U.S. Department of Defense (DoD) Approach to Best Practices: Building Evidence for Practice Selection Based on Real Experiences

Forrest Shull, Fraunhofer Center Maryland

NDIA Systems Engineering Conference October 25, 2007
Topics

- **Why** do we need a Clearinghouse?
- **What** to expect in the Best Practices Clearinghouse (BPCh)?
- **How** does the BPCh work?
- **When** can I get involved?
- **Who** to contact?
Why a Clearinghouse?

“Best” practices are recommended, but...

- Too many lists to choose from
- No basis for selecting specific practices
- Proof of effectiveness is not generally available
- Not easy to see connection between practices and specific program risks or issues
- Practice’s success factors not well understood
- Resources are limited and the return on practice investment is unknown (costs/benefits)
- Implementation guidance is inadequate
What are the main requirements?

Contents

Why do we need a BPCh?
What to expect in the BPCh?
How does the BPCh work?
When can I get involved?
Who to contact?

Process Components

Communities

IT components

Roles

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Center for Experimental Software Engineering
Maryland

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Why do we need a BPCh?

What to expect in the BPCh?

How does the BPCh work?

When can I get involved?

Who to contact?

DoD & Industry Best Practices

• Will stand alone as a best practices resource
• Will also provide content for CoPs to allow for additional collaboration/input on best practices
• Will be included in the enterprise search index/results

Central Repository for AT&L Policy & Reference Materials

Also serves as the home for knowledge gateways like:
• Defense Acquisition Guidebook
• AT&L Integrated Framework Chart (IFC)
• Ask A Professor

Acquisition Knowledge Management System

Enterprise Search System

• Stand-alone search and discovery for AT&L workforce
• Integrated search for AKSS
• Searches open areas of ACC
• Integrated search for DAU Homepage
• Integrated search for DAU Intranet

Collaborative Tool for the AT&L Community Where the Workforce Contributes Knowledge and Interacts to Share “Know-How”

Provides a nest of collaborative tools:
• Communities of Practice/Interest
• Special Interest Areas
• Limited Access Workspaces
• DAU Course Spaces
• Workflow Learning Tools
• IFC Templates

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Slide 5
How do we define a practice?

Operational definition:

- A *documented activity* that is described in an *actionable, repeatable way*
- A description of *how to do* something, not a general goal of *what* to do
- Usable by targeted acquisition end users
- About which we can collect empirical data or experiences.

→ may be a process, method, or tool
What is a practice?

Distinguished from:

- A **best practice area**
  - ...a type of activity the user can’t neglect, without specific advice on *how* to do it. E.g., risk management

- A **lesson learned**
  - ...good advice, drawn from experience, without enough detail to be clearly repeatable. E.g., don’t overestimate cost savings from using COTS components.
What is a practice?

For example:

- **System Engineering Plan:**
  - **Risk Management Strategy**
    - Options to consider:
      - COTS Usage Risk Evaluation (CURE)
      - Willoughby templates
      - SEI's Taxonomy-based Risk Identification
      - Probability Consequence Software
What makes BPCh unique?

- Not all best practices are “best” for everybody
  - Descriptions of past results in context, not just what to do
- Context-sensitive search
- Levels of vetting of content
- Subject Matter Experts as practice owners
- Pointers to existing sites, resources, examples
What are the main process steps?

<table>
<thead>
<tr>
<th>Name: Practice X</th>
<th>Practice Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Practice X has been successfully applied …</td>
<td>(Bronze)</td>
</tr>
<tr>
<td>• Use It to …</td>
<td>(Silver)</td>
</tr>
<tr>
<td>• For more information click on the following links:</td>
<td>(Gold)</td>
</tr>
<tr>
<td>…</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence 1</th>
<th>Evidence 2</th>
<th>Evidence 3</th>
<th>Evidence 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Source</td>
<td>Source</td>
<td>Source</td>
</tr>
<tr>
<td>Context</td>
<td>Context</td>
<td>Context</td>
<td>Context</td>
</tr>
<tr>
<td>Results</td>
<td>Results</td>
<td>Results</td>
<td>Results</td>
</tr>
</tbody>
</table>

Clearinghouse content starts with practices recommended by government and industry experts. BPCh recommendations must be based on evidence from real programs:

- From publications
- From interviews & feedback with users
- From vetted expert guidebooks & standards
What are examples of content sources?

