Discussion:
Enabling & Institutionalizing Software Acquisition Transformation

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Transforming Software Acquisition Policy & Practice

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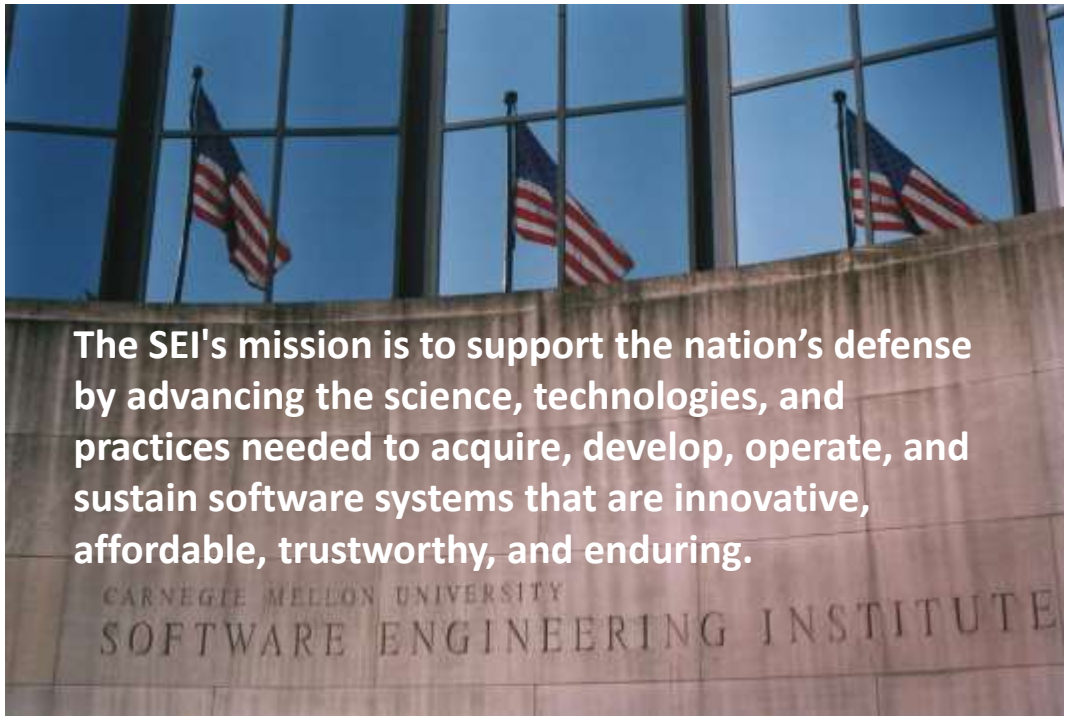
CMU SEI is a DoD R&D Federally Funded Research and Development Center



Established in 1984 at Carnegie Mellon University

~700 employees

Offices in Pittsburgh and DC, with locations near customer facilities in MA, MD, TX, and CA

~$145M in annual funding (~$20M USD(R&E) 6.2 and 6.3 Line funding)

CMU SEI is the only FFRDC charged to improve the state of the art and practice of software engineering

Software is a National Defense Priority

NDS Priority – Streamline rapid, iterative approaches from development to fielding

SEI Response – Experiment in situ; establish continuous verification and validation; continuous ATO

NDS Priority – Continuously delivering performance with affordability and speed

SEI Response – Advanced analysis to manage performance and cost (causal modeling, ML, automated software metrics)

NDS Priority – Advanced autonomous systems, artificial intelligence, machine learning

SEI Response – Develop architectures, analyses, and algorithms for intelligent systems

NDS Priority – Address the scope and pace of our adversaries' ambitions and capabilities

SEI Response – Develop and assure AI, cyber physical, and edge systems

NDS Priority – Modernize key capabilities

SEI Response – Modernize acquisition lifecycle practices to continuously deploy capability; Adapt Agile and DevOps for DoD

NDS Priority – Evolve innovative operational concepts

SEI Response – Build innovative mission capabilities at the edge

Source: Summary of the 2018 National Defense Strategy (NDS) for the United States of America Department of Defense https://dod.defense.gov/Portals/1/Documents/pubs/

Mission Capability Is a Function of Software Capability

"The United States must regain the element of surprise and **field new technologies at the pace of modern industry**. Government agencies must shift from an archaic R&D process to an approach that **rewards rapid fielding** and risk taking."

– 2017 National Security Strategy

"Compile to Combat in 24 Hours (C2C24)…will allow the Navy to **deploy new software capabilities in under 24 hours**, not the 18-month timeframe that's now common."

– *CHIPS*, The Navy's Information Technology Magazine

"Greater **speed in translating technology into fielded capability** is where we can achieve and maintain our **technological edge**."

– Mike Griffin, Under Secretary of Defense for Research and Engineering

"The ability of the DoD to produce and evolve software is **central to its ability to maintain superiority** across domains."

