Scientific Software Ecosystems: A Panel Discussion

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

Established in 1984 at Carnegie Mellon University (CMU) in Pittsburgh, PA

Charged to improve the state of the practice of software engineering, cybersecurity, and AI Engineering

Collaborates with other departments in CMU and broadly in academia, government, and industry

Capable of conducting both fundamental research and classified work

~610 staff members

FY20 total funding ~$140M. Offices in Pittsburgh and DC, with locations near customer facilities in MA, TX, and CA

Anita Carleton, Division Director of the Software Solutions Division (SSD) at Carnegie Mellon University's Software Engineering Institute

- More than 30 years of technical and senior leadership experience in the software engineering industry.
- Mission of SSD is to advance the state of the practice in software engineering through applied research, development, and transition of innovative technologies for building and acquiring software-intensive systems, with the specific goal of making software a strategic advantage for the Department of Defense.
- Provides leadership through research collaborations with CMU and others in academia, directly engaging with major defense acquisition projects, partnering with industry, and informing DoD policy makers.

Most recently led an SEI study engaging the software engineering community to define a national agenda for software engineering research and development for the next decade titled Architecting the Future of Software Engineering: A National Agenda for Software Engineering Research & Development.

What Are The Value Propositions Of Your Ecosystem To Its Developer And User Communities?

- We are a CATALYST for the DoD.
- We bring value by BRIDGING disparate communities (researcher, practitioner, acquirer AND academia, industry, government), who operate according to their own respective incentives,
- We ACCELERATE the ADOPTION of the best techniques and practices and ACCELERATE RESEARCH in key areas where the state of the art falls short.
- We do this, in part, by addressing customer-specific needs, but always in a way that also addresses the community's needs as well.

It is in this way that ***we make software a strategic advantage for the DoD***.

What Is The Business Model Of Your Ecosystem (how do people fund their efforts)?

The SEI's choice of technical work is driven by its sponsoring agreement and by its close alignment with DoD technology modernization priorities:

- Congressionally allocated funding for selected research.
- SEI performs work on direct program work plans that benefit Major Defense Acquisition Programs (MDAPs), executive agencies, service branches, combat support agencies and service labs.
- Additionally, the SEI works with federal civilian, independent federal agencies, and private sector companies and collaborates with CMU and other universities on research projects.
- Influences the software engineering community by holding leadership positions in key technical societies such as the Institute of Electrical and Electronics Engineers (IEEE), the largest technical professional organization. SEI technical staff serve as IEEE Computer Society President, on the IEEE Board of Governors, as the *IEEE Software* Editor-in-Chief, and on the *IEEE Software* Advisory Board.

What Are Some Of The Challenges You Face In Providing Value To Your Members And Other Stakeholders?

The DoD faces enduring challenges as the need for software innovation and cybersecurity evolves and intensifies. The 2018 National Defense Strategy (NDS) and other DoD guidance make clear that the DoD needs its software-enabled systems to

- **Bring Capabilities** that make new missions possible or improve the likelihood of success of existing ones
- **Be Timely** so that the DoD is able to field new software-enabled systems and their upgrades faster than our adversaries
- **Be Trustworthy** in construction and implementation and resilient in the face of operational uncertainties including known and yet unseen adversary capabilities
- **Be Affordable** such that the cost of acquisition and operations, despite increased capability, is reduced and predictable and provides a cost advantage over our adversaries

Other challenges:

- Tension between today's challenges and future anticipated needs…How do we convince people to pay for something that is not yet causing them problems?
- Another challenge is that we are a small organization, so that we need to produce work products that have benefit beyond a specific customer.
- We also have to find other sources of leverage like standards, communities of interest, practitioner conferences, ...

What Are Your Sustainability Challenges?

Design for Sustainability in Computing will require:

- Fundamentally new and disruptive research across all aspects of computing including modeling, design, reuse, programming, data management, and digital and computing-based technologies
- Discovering new design and analysis principles for engineering intelligent software systems
- Contributing to the development of a discipline for AI engineering by building on its software engineering strengths in assurance, architecture, formal analysis, DevOps, and automation
- Design for reusability principles across some or all levels of the entire computing stack to avoid obsolescence and enable longevity for devices (e.g., smartphones, IoT), including modular design for updating or common product-line sharing
- Advances in computer architectures including reconfigurable architectures
- Investigating emerging technologies, such as integration of quantum components into software systems, use of low-code platforms, and designing self-modifying architectures