Sustainment Capability and Capacity

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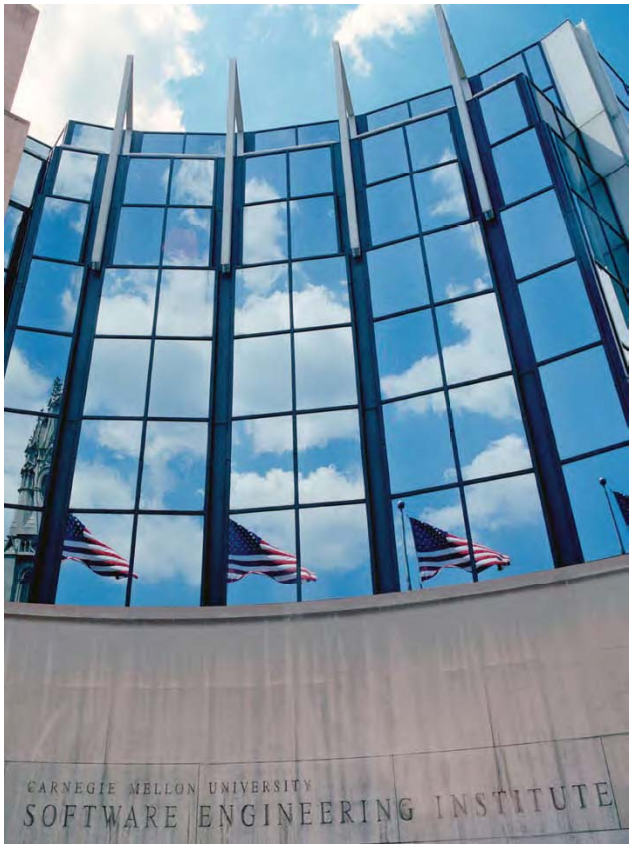
Software Engineering Institute | Carnegie Mellon

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



Two SEI sustainment presentations

Sustainment Capability and Capacity	System Dynamics of Sustainment
This presentation	Bob Ferguson (4:05 p.m.)

Value of Sustainment
Sustainment Cycles
Why Invest?
Sustainment Capability
Sustainment Capacity
Sustainment Processes
System Dynamics Model
Future Work

Research Questions
Need for Sustainment Work
Gaps as Sustainment Forces
System Dynamics Model
Scenarios
Outcomes
Plans