– National Research Council

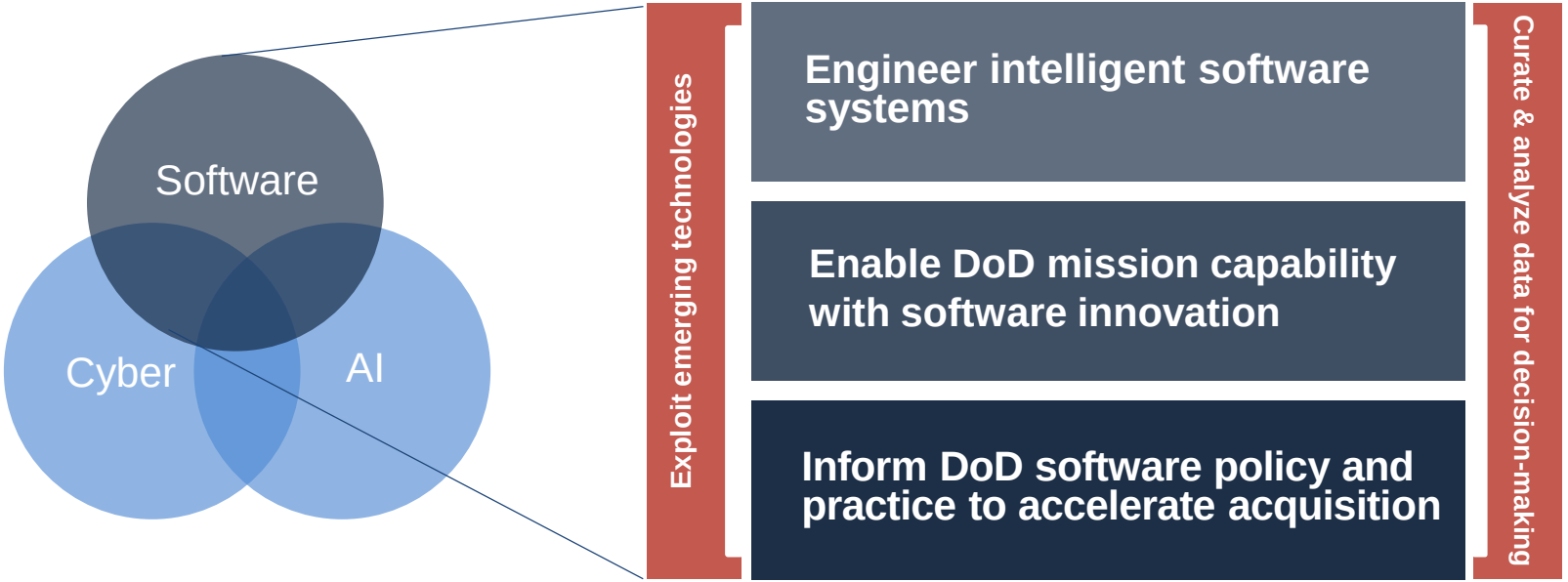
"We must **anticipate the implications of new technologies** on the battlefield, rigorously define the military problems anticipated in future conflict, and **foster a culture of experimentation** and calculated risk-taking."

– 2018 National Defense Strategy

"To maintain dominance, we must be dominant developing and employing software, becoming a **truly digital Air Force**."

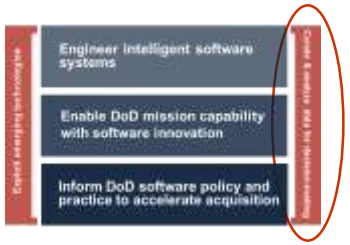
– Steven Wert, PEO Digital

SEI's Software Engineering Strategy:
Rapidly Deploying Software Innovations with Confidence in DoD



SEI Strategic Framework

Curate and Analyze Data for Decision-making



The curation and analysis of data enables the SEI's strategic goals for software.

Treating data as an asset
The SEI maintains its own data repositories and its FFRDC status allows it to access data from DoD programs and contractors.

Access to SRDR data enabled the development of the SEI's *Department of Defense Software Factbook* and supports analyses of data for the Services, OSD, and Congress.

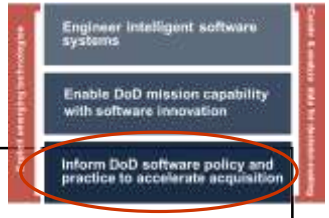
Software studies and analysis
The SEI provides an advanced capability for data-driven software analysis, bringing its analytical expertise to bear on DoD and industry problems.

Analyses have been performed on MDAP and other program data, including architecture, source code, and defect analysis.

Tool and infrastructure development
The SEI provides infrastructure and a continually updated portfolio of tools for managing, organizing, and analyzing data.

The SEI Software Analysis Lab is designed to rapidly meet customer needs and support research activities for Secret and unclassified analyses on demand.

