
</tr>
<tr>
<td></td>
<td>Fagan inspections</td>
</tr>
<tr>
<td></td>
<td>Test procedures</td>
</tr>
<tr>
<td></td>
<td>Change control</td>
</tr>
</tbody>
</table>

Competency Family: Software Engineering

Current Resource Profile (initial inventory)

<table>
<thead>
<tr>
<th>Workforce Competency</th>
<th>Staffing by Capacity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Software Engineer</td>
<td>17</td>
</tr>
<tr>
<td>User Training</td>
<td>2</td>
</tr>
</tbody>
</table>

Current Resource Needs (one-year cycle)

<table>
<thead>
<tr>
<th>Workforce Competency</th>
<th>Current Staffing Level Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Software Engineer</td>
<td>23</td>
</tr>
<tr>
<td>User Training</td>
<td>4</td>
</tr>
</tbody>
</table>

Strategic Workforce Needs (2-5 year)

<table>
<thead>
<tr>
<th>Workforce Competency</th>
<th>2010 Staffing Level Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Software Engineer</td>
<td>31</td>
</tr>
<tr>
<td>User Training</td>
<td>4</td>
</tr>
</tbody>
</table>

Source – SEI 2009
Human Capital: Changing Demographics

Demographics of workforce are changing and different views may emerge with four generations to consider.

Generation Y professionals entering workforce will likely necessitate non-traditional training techniques, such as virtual approaches.

- **Baby Boomers** (1946-1964): Workaholic, Questions authority, Works efficiently, Competitive, Little work/life balance
- **Silent Generation** (1928-1945): Hard worker, Respects authority, Work is obligation, Formal communicator, Work/family separation
## Client Business Environment: Increasingly Complex

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Commercial Software Products</th>
<th>Information Technology &amp; Internet Financial Services</th>
<th>Government Aerospace Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>Commercial</td>
<td>Information technology &amp; internet</td>
<td>Government</td>
</tr>
<tr>
<td>Industry</td>
<td>Software</td>
<td>Financial</td>
<td>Aerospace</td>
</tr>
<tr>
<td>Packaging</td>
<td>Products</td>
<td>Services</td>
<td>Systems</td>
</tr>
<tr>
<td>Primary Output</td>
<td>Software</td>
<td>Integrated system engr &amp; HW &amp; SW &amp; network</td>
<td>Integrated system engr &amp; HW &amp; SW &amp; network</td>
</tr>
<tr>
<td>Purpose</td>
<td>User empowerment: effectiveness, efficiency, creativity</td>
<td>Organization/business operations</td>
<td>Mission/science capabilities</td>
</tr>
<tr>
<td>Project Duration</td>
<td>1-36 months</td>
<td>1-18 months</td>
<td>6 months - 10 years</td>
</tr>
<tr>
<td>Team Size</td>
<td>1-1000’s</td>
<td>1-1000’s</td>
<td>10’s-1000’s</td>
</tr>
<tr>
<td>Ratio of Custom to COTS/Reuse</td>
<td>Software: Low-high</td>
<td>Business logic: High Others: Low</td>
<td>All: High</td>
</tr>
<tr>
<td>Agreement</td>
<td>License</td>
<td>Service level agreement</td>
<td>Contract</td>
</tr>
<tr>
<td>Customer</td>
<td>External</td>
<td>Internal and external</td>
<td>External</td>
</tr>
<tr>
<td># Customers</td>
<td>100’s-1,000,000’s</td>
<td>1-1,000,000’s</td>
<td>1</td>
</tr>
<tr>
<td>Focus</td>
<td>Features, Time-to-market, Ship it</td>
<td>User experience, Workflow cycletime, Uptime</td>
<td>Reliability, Milestones, Interdependencies</td>
</tr>
</tbody>
</table>

Source – Northrop Grumman
2005 study confirmed*:
- In advanced knowledge-based organizations, management’s desire for the flow of knowledge is greater than the desire to control boundaries
- Unlike the matrix organization, there is less impact on the dynamics of formal power and control

* Using Communities of Practice to Drive Organizational Performance and Innovation, 2005, APQ study

Ref: Jim Smith, (703) 908-8221, jds@sei.cmu.edu

From “Science and Technology to Support FORCEnet,” Raytheon TD-06-008. Used by permission.
Systems Engineering Approach

Selected based on
- amount/type of data to be reviewed
- availability of a reference model
- requirements, logical and physical loops
- iteration and recurrision activities
- access to key stakeholders

Phase 1
Identify/Collect Data

- Identify Training Courses
- Identify/Select Reference Model
- Identify Org. Training Process
- Identify Stakeholders
- Review Legacy/Current Efforts

Phase 2
Perform Gap Analysis

- Survey
- CMML-ACQ Reference Model
- Training Class Coverage Gaps
- Organizational Process Gaps
- Framework Space Gaps

Phase 3
Formulate/Codify Findings

- Findings, Impacts, Recommendations
- Write Draft Report

Phase 4
Develop/Deliver Results

- Write Final Report
- Communicate Results and Collect Feedback
Project Objectives

During assessment Phase 1 project objectives were formulated in terms of five questions:

• Do coverage gaps exist in the training of acquisition best practices?
• Do gaps exist in acquisition training on the unique aspects of the client’s system acquisitions?
• Do gaps exist in the training of the client’s acquisition lifecycle framework and processes?
• Do best-practice gaps exist in the client’s organizational training processes?
• Do gaps exist in identifying training requirements for satisfying the acquisition workforce core competencies?
Reference Model

Evaluated client’s acquisition training program components using Capability Maturity Model Integration® for Acquisition (CMMI® -ACQ) as reference model
Assessment Framework: CMMI®-ACQ

Operational Need

Focus on Acquisition Best Practices (Acquirer)

Development (Developer)

Plan | Design | Develop | Integrate and Test | Deliver
## Representative Results: Question 1

### Question 1: Do Coverage Gaps Exist in the Training of Acquisition Best Practices?

#### Findings:
- Detailed findings awaiting client approval

#### Impacts:
- Missing opportunities to
  - attract more students
  - provide training on the most relevant issues
  - effectively plan
  - save resources
  - provide a richer variety of courses
  - continuously improve training processes

#### Recommendations:
- Conducting a review to assess use of web-based and non-traditional acquisition training

#### Considerations:
- **Consider**: Leveraging of efforts by DAU, commercial industry and academia
  - Conducting a review of best practices for e-learning
- **Consider**: Using DAU’s Acquisition Best Practices
  - Making a better use of repository information
Lessons Learned

- Tsunami-like impacts on new acquisition training requirements
  - Rapid, large-scale disturbance of current training needs envisioned
  - Forces will include technological, human capital, external and government needs
- Training departments have incorporated best acquisition practices into their training courses; however
  - Mapping of core competencies to training courses needs to be done
  - Training architectures needed
- Developers of organizational training processes could benefit from the application of systems engineering

Tsunami

Images of the Ocean Floor
Wrap Up
Contact Information

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