Value of Sustainment

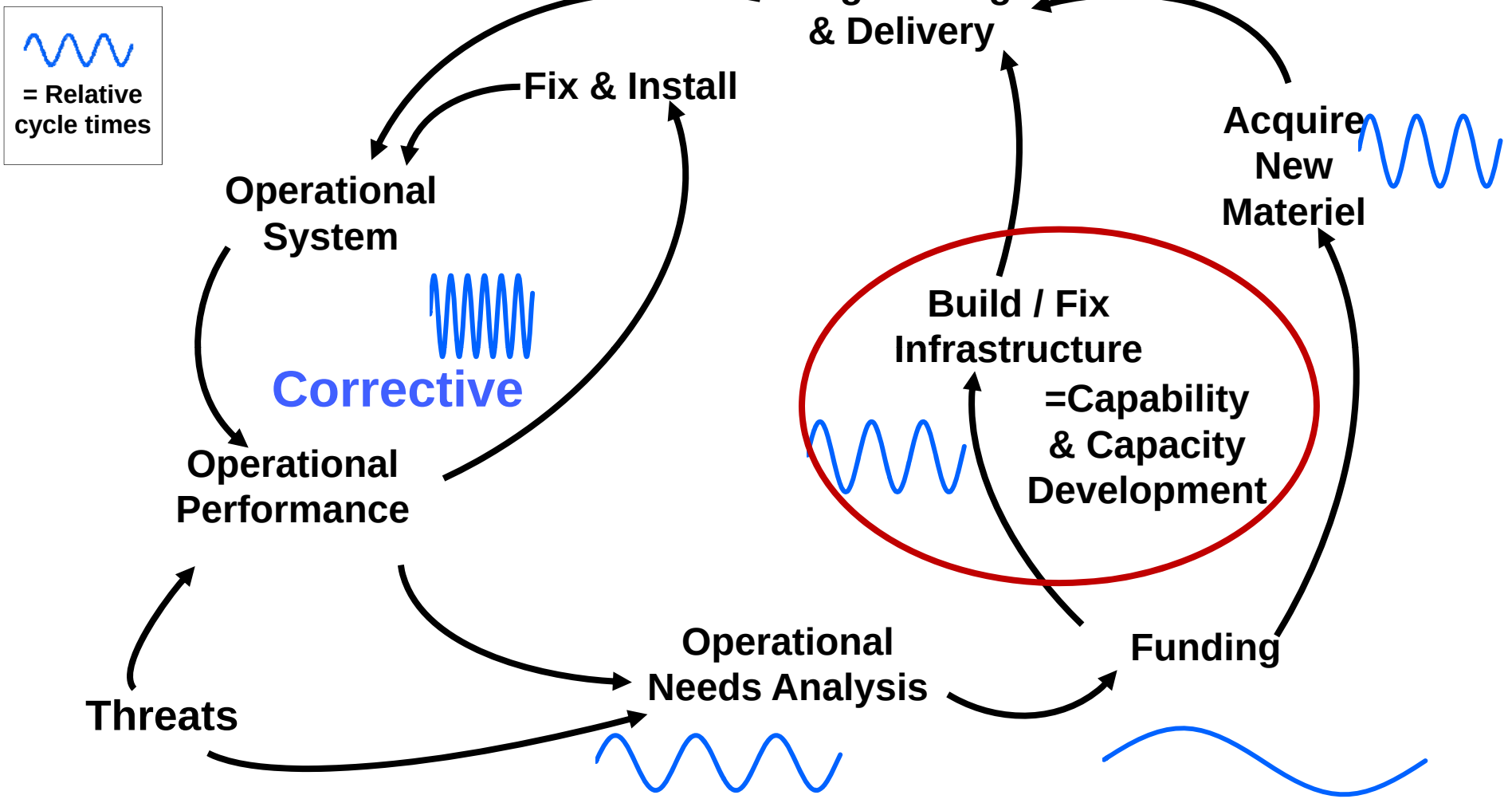
Make equipment ready for operational theater

Prevent obsolescence in older equipment (technology refresh)

Reduce need for costly new-start programs