Transforming the Acquisition Ecosystem



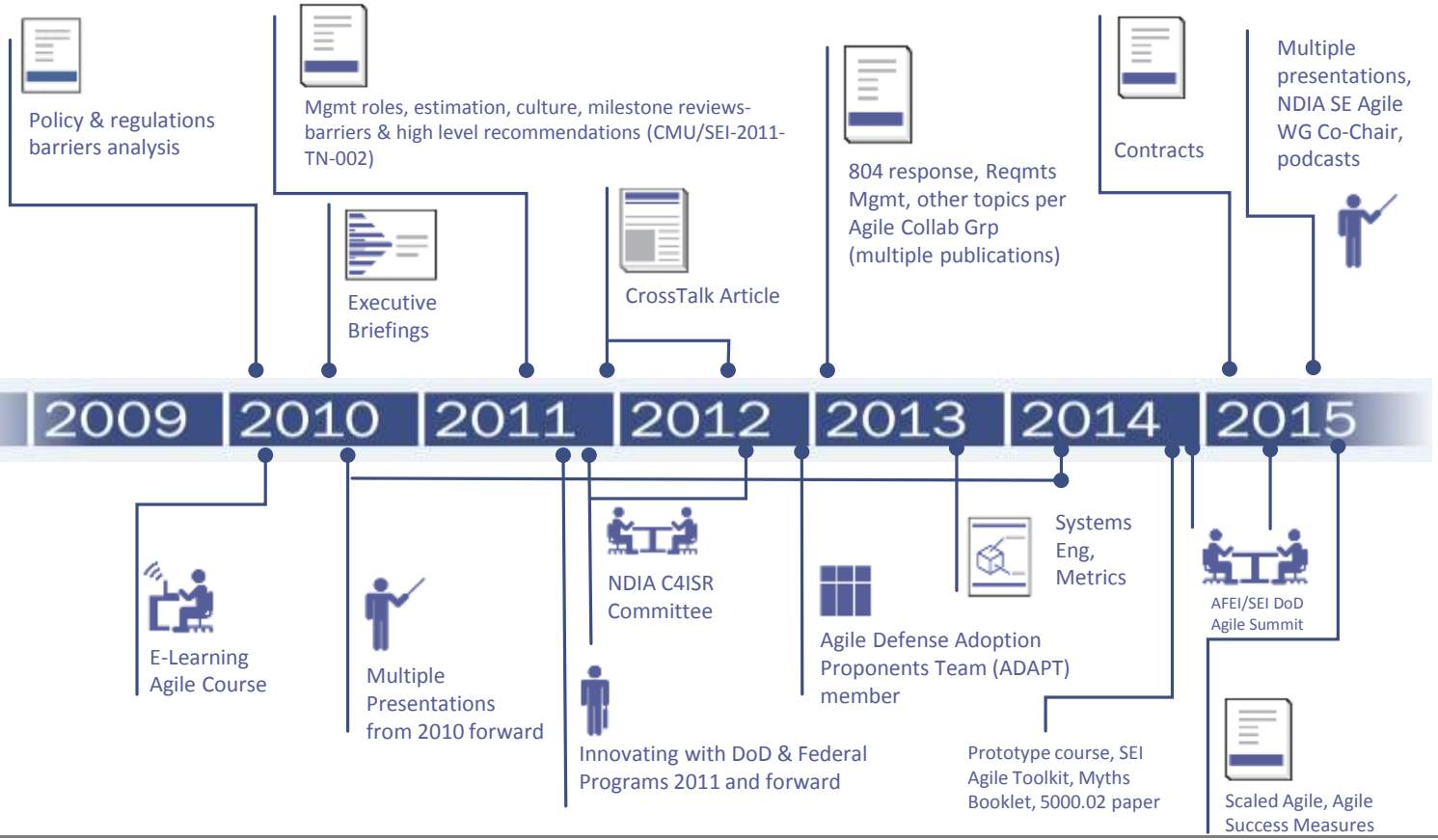
SEI research and program engagement inform the revision of policies, guidance, and processes across the ecosystem. The SEI:

- Leverages rich expertise in in measurement/analytics, enterprise data management, and causal learning to enable programs, agencies, and policymakers to **capitalize on data to drive evidence-based decisionmaking**
- **Pilots improvements** with end users, resulting in models and guidance for broad transition.
- Collaborates with researchers to speed the **insertion & adoption of technology & methods into programs**; piloting new approaches & guidance for acquisition of new & disruptive tech (SEI research, new commercial innovations, etc)
- Leads a unique **community of practice** across DoD, government, industry, and academia.