- **Systems Engineering**
  - OUSD / SEP Review Team
  - OUSD / PSR Teams and Systemic Analysis
  - Experience reports from NDIA-SE & similar

- **Software engineering**
  - ARDEC's Software Enterprise / Picatinny Arsenal

- **Acquisition**
  - NDIA

- **Other ideas?**
  - Existing DOD guidebooks / standards
  - Existing best practice / lessons learned sites
  - Expert interviews
  - Conference presentations, experience reports
What are some example practices?

- **Requirements analysis**
  - Govt-only review of RFP
  - Distribute requirements database for bidders

- **Reporting / stakeholder communication**
  - Establish a battle rhythm for meetings in SEP – what gets done daily, weekly, semi-annually.

- **Interfaces**
  - PEO-level coordination

- **General…**
  - Independent technical reviews
  - Integrated data environment
What is the BPCh content pedigree?

- Pedigree comes from information that is available on each piece of evidence:
  - **Target role** (acquirer, developer)
  - **Domain** (warfighter, business, intelligence, enterprise integration environment)
  - **Criticality level** (normal, mission, safety, security)
  - **Integration level** (software application, standalone subsystem, platforms, major system, system of systems)
  - **Environment** (military, other govt., industry, academia)
  - **ACAT level** (I, IA, II, III)
  - **Lifecycle phases** where practice used: (Concept refinement, Technology development, System development & demonstration, etc.)
  - **Organizational scope** (individual, project, program, organization, enterprise)
How do we classify “trustability”? 

- Evidence is scored based on objective measures:

<table>
<thead>
<tr>
<th>Total</th>
<th>How practice applied</th>
<th>How results measured</th>
<th>How reported</th>
<th>Who reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0..20]</td>
<td>[0..7]</td>
<td>[0..5]</td>
<td>[0..5]</td>
<td>[0..3]</td>
</tr>
</tbody>
</table>

- Practices are described as a sum of evidences with different ratings:
How does it work for a particular example?

**Practice Name:** Inspections

**Description:**
Formal inspection is a well-defined review process for finding and fixing defects in work products from all phases of development.

**Practice Status:** Summarized - waiting for vetting

**Resources:**

<table>
<thead>
<tr>
<th>Resources</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAU's Tech Review Course</td>
<td></td>
</tr>
</tbody>
</table>

**Summary**

**Primary Benefit:**
The majority of sources show that inspections have a measurable impact on the number of defects taken out of software documents.

Inspections have a better ROI for the effort spent performing them, than other common means of defect reduction like testing.

All sources agree that inspections are useful within the system development phase. Multiple authors discuss that inspections are usable in all phases of software development, although more benefits accrue when they are used earlier in the lifecycle.

**Organizational Scope:**
Summary

**Primary Benefit:**
The most often-mentioned impact is on quality: The majority of sources show that inspections have a measurable impact on the number of defects taken out of software documents. As a side-effect, some sources also argue that they lead to fewer defects being generated in the future, through skill development of the personnel involved.

A secondary benefit is on cost: Inspections have a better ROI for the effort spent performing them, than other common means of defect reduction like testing.

**Life Cycle Phases:**
All sources agree that inspections are useful within the system development phase. Multiple authors discuss that inspections are usable in all phases of software development, although more benefits accrue when they are used earlier in the lifecycle.

**Organizational Scope:**
While there are numerous benefits that can be achieved within a project, authors also described an overall advantage to the entire organization or a given program that can result from implementation of inspections across projects.