Fill gaps before new-start programs are ready

Sustainment Cycles



Sustainment Investment Needs

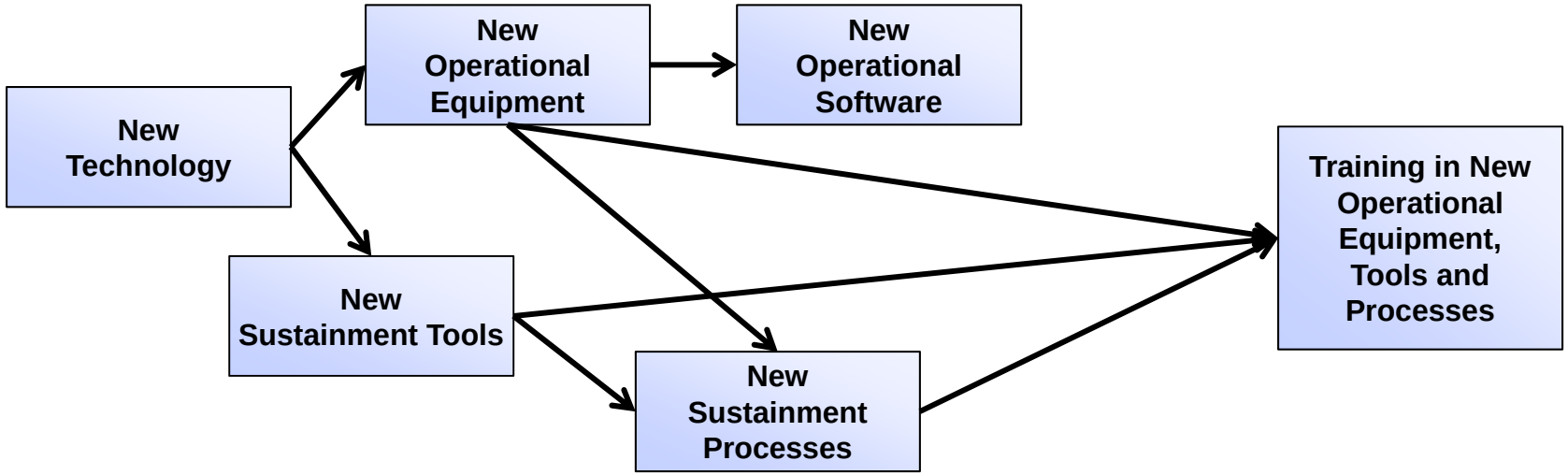
Understand new hardware (staff must learn how new hardware works)

