

From the Army Acquisition Executive

A Better Army Through Focused Research and Technology Development

Throughout history, the Army has focused on Soldier needs, combat requirements and the lessons of history as opportunities to build a force that is the most powerful, most capable and most respected in the world. Army science and technology (S&T) has had a major role in our success.

Through our S&T program, we pursue technologies to enable the Future Force while simultaneously seeking opportunities to enhance Current Force capabilities. We develop technology through investments in the three S&T components:

- For the near-term, demonstrating mature technology in relevant operational environments and facilitating technology transition to acquisition programs.
- In the mid-term, translating research into militarily useful technology applications.
- In the far-term, conducting research to create new understanding for technologies that offer paradigm-shifting capabilities.

The Army's laboratories and research, development and engineering centers support the focused research and technology development necessary to enable our Army to maintain its preeminence within the world. Army scientists and engineers execute their work in world-class Army facilities and also in cooperation with industry, academia and other government scientists and engineers.

In addition, the Army currently maintains four University Affiliated Research Centers that partner with industry and Army laboratories to transition new knowledge and novel technology concepts for further development. The Institute for Advanced Technology (IAT), established with the University of Texas-Austin, conducts focused, long-term, theoretical and applied research and development in electrodynamics and hypervelocity physics. IAT's primary focus is to enable military applications for electromagnetic gun capabilities.

The Institute for Creative Technologies (ICT), established with the University of Southern California, performs research in advanced simulation and immersive environments. The ICT enlists and leverages the resources and talents of the entertainment and game