Leveraging CMMI® for Acquisition to Improve Organizational Workforce Performance

Dr. Kenneth E. Nidiffer
Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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Overview

• Is your organization working towards achieving acquisition excellence?
  – The application of model-driven approach 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?
Procurement Budget vs. DoD Acquisition Workforce

Increasing # of Procurements & Complex Systems Coupled With Huge Decrease In Acquisition Workforce

Source: OSD (DDR&E)
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

Source: OSD (DDR&E)
Project Purpose

Use a systematic model-driven approach to assess acquisition training and organizational training processes for improving acquisition excellence.

Experience

Workforce Attributes – Training Easiest to Manage

Training Ability
Business Motivation

Internal

• Improve organization’s performance efficiencies by putting in place trained workforce that can leverage suppliers’ capabilities to deliver quality solutions rapidly, at lower costs, and with appropriate technology

External

• President Barack Obama – Mar/May 2009
  “The government will assist agencies in assessing the capacity and ability of the Federal acquisition workforce to develop, manage, and oversee acquisitions” and Weapon Systems Acquisition Reform Act of 2009, Public Law 111-23, 22 May 2009
Drivers for Improving Acquisition Excellence

- External Forces
- Technological
- Human Capital
- Client Unique
Summary of 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

Bimodal Demographics (Space Industry)

Professional Growth vs. Time

Source: DAU

Source: LMSC

Source: DAU
External Forces

Notional DoD Systems Engineering Workforce Strategy

Develop / Train and Retain

Recruit: Interns

Recruit: Journeymen
Retired Military
SE FFRDCs

Recruit: Highly Qualified Experts

Develop / Train: Mentors

Workforce Size

25-35
35-45
45-55
>55

Workforce Age

Source: OSD (DDR&E)
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

Linear vs. Exponential Growth:

- Exponential trend
- Linear trend

Knee of Curve
Technological: Moore's Law Holding - The Number of Transistors That Can be Placed on an Integrated Circuit is Doubling Approximately Every Two Years
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: Increasing Rate of Adoption

<table>
<thead>
<tr>
<th>Technology</th>
<th>Year of Invention</th>
<th>Years Since Invention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>1926</td>
<td>56</td>
</tr>
<tr>
<td>Telephone</td>
<td>1876</td>
<td>136</td>
</tr>
<tr>
<td>Television</td>
<td>1926</td>
<td>40</td>
</tr>
<tr>
<td>Radio</td>
<td>1905</td>
<td>111</td>
</tr>
<tr>
<td>VCR</td>
<td>1952</td>
<td>79</td>
</tr>
<tr>
<td>Microwave</td>
<td>1953</td>
<td>66</td>
</tr>
<tr>
<td>PC</td>
<td>1975</td>
<td>28</td>
</tr>
<tr>
<td>Cell Phone</td>
<td>1983</td>
<td>20</td>
</tr>
<tr>
<td>Internet</td>
<td>1975</td>
<td>32</td>
</tr>
<tr>
<td>Electricity</td>
<td>1873</td>
<td>130</td>
</tr>
<tr>
<td>Automobile</td>
<td>1886</td>
<td>123</td>
</tr>
</tbody>
</table>

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.

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></td>
<td>I</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></td>
<td>I</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></td>
<td>I</td>
</tr>
<tr>
<td>Software Engineer</td>
<td>31</td>
</tr>
<tr>
<td>User Training</td>
<td>4</td>
</tr>
</tbody>
</table>
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.
### 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</td>
<td>All: High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others: Low</td>
<td></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 cyclertime, Uptime</td>
<td>Reliability, Milestones, Interdependencies</td>
</tr>
</tbody>
</table>

Source – Northrop Grumman
Client Business Environment: Acquisition Shifts

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 recursion 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
- CMU-ACQ Reference Model
- Training Class Coverage Gaps
- Organizational Process Gaps
- Framework Space Gaps

Phase 3
Formulate/Codify Findings
- Findings, Impacts, Recommendations
- Write Draft Report
- Communicate Results and Collect Feedback

Phase 4
Develop/Deliver Results
- Write Final Report

Source: SEI
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)

Source: SEI

Development (Developer)