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)

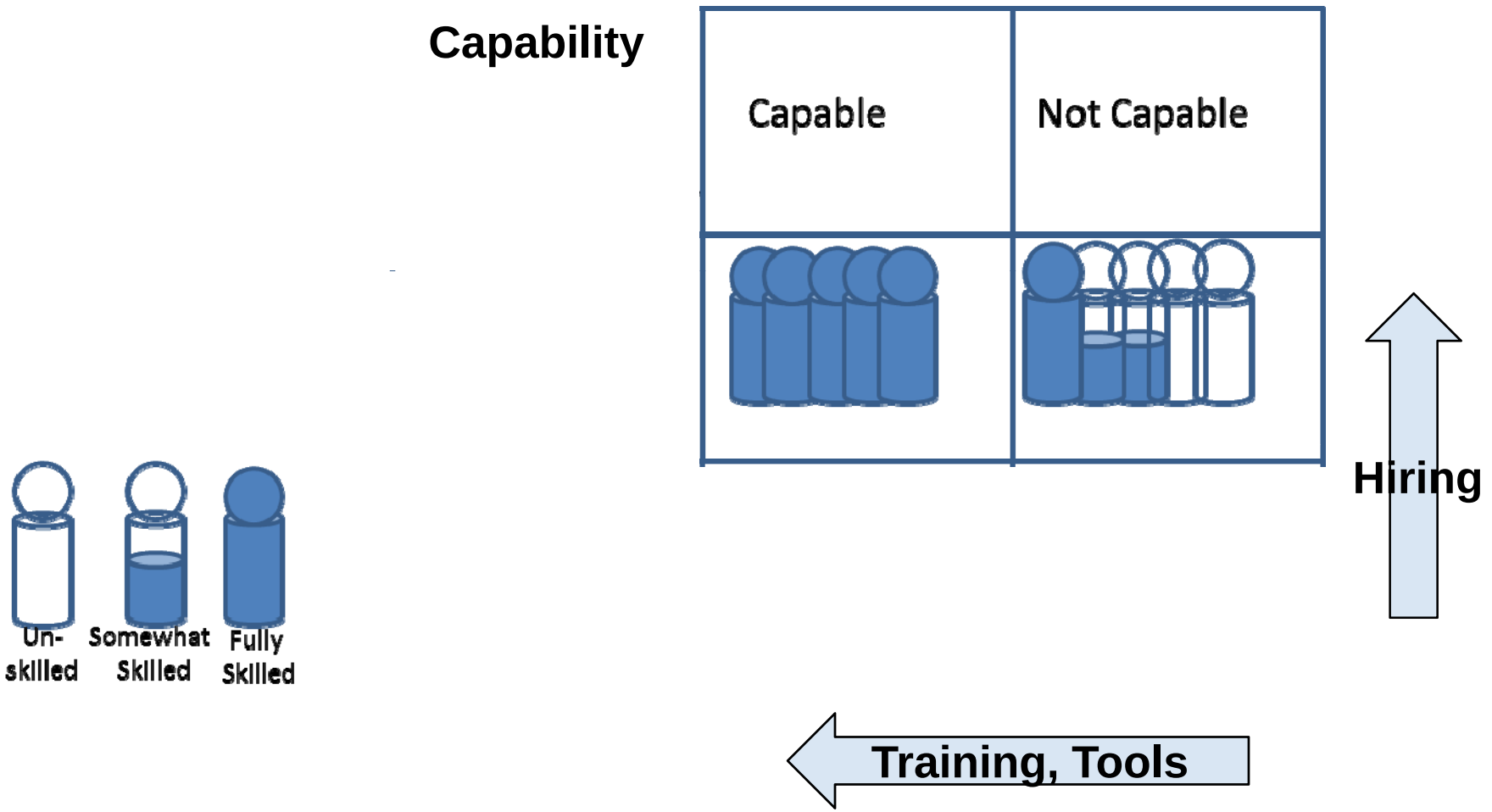
Reduced **cost** (skilled employees work faster)