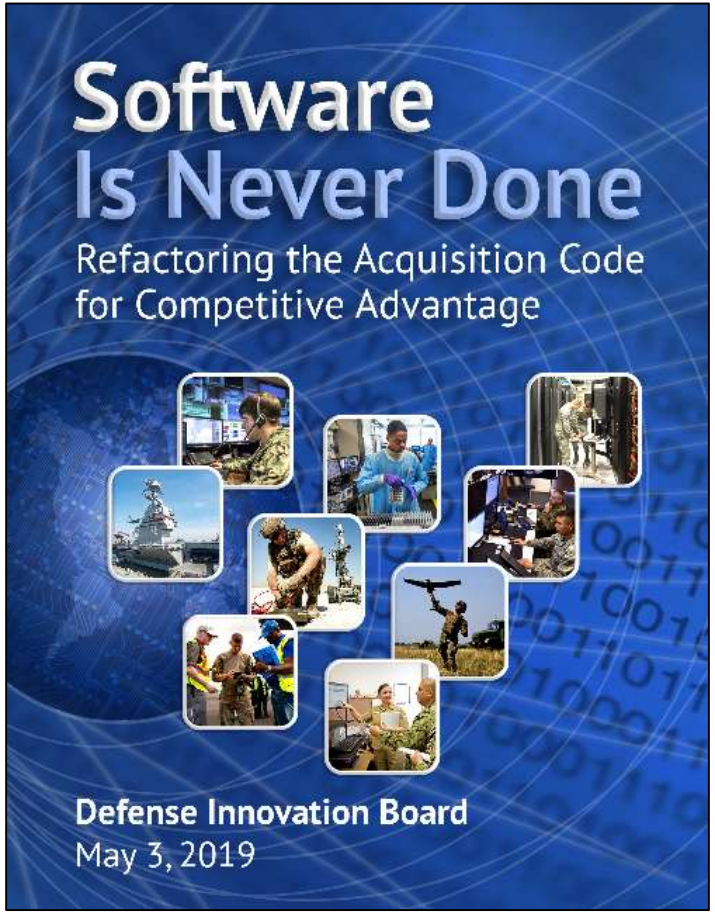
DoD Benefits

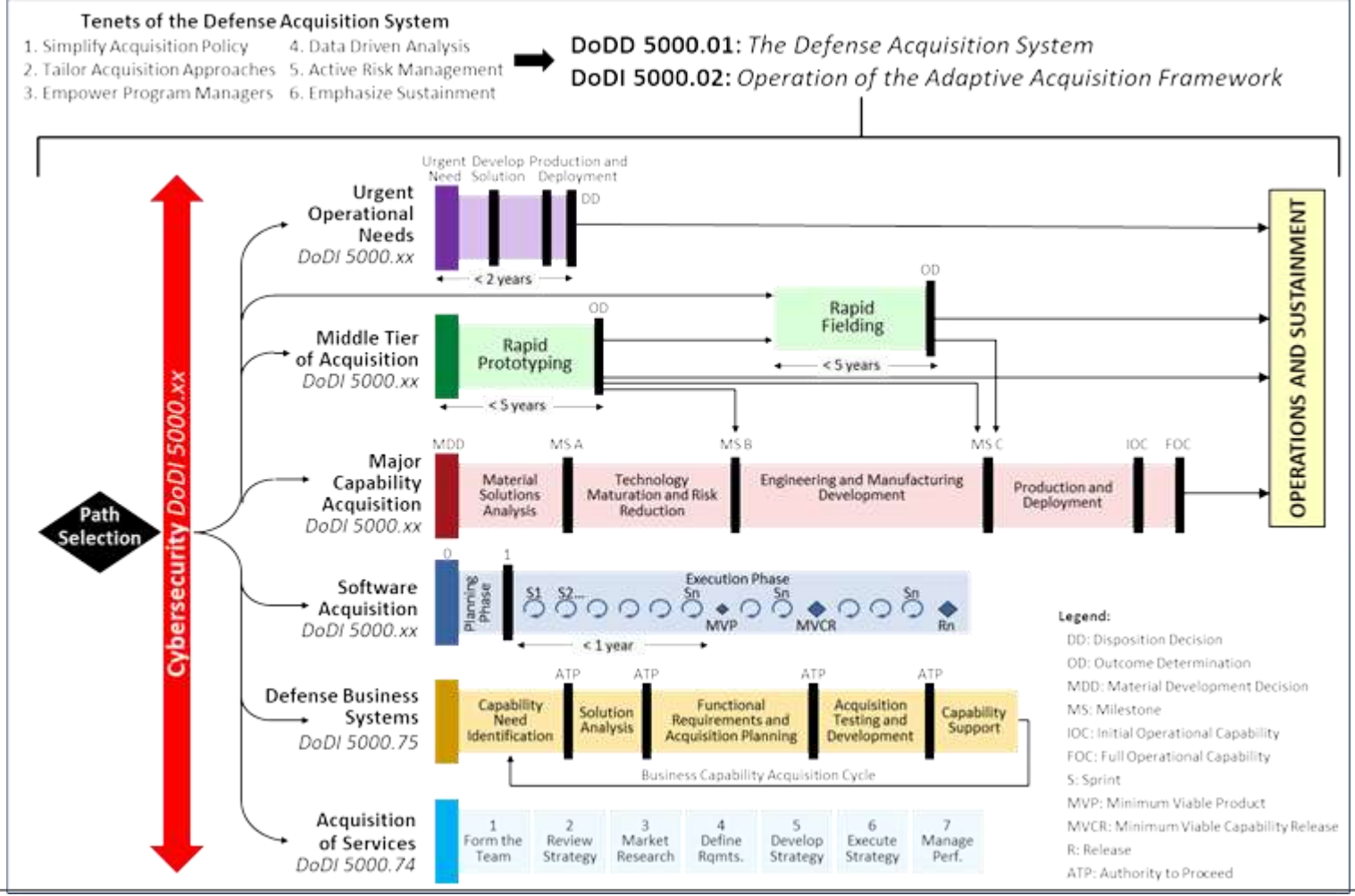
Transforming the acquisition ecosystem will allow the DoD to **capitalize on the use of advanced practices for software engineering**. New acquisition policies will also **promote experimentation (supported by data),** bringing innovative capabilities to the warfighter much sooner than is currently possible.

