

The Software Engineering Institute: The DoD's Center for Software, Cyber-Related Capability, and Emerging Technology R&D

At the Carnegie Mellon University (CMU) Software Engineering Institute (SEI),¹ we research complex software engineering, cyber operations, and Artificial Intelligence (AI) engineering solutions; create and pilot innovative technologies; and transition maturing solutions into practice. In this work, we focus on the entire software and cyber lifecycle from early technology prototyping to sustainment. As the technology landscapes in our focus areas continue to evolve, the SEI adjusts how it applies our expertise to enable the U.S. Department of Defense (DoD) to maintain strategic advantage through software. Our adjustments enable us to continue to do our job of identifying threats to that advantage and creating new opportunities for the DoD to exploit ever-greater software-based capabilities. We routinely produce research findings, software (both restricted to DoD and open source), methods, books, training, datasets, academic publications, models, and other high-impact deliverables.

About the SEI

The SEI is a university-operated federally funded research and development center (FFRDC) sponsored by the Undersecretary of Defense (Research and Engineering) (USD(R&E)) and administered by CMU, established to meet special-long-term research or development needs² owing to the continuing growth of DoD's reliance on software and related technologies as missions become more complex. The SEI's association with a world-class research university follows the model of MIT Lincoln Labs; it is the second research and development (R&D) lab established by the DoD. Its R&D FFRDC designation distinguishes it from systems engineering FFRDCs, such as MITRE, which are free-standing, non-profit corporations.

USD(R&E) oversight of the SEI's technical portfolio is provided by a Joint Advisory Committee (JAC) consisting of senior executives from the Office of the Secretary of Defense and flag officers from the military departments. This oversight body reviews and approves the strategy and the annual program plan. The JAC is supported by an executive group (JAC-EG), comprising executives representing the JAC organizations. A Technical Advisory Group (TAG) of government and academic experts evaluates the SEI technical portfolio and plan for use of Line funding.

The SEI is a college-level unit within CMU, and SEI leadership reports to the Office of the Vice-President for Research (OVPR). CMU maintains oversight of the SEI through its Board of Visitors (BoV), which reports to the OVPR. The BoV comprises experienced senior executives and researchers.

The SEI in recent years has received annual funding around \$145 million, of which ~\$20 million is congressionally allocated for SEI-selected research (Line funded) (See Table 1 for FY20 projections). Each fiscal year, the SEI performs work on about 70 Project Work Plans (PWP) that benefit Major Defense Acquisition Programs, executive agencies, service branches, combat support agencies, and service labs. Additionally, the SEI works on cooperative agreements with federal agencies and private sector companies, and collaborates on research with CMU and other universities to cost share common problems with the DoD, ensure transition, and inject innovation into the DoD. The SEI's choice of technical work is driven by its Sponsoring Agreement and by its close alignment with DoD technology modernization priorities.

¹ In December 1984, the U.S. Department of Defense (DoD) awarded a contract CMU to manage an FFRDC called the Software Engineering Institute.

² U.S. Code of Federal Regulations, Title 48, Part 35, Section 35.017

Motivation for SEI Technical Work

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 to enable DoD to field new software-enabled systems and 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

Those four requirements are the drivers for all SEI work—whether applied R&D, sponsored engagements, or transition activities—towards our goal to see software transform the DoD mission. The SEI measures all new ideas against DoD’s technology modernization priorities, as well as its Sponsoring Agreement, vision, and evolving strategy. The SEI establishes a pipeline for technology development and transition through activities that study the DoD software-and-cyber-enabled problem space, create solutions, and transition the solutions for DoD mission impact.

Table 1: FY20 Preliminary Funding by Source for SEI Objectives (percentage projected total)

Funding Source → Objective ³ ↓	DoD Line Funding	DoD PWP	Federal Agencies	Non-Federal
Creating Strategic Advantage for the DoD Through Software	5.1%	17.4%	7.2%	0.3%
Ensuring U.S. Cyber Dominance and Resilience	0.3%	15.0%	37.9%	0.3%
Emerging Technologies and AI Engineering	8.5%	6.9%	0.8%	0.1%
<i>Total by Source</i>	<i>14.0%</i>	<i>39.3%</i>	<i>46.0%</i>	<i>0.8%</i>

Technical Staff Profile

The SEI employs around 700 technical and non-technical staff in its Pittsburgh, PA and Arlington, VA offices and in locations near customer facilities in Massachusetts, Maryland, Texas, and California. The SEI recruits science, engineering, and technology leaders to ensure that our results maintain currency with emerging technologies in our fields of expertise as we assure ongoing alignment with DoD needs. The backgrounds and experiences of SEI technical staff map to the core competencies prescribed in SEI’s Sponsoring Agreement with the DoD (

Table 2). Many SEI technical staff hold PhD degrees from leading universities including CMU, Johns Hopkins, MIT, and the Georgia Institute of Technology, faculty appointments and leadership positions in professional societies. They regularly publish about their fundamental research (Table 3).

Table 2: SEI Technical Staff Degrees Aligned to SEI Core Competencies

Core Competency	Percent
Computer science	24%
Software engineering	8%
Systems engineering for software systems	8%
Mathematics	5%
Measurement of software systems	3%
Acquisition & lifecycle management of software systems	14%
Cybersecurity and software assurance	38%

Table 3: Publishing- (2015-19 unless noted)

³ For information on how SEI is working in these objectives, see the companion two-page descriptions.

Area	Number
Conference Papers	261
Best Conference Paper Awards	13
Journal Articles	68
Books and Book Chapters	17
Technical Reports (public release)	78
Blog Posts	137
Citations by others (2018: Last full year for which citation data is available)	1301