Higher **quality** software (tools with error detection)

Reduced maintenance **errors**

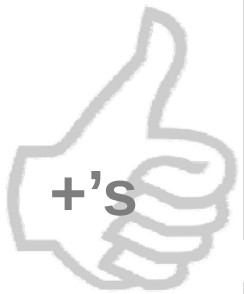
Innovation easier (new tools and techniques)

Definition: Sustainment Capability, Capacity



Increasing Sustainment Capacity

Hiring / Contracting (Count & Capability)



Fresh skills

Hiring: Costs, delay, difficulty (government salaries, instability); two years to understand job

Contractors: Domain experience? Organic/Contractor law

Training (Capability)

Long-term retention, long-term domain expertise, better performance

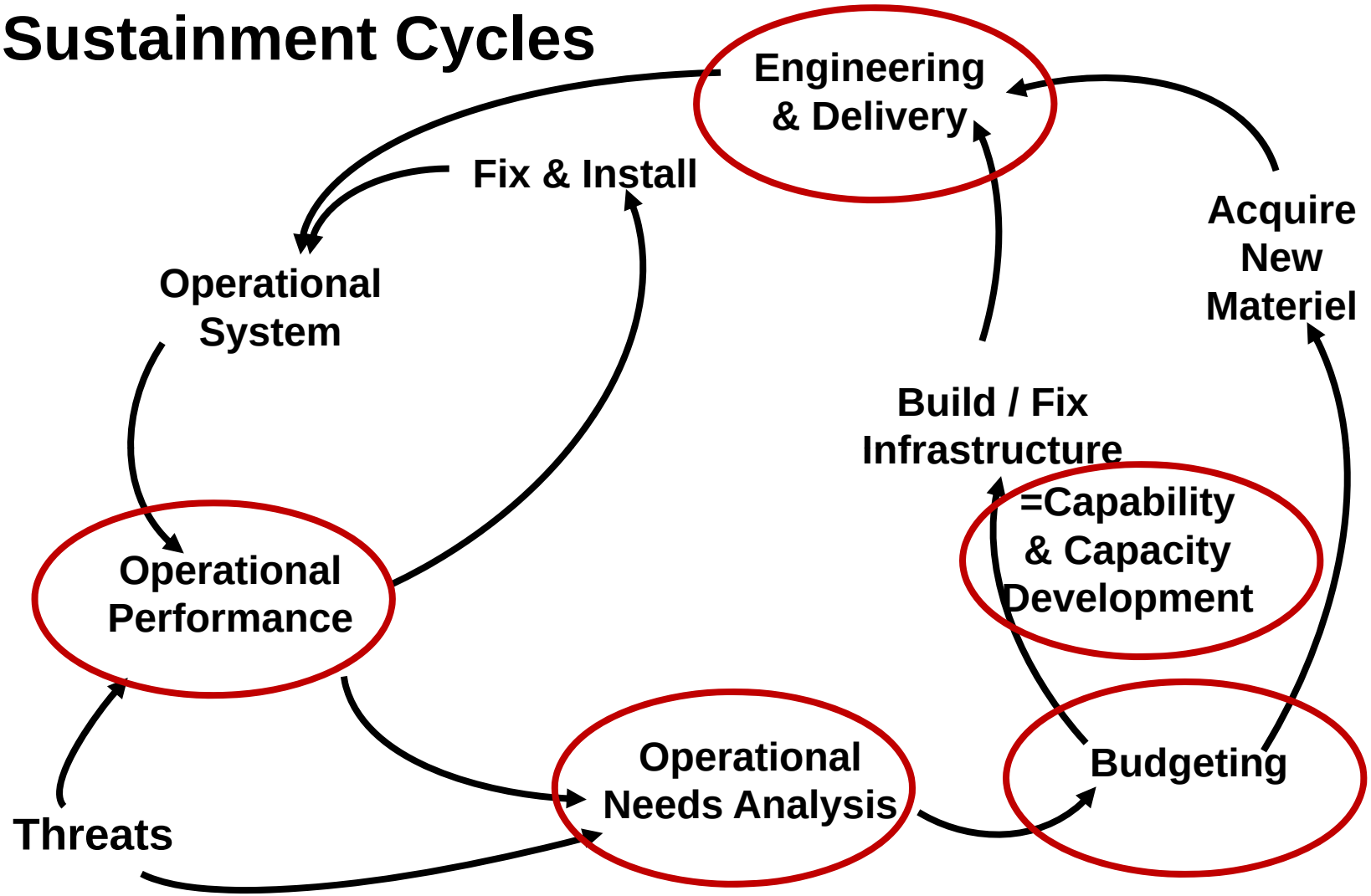
Takes time, takes people away from sustainment