Agility in the DoD: Research, practice, and outreach

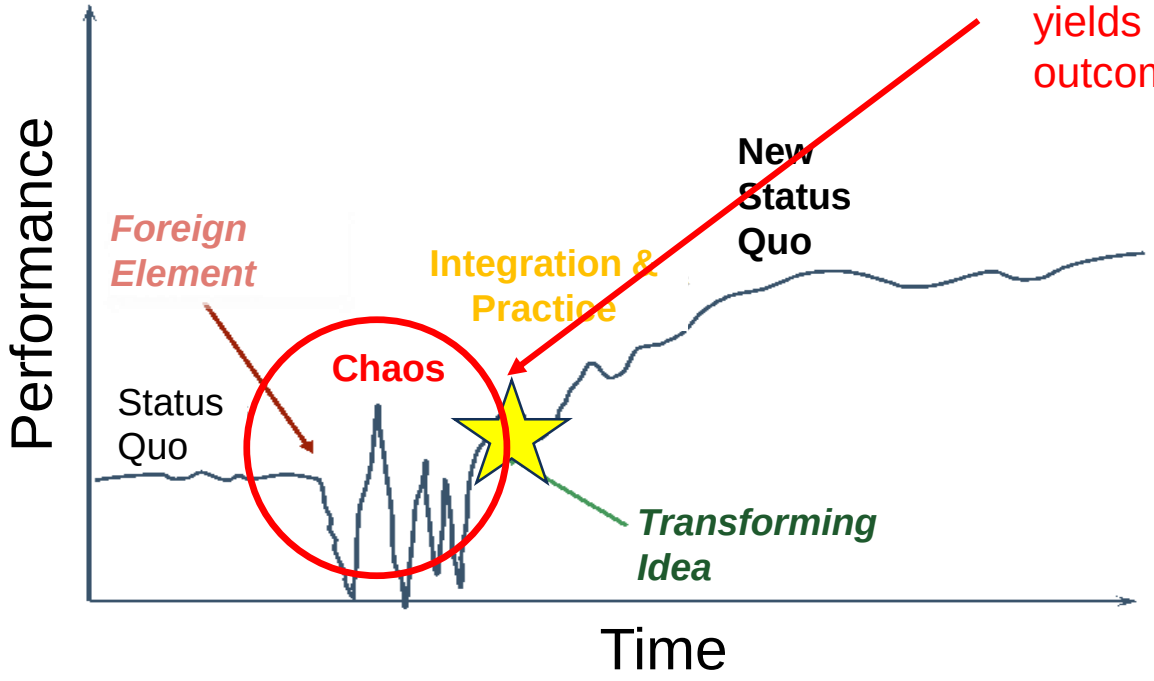


- Congressional Testimony
- Webinars
- Courses
- Blogs
- Conferences
- Symposia
- Program Coaching
- Section 809 Panel





Changing the status quo



Old status quo no longer yields predictable/desirable outcomes

Weinberg, Gerald R. *Quality Software Management Volume 4: Anticipating Change,* Dorset House Publishing, 1997.

What Technology Adoption Looks Like

We can apply this model to *ideas and approaches*, too.