**Primary Target:**
Almost all sources focus on the use of inspection within the development organization (to minimize their test and rework effort).

However, the technical review process at NavAir can be considered a variant. It has been used across many projects by acquirers to help monitor the developers they are overseeing.

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**Barriers:**
The primary inhibitors seem to be in the realm of developer motivation:

- Inspections are perceived as being labor intensive in nature
- Payback is delayed (i.e. benefits are not seen until long after the effort is spent)

than the team to coordinate the process, and personnel who provide support for measurement and interpretation.

Inspections may not be put into common use if there is no way to allow some customization to the division/group.

Madachy argues that, since there is some overhead cost involved in inspections, projects that already have extremely low defect rates (e.g. development using the Cleanroom paradigm) may not see a cost-benefit.

**Enablers:**
There is a need for local champions and management support. Development teams who implement inspections need trained moderators and support materials. Providing explicit training helps improve effectiveness.

Inspections work best if management is not present at inspections, to remove the threat that defect information could be used to evaluate workers.

**Net Impact on Cost:**
Unchanged.
Is there any evidence that inspections will actually save us time and money?

**List of evidences for this practice**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Status</th>
<th>Evidence Name</th>
<th>Created on</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Included in summary</td>
<td>Advances in Software Inspections</td>
<td>2/16/2005</td>
</tr>
<tr>
<td>19</td>
<td>Included in summary</td>
<td>An Analysis of Defect Densities Found During Software Inspections</td>
<td>1/13/2005</td>
</tr>
<tr>
<td>19</td>
<td>Included in summary</td>
<td>Measuring Inspections at Litton</td>
<td>1/12/2005</td>
</tr>
<tr>
<td>18</td>
<td>Included in summary</td>
<td>Experience with Inspection in Ultralarge-Scale Developments</td>
<td>1/13/2005</td>
</tr>
<tr>
<td>17</td>
<td>Included in summary</td>
<td>Key Lessons in Achieving Widespread Inspection Use</td>
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<td>Included in summary</td>
<td>Space Shuttle Primary Onboard Software Development: Process Control and Defect Cause Analysis</td>
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<td>15</td>
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Is there any evidence that inspections will actually save us time and money?

<table>
<thead>
<tr>
<th>Sources:</th>
<th>Madachy, Ray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliations:</td>
<td>Litton</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain: Business</td>
</tr>
<tr>
<td>Environment: Industry</td>
</tr>
<tr>
<td>Applied how: Multiple production projects</td>
</tr>
<tr>
<td>Total System cost:</td>
</tr>
<tr>
<td>ACAT Level:</td>
</tr>
<tr>
<td>Team Size:</td>
</tr>
<tr>
<td>Team Environment: System Development &amp; Demonstration</td>
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<td>Life Cycle Phases:</td>
</tr>
<tr>
<td>Organizational scope: Organization</td>
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<td>Target Role: Developer</td>
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</table>

| Primary Benefit: | Improve Quality |
Net Impact on Cost:

- During design and coding, about 3% of the total project effort was used for inspection.
- The net return per inspection range from 64 to 200 person-hours saved per inspection.

Cost involves extra effort in addition to meeting time. Our results concur with [Grady92] and other references that suggest a large proportion of preparation time to meeting time.

Resulting recommendations

<table>
<thead>
<tr>
<th>Primary Benefit</th>
<th>Barriers</th>
</tr>
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<tbody>
<tr>
<td>Improve Quality</td>
<td></td>
</tr>
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p6: "Our project director set goals to save at least 50% of integration effort..." which are being met using inspections.

p9: "The net return per inspection... range from 64 to 200 person-hours saved per inspection..."

p9: "Our results concur with [Grady92] and other references that suggest a large proportion of preparation time to meeting time..."

p13: "We have also found that the use of an SEPG peer review coordinator goes a long way to keep the process intact." That is, sustaining requires someone at a higher level responsible for coordinating the practice.

p13: "While inspection and preparation effort stay fairly constant, the rework and test error fixing effort vary with the defect rates..."
Is there any evidence that inspections will actually save us time and money?