Tooling (Capability)

Faster development, possibly fewer defects

Learning curve

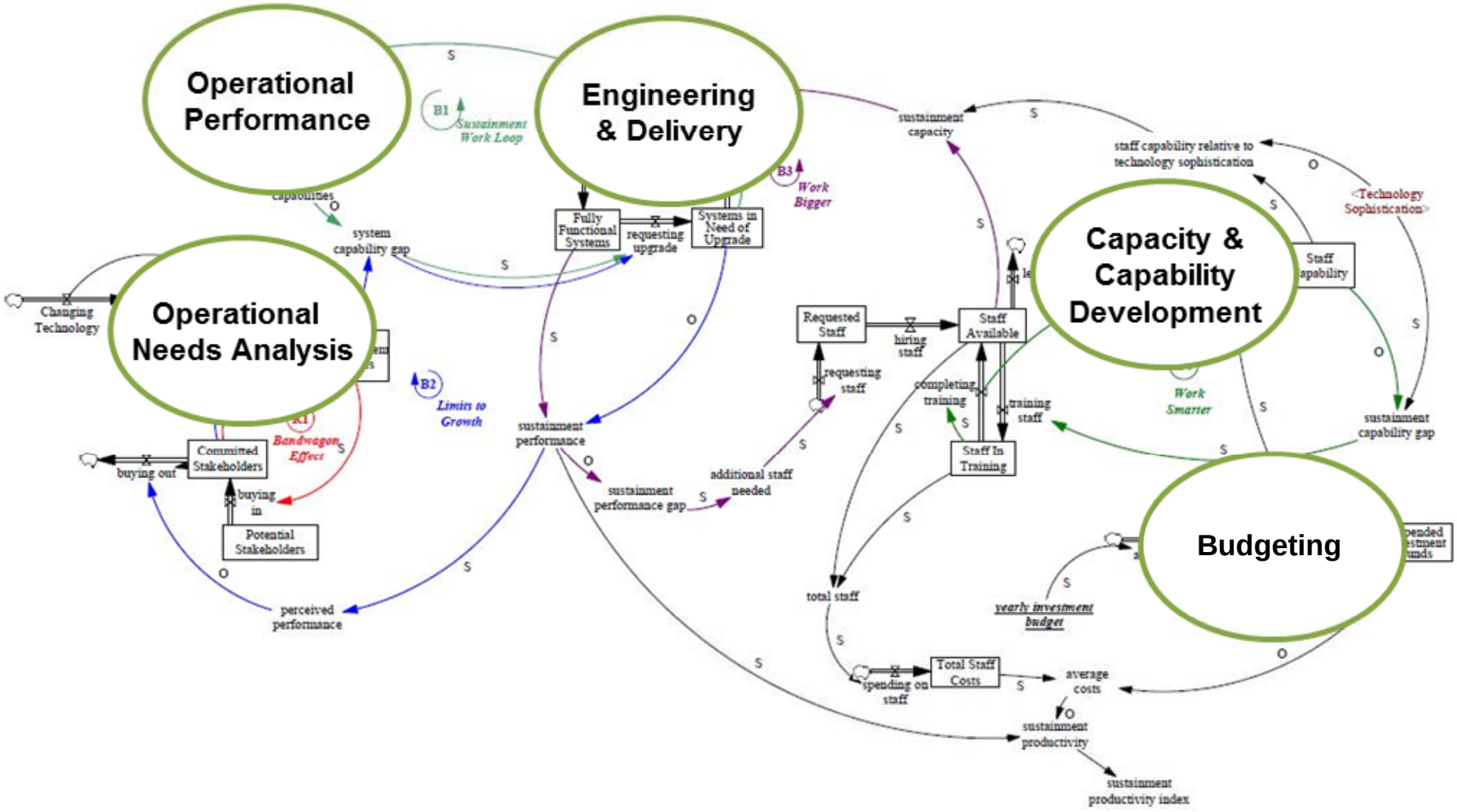
Sustainment Cycles



Measuring Sustainment Processes

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

System Dynamics Model



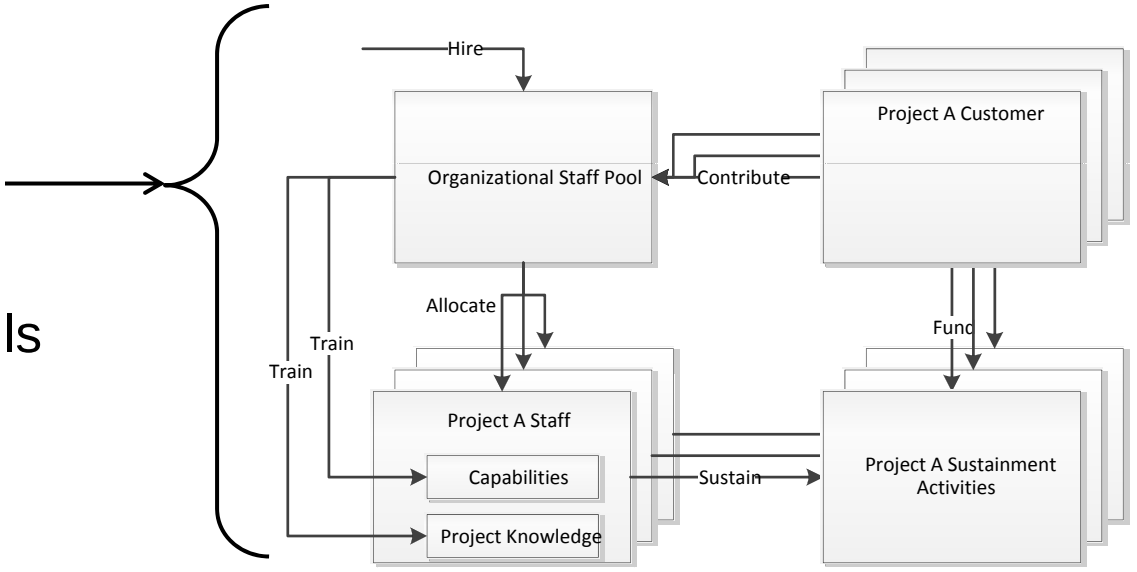
Future Work

Portfolios of projects

Colors of money

Capability: Specific skills

Organic vs. contractor considerations