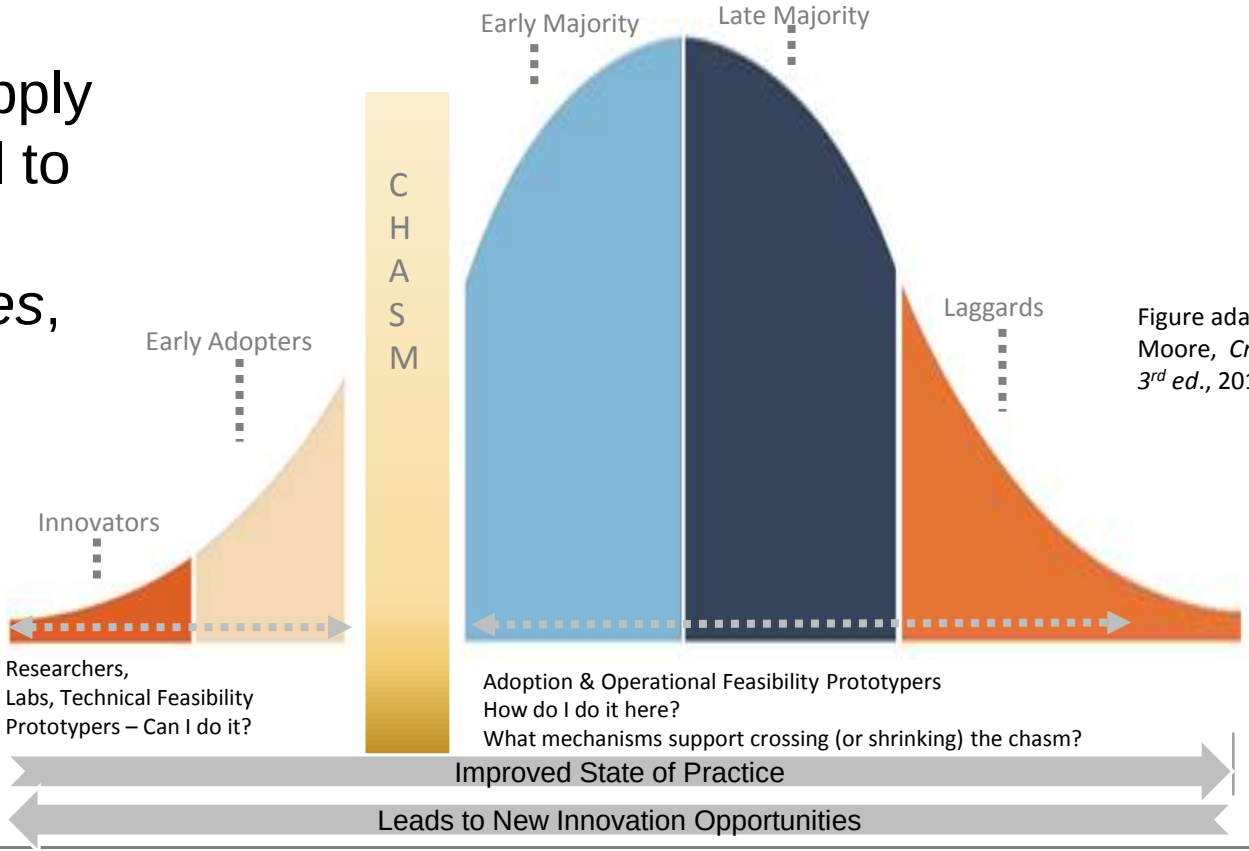


Figure adapted from Geoffrey Moore, *Crossing the Chasm 3rd ed.*, 2014.

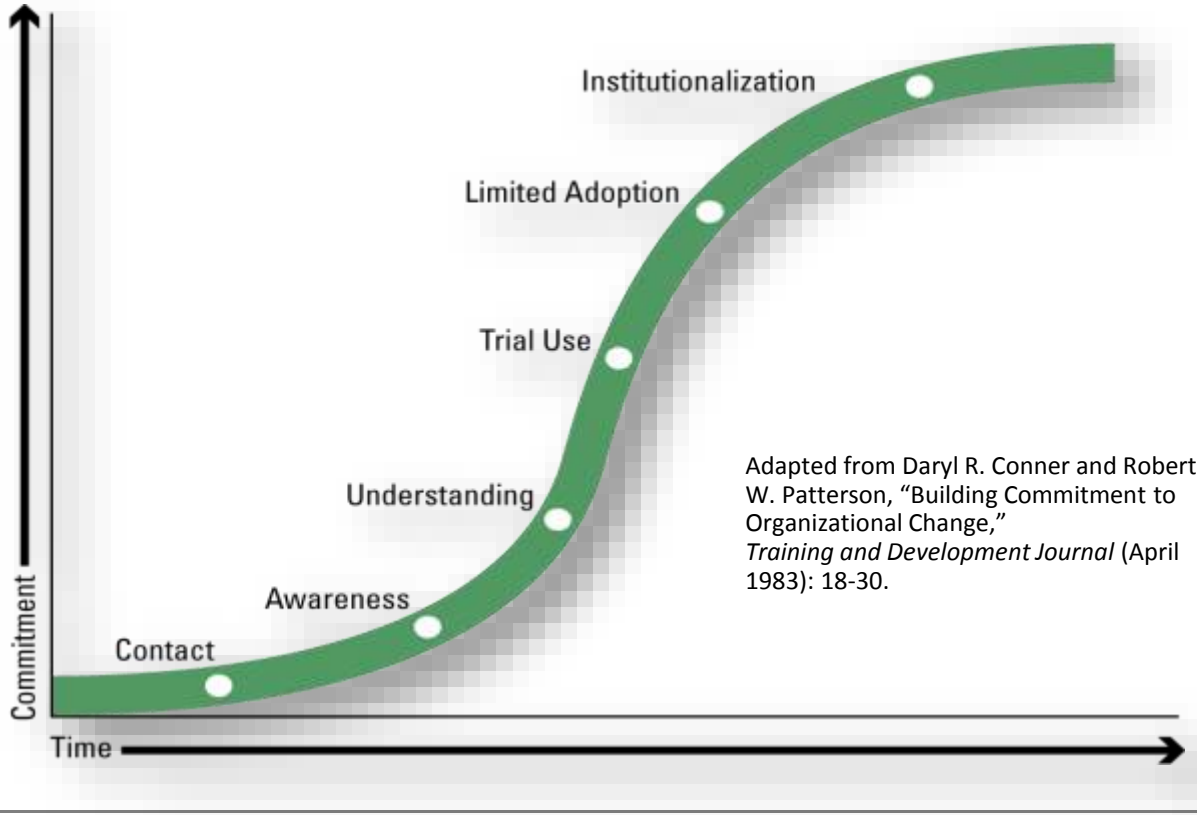
Good news!

