Sustainment Capability and Capacity

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SEI Objectives

The SEI works to:

• Identify, research, evaluate, and advise on software engineering technologies, trends, and practices
• Collaborate with and leverage work found in industrial research, academia, and government laboratories
• Mature promising software engineering technologies to enable standards, transition, and adoption
• Enable government & industry organizations to make measured improvements in their software engineering practices
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Value of Sustainment

Make equipment ready for operational theater
Prevent obsolescence in older equipment (technology refresh)
Reduce need for costly new-start programs
Fill gaps before new-start programs are ready
Sustainment Investment Needs

Understand new hardware (staff must learn how new hardware works)

Upgrade software of existing equipment to correctly command, and manage data, from new equipment

Purchase or develop tools; finance learning curve

Rewrite processes for new equipment, knowledge, and tools

Purchase or create training courses; send people to courses
Why Invest in Sustainment Infrastructure?

Capable, stable **workforce** (lower turnover, refreshed skills)
Reduced sustainment **time** (skilled employees ready now)
Reduced **cost** (skilled employees work faster)
Higher **quality** software (tools with error detection)
Reduced maintenance **errors**
**Innovation** easier (new tools and techniques)
Definition: Sustainment Capability, Capacity

Capability

- Capable
  - Unskilled
  - Somewhat Skilled
  - Fully Skilled
  - Not Capable

Hiring

Training, Tools

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Increasing Sustainment Capacity

Hiring / Contracting (Count & Capability)

**Fresh skills**

- **Pros**
  - Hiring: Costs, delay, difficulty (government salaries, instability); two years to understand job
  - Contractors: Domain experience? Organic/Contractor law

- **Cons**
  - Long-term retention, long-term domain expertise, better performance
  - Takes time, takes people away from sustainment

**Training (Capability)**

- Faster development, possibly fewer defects
- Learning curve

**Tooling (Capability)**
# Measuring Sustainment Processes

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<th>Input</th>
<th>Output</th>
<th>Throughput</th>
<th>Cycle Time</th>
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<tr>
<td><strong>Operational Performance</strong></td>
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<tr>
<td>Missions measured by capabilities used and mission-capable availability</td>
<td>Action reports measured by %success and availability gap</td>
<td>Missions performed</td>
<td>Days to months</td>
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<tr>
<td><strong>Operational Needs Analysis</strong></td>
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<tr>
<td>Mission performance measures</td>
<td>New capability definition</td>
<td>Prioritized operational needs</td>
<td>Weeks to months</td>
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<td>New potential threats, technologies, uses, and mission capabilities</td>
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<tr>
<td><strong>Engineering &amp; Delivery</strong></td>
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<tr>
<td>Sustainment demand (accepted and not-accepted requests)</td>
<td>Delivered products by count of deployments and costs</td>
<td>Sustainment capacity</td>
<td>Hours to months</td>
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<tr>
<td>Sustainment capability required (skills, tools, facilities)</td>
<td>Sustainment gap (i.e., requests not accepted)</td>
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<td><strong>Capability &amp; Capacity Development</strong></td>
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<tr>
<td>Changes to training, tooling, facility, and processes</td>
<td>Capacity available (%request)</td>
<td>Capability changes, capacity improvement</td>
<td>Months to years</td>
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<tr>
<td>Hiring, furloughs, and attrition</td>
<td>Capability availability date or delay</td>
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<tr>
<td><strong>Budgeting for Improvement</strong></td>
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<tr>
<td>Funding requested for capability and capacity development</td>
<td>Time required to fund, amount funded</td>
<td>Funding requests satisfied</td>
<td>Multiple years</td>
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System Dynamics Model

Operational Performance

Engineering & Delivery

Operational Needs Analysis

Capacity & Capability Development

Budgeting
Future Work

Portfolios of projects
Colors of money
Capability: Specific skills

Organic vs. contractor considerations

Systems/Software sustainment integration issues

Early life-cycle sustainment considerations:
  • What sustainment costs depend on system design?
  • What design aspects will reduce sustainment costs?
  • How to estimate sustainment costs early
Distinctive Competencies

The SEI’s distinctive competencies include

• Software Engineering and Research
• Cybersecurity
• Emerging Software Technologies
• Acquisition Solutions
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BACKUP SLIDES
Sustainment vs. Maintenance

**Sustainment**
- A phase
- Software and hardware upgraded together
- Includes maintenance activities
- Includes infrastructure improvement and investment
- People, processes, tools, …

**Maintenance**
- Activities
- Some take place before sustainment phase
- Hardware maintenance “return to original function”
- Software maintenance “change to original function”
Kinds of Software Sustainment

**Corrective:** Correct discovered problems (bug fixes)

**Perfective:** Add features for performance and value (new algorithm for improved resolution)

**Adaptive:** Addressing external changes (other system, data standard)

**Preventive:** Correct latent flaws, system assurance (information, safety)

**Sustainment cycles**

- **Fastest (<3 months):** Immediate bug fixes
- **Fast (1–12 months):** Obtain tools and equipment, obtain supplies
- **Slower (12 – 24 months):** Preventive, Adaptive, and Perfective
- **Slowest (2 – 5 years):** POM cycle major upgrade, modernization
Motivation: Software Sustainment

How Is Software Sustainment Different?

**Hardware Maintenance:**
Updating and replacing parts
Modernization is separate

**Software Sustainment:**
Fixing problems, designing for new technology, adding features

Problems
Cost is huge, undefined (70% of life-cycle cost)
Software grows through >20 years of technology changes
Technology changes require updates to people, skills, tooling, processes

Working assumption
Failure to invest in infrastructure produces “tipping point” – fleet requires modernization or new program.

Project goal: Develop an *investment model* of software sustainment costs to improve decisions and prevent tipping points.
Customer and Sustainment Space
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