Systems/Software sustainment integration issues

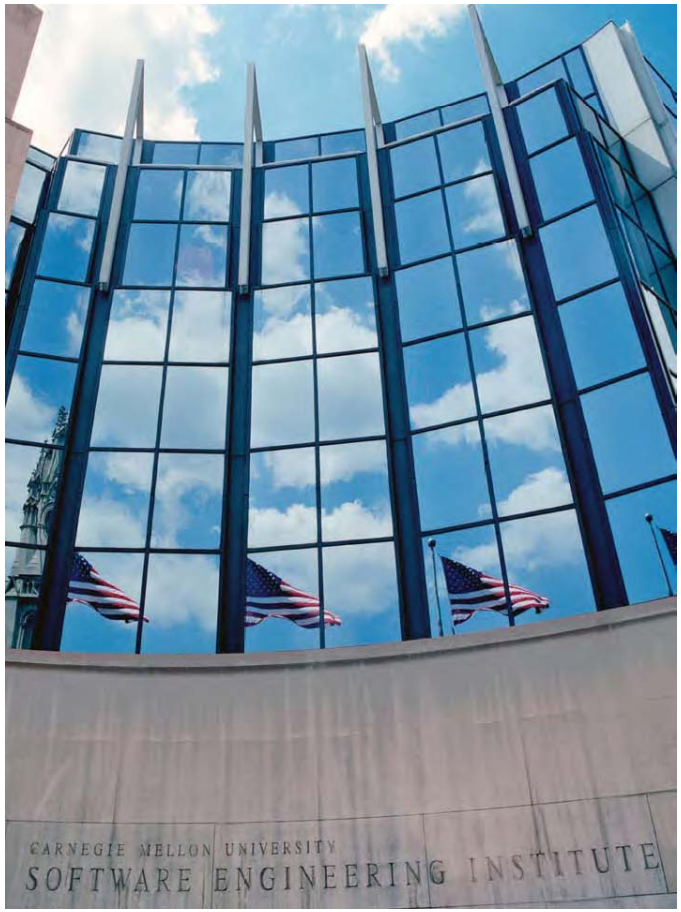
Early life-cycle sustainment considerations:

- 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, …

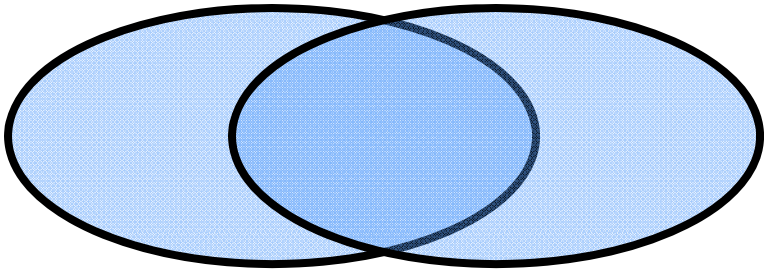
Maintenance

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:

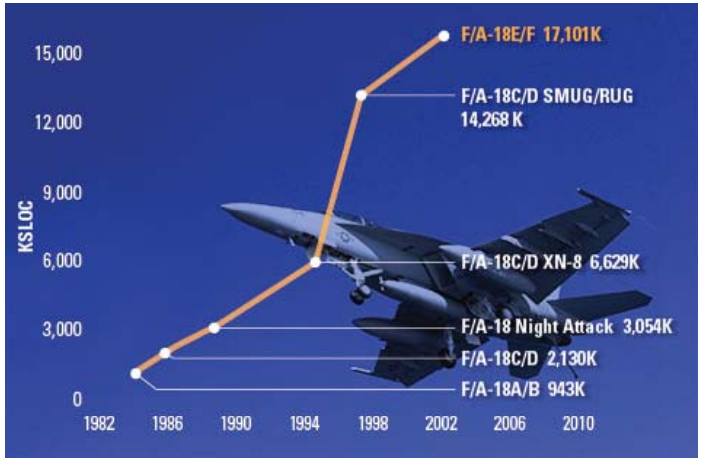
Fixing problems, designing for new technology, adding features