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Is there any evidence that inspections will actually save us time and money?

**Resulting recommendations**

**Primary Benefit:** Improve Quality

**Barriers:**

Lack of training can be a barrier; p. 748: "Some organizations have started inspections without proper education and have achieved some success, but less than others who prepared their participants fully. This has caused some amount of start-over, which was frustrating.

- p. 748
- Ex. PR - Ex.

**Net Impact on Cost:**

Inspections have the effect of slightly front-end loading the commitment of resources, adding to requirements and design.

In each instance, the new uses of inspection were found to improve product quality and to be cost effective, i.e., it saved more than it cost.

<table>
<thead>
<tr>
<th>Net Impact on Quality:</th>
<th>Increased quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>p. 744: &quot;In each instance, the new uses of inspection were found to improve product quality and to be cost effective, i.e., it saved more than it cost.&quot;</td>
<td></td>
</tr>
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</table>
| p. 744: Fagan quotes an IBM director saying: "Since we introduced the inspection process in 1974, we have achieved significant improvements in quality. IBM has nearly doubled the number of lines of code shipped... since 1976, while the number of defects per
What is the status of BPCh?

- **Run by** Defense Acquisition University (DAU)
  - An OUSD(AT&L) training institution

- **IT Components:**
  - BPCh v1.0 developed, undergoing usability training

- **Processes:**
  - Piloted for submitting practices and evidence, e.g.
    - Integration with DAU traditional and e-classrooms
    - Solicited via the tool

- **Roles / Communities:**
  - SMEs from DAU, Services, Agencies and Industry are being engaged
  - Practice Provider Network being forged to create a list of trusted content sources

→ Public debut of BPCh v1.0 planned for Spring 2008
How are practices prioritized?

- Priorities are set by Content Advisory Group
  - Periodic meetings to review content, recommend areas of interest
    - Low-hanging fruit or areas of high concern
  - Also to review opportunities to share content with other best practice / lessons learned initiatives
    - Looking for speakers!
  - Chaired by David Castellano, OUSD (AT&L)
  - Recommendations executed by Content Manager, Forrest Shull
  - Current hot topics include: Risk management, Earned Value Management, Requirements engineering

→ Priorities constantly reviewed and updated
Can I suggest content?

- YES!
  - We are looking for practice suggestions to ensure the usefulness of the BPCh to the user community
  - We are looking for evidence to add to an existing practice
  - Everyone can suggest practices
    - simply e-mail us

→ please fill in the survey that we circulate
How can I participate next year?

- Visit: https://acc.dau.mil/bpch
- Built-in feedback forms in the application
  - …To give us a lead
  - …To suggest a practice we should have
  - …To tell us your experience with a practice
  - …To give us a detailed experience report
- Ability to integrate BPCh with in-house best practice / lessons learned systems
- Elicitation workshops
  - Send us your suggestions
Questions?

Feel free to contact:

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fshull@fc-md.umd.edu
301-403-8970

or

Mike Lambert
Michael.Lambert@dau.mil
703-805-4555
List of used abbreviations

- ACC: Acquisition Community Connection
- ACAT: Acquisition CATegory
- AKSS: AT&L Knowledge Sharing System
- AT&L: Acquisition, Technology and Logistics
- BPCh: (Acquisition) Best Practices Clearinghouse
- CoP: Communities of Practice
- COTS: Components Off The Shelf
- DAU: Defense Acquisition University
- DoD: U.S. Department of Defense
- IFC: Integrated Framework Chart
- MOSS: Microsoft Office SharePoint Server
- OSD: Office of the Under Secretary of Defense
- ROI: Return On Investment
- SAM: Software Acquisition Management
- SE: Systems Engineering
- SEI: Software Engineering Institute
- SMEs: Subject Matter Experts