We know a lot from organizational change research:

Both communication and implementation support mechanisms are necessary

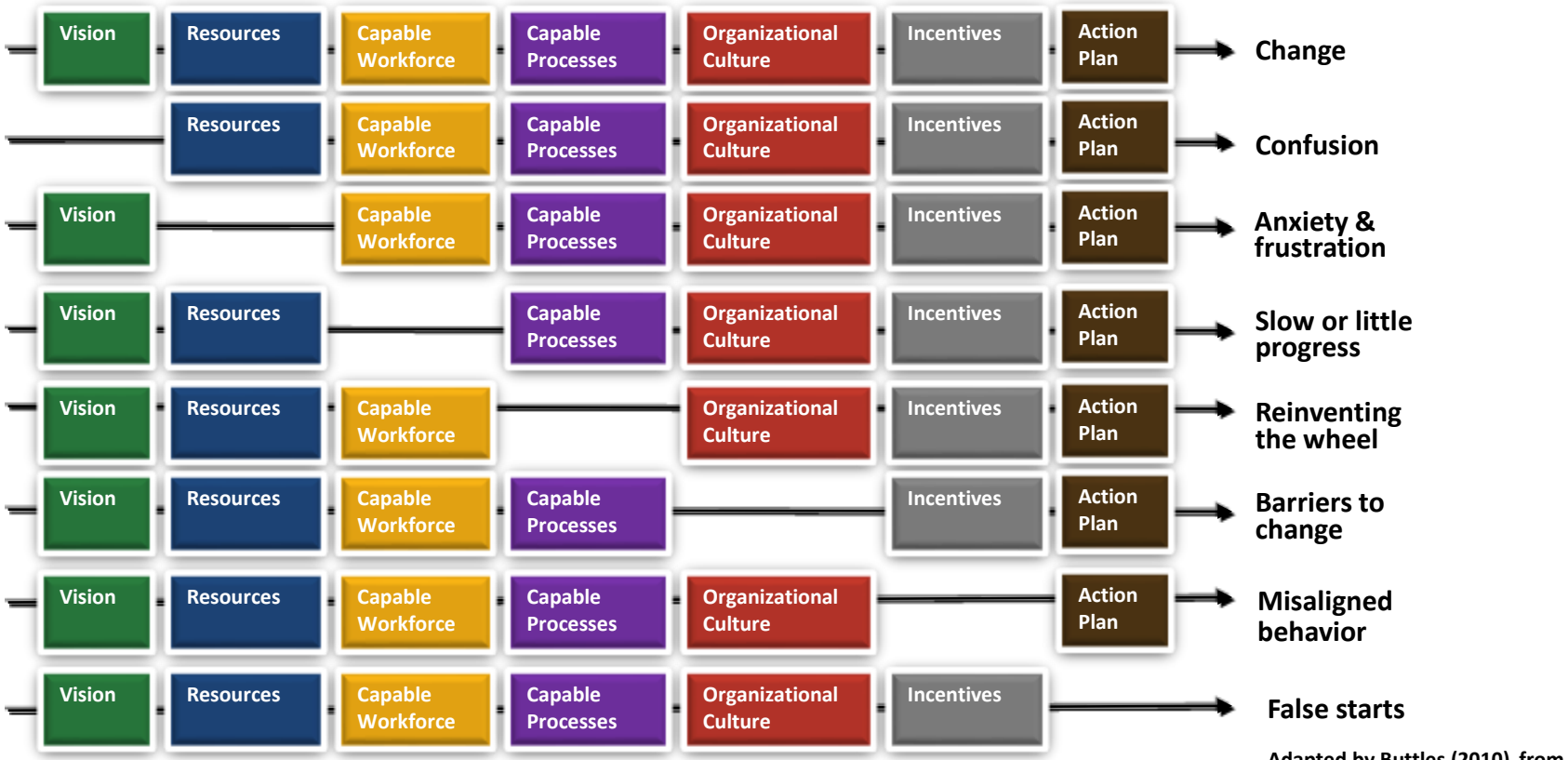
Those mechanisms are different for different populations

What do you see today?



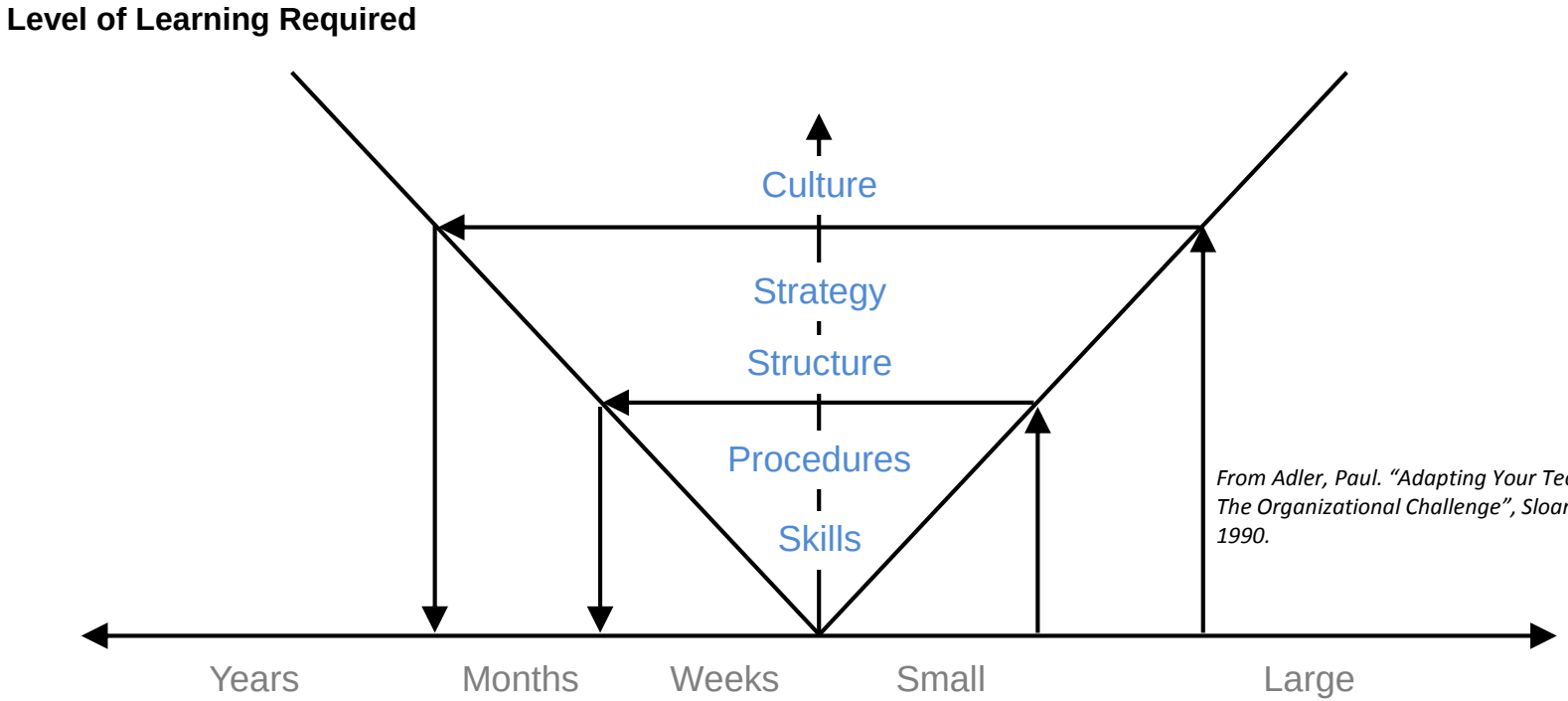
Adapted from Daryl R. Conner and Robert W. Patterson, "Building Commitment to Organizational Change," *Training and Development Journal* (April 1983): 18-30.

Organizational change: elements and failure modes



Adapted by Buttles (2010) from Delorise Ambrose, 1987

“Culture eats strategy for breakfast”



From Adler, Paul. “Adapting Your Technological Base: The Organizational Challenge”, Sloan Mgmt Review, 1990.

Food for Thought: Fundamental Shifts in Software Engineering

As software and systems are increasingly becoming **bigger**, **more complex**, and **intertwined**, software engineering and the roles people play are evolving in response.

Time

Developers write code	Models generate code	AI/ML assists in generating models/code
Software release based on milestones (typically 12 – 24 months)	Continuous integration and continuous deployment (CI/CD)	Automated release-observe-refine
Collect data and evidence from past projects to make predictions	Moving beyond prediction to determining causality	Feedback of data and results to re-train models
Software and hardware must work together	Increasing diversity of languages, platforms, hardware & systems must be made to work together	Systems of people, policies, sensors, software, hardware, etc., continuously learn ways to work together
Developers do nearly everything	Developers determine processes and rules and create automation	Machines continually learn what to do to achieve goals
Black box test for correctness	Formal analysis of correctness	Mathematically verified enforcers watch rest of system
Human in the loop (humans invoke computers)	Humans on the loop (humans monitor computers)	Humans out of the loop (computers notify humans only when needed)

Final thoughts

- The pace of innovation will continue to grow
- The ubiquity of software and its critical role require fundamental shifts in software engineering and acquisition to maintain DoD's competitive advantage
- Adaptive capacity of the acquisition ecosystem is critical to enabling the DoD to rapidly deploy innovation with confidence within this shifting landscape
- Institutionalizing changes in the acquisition ecosystem to prioritize speed, user engagement, and flexibility will require capitalization on data and a variety of communication and implementation support mechanisms … and a lot of collaboration
- **We're all up to the challenge.**

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