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

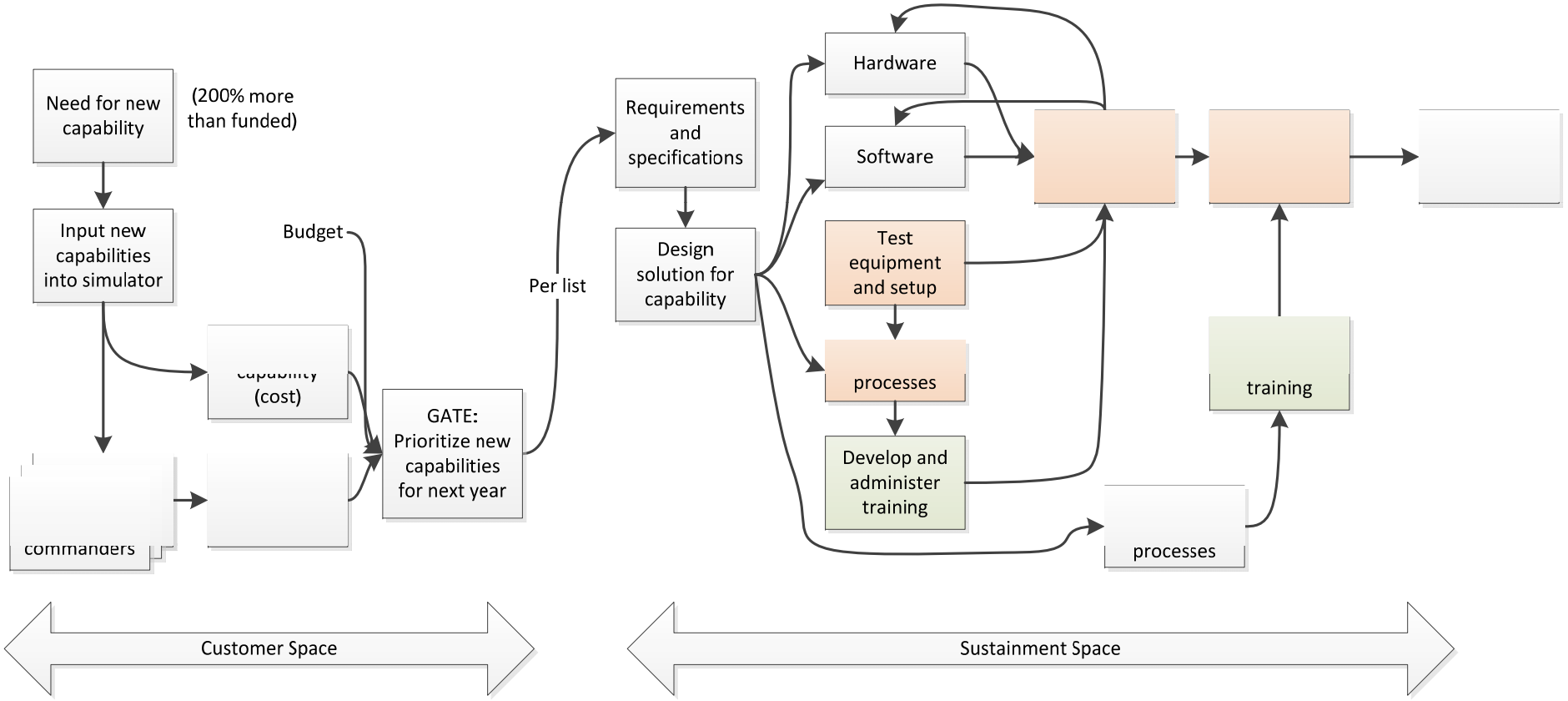


Working assumption

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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