Operational Capabilities
### CMMI® -ACQ categories and process areas

<table>
<thead>
<tr>
<th>Category</th>
<th>Process Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acquisition</strong></td>
<td>Agreement Management (AM)</td>
</tr>
<tr>
<td></td>
<td>Acquisition Requirements Development (ARD)</td>
</tr>
<tr>
<td></td>
<td>Acquisition Technical Management (ATM)</td>
</tr>
<tr>
<td></td>
<td>Acquisition Validation (AVAL)</td>
</tr>
<tr>
<td></td>
<td>Acquisition Verification (AVER)</td>
</tr>
<tr>
<td></td>
<td>Solicitation and Supplier Agreement Development (SSAD)</td>
</tr>
<tr>
<td><strong>Process Management</strong></td>
<td>Organizational Innovation and Deployment (OID)</td>
</tr>
<tr>
<td></td>
<td>Organizational Process Definition (OPD)</td>
</tr>
<tr>
<td></td>
<td>Organizational Process Focus (OPF)</td>
</tr>
<tr>
<td></td>
<td>Organizational Process Performance (OPP)</td>
</tr>
<tr>
<td></td>
<td>Organizational Training (OT)</td>
</tr>
<tr>
<td><strong>Project Management</strong></td>
<td>Integrated Project Management (IPM)</td>
</tr>
<tr>
<td></td>
<td>Project Monitoring and Control (PMC)</td>
</tr>
<tr>
<td></td>
<td>Project Planning (PP)</td>
</tr>
<tr>
<td></td>
<td>Quantitative Project Management (QPM)</td>
</tr>
<tr>
<td></td>
<td>Requirements Management (REQM)</td>
</tr>
<tr>
<td></td>
<td>Risk Management (RSKM)</td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td>Causal Analysis and Resolution (CAR)</td>
</tr>
<tr>
<td></td>
<td>Configuration Management (CM)</td>
</tr>
<tr>
<td></td>
<td>Decision Analysis and Resolution (DAR)</td>
</tr>
<tr>
<td></td>
<td>Measurement and Analysis (MA)</td>
</tr>
<tr>
<td></td>
<td>Process and Product Quality Assurance (PPQA)</td>
</tr>
</tbody>
</table>

CMMI® -ACQ model was developed to codify best practices to help organizations improve acquisition processes.

CMMI® reference models have gained significant traction across commercial and defense community and are widely used throughout world [CMMI Product Team 07]

Source: SEI
Summary of Results

• Strengths
• Areas for Improvement
• Lessons Learned
Results – General Overall Strengths

• Excellent coverage in the training of acquisition best practices
• Adequate number and variety of course offerings
• Simple but adequate training facilities
• Consistency of course material & presentation layout & style
• Variety of media used for announcing upcoming courses
• Scope and breath of Earned Value programs
• Knowledgeable SME* teach classes
• Talented instructor workforce
• Intelligent student population
• Professionalism of the training staff
• Desire to improve

* SME = Subject Matter Expert
## Results

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Findings</td>
<td>25</td>
</tr>
<tr>
<td>Impacts</td>
<td>20</td>
</tr>
<tr>
<td>Recommendations</td>
<td>23</td>
</tr>
<tr>
<td>Considerations/ Potential Solutions - ways to address some of the recommendations</td>
<td>40</td>
</tr>
</tbody>
</table>

Systematic Improvement in Client’s Organizational Training Processes Needed
## 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 and Considerations
- Conducting a review to assess use of web-based and non-traditional acquisition training
  - **Consider:** Leveraging of efforts by DAU, commercial industry and academia
- Conducting a review of best practices for training among different types of acquisitions
  - **Consider:** Developing and teaching approaches that focus on agile and SOA acquisition approaches
- Making a better use of repository information
  - **Consider:** Using DAU’s Acquisition Best Practices
- Putting a systematic process improvement program in place
  - **Consider:** Using CMMI-ACQ and IDEAL
- Developing a strategic plan
  - **Consider:** Socializing plan among relevant stakeholders
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
Wrap Up
Contact Information

Dr. Kenneth E. Nidiffer, Director of Strategic Plans for Government Programs

Software Engineering Institute, Carnegie Mellon University
Office:  +1 703-908-1117
Fax:     +1 703-908-9317
Email:   nidiffer@sei.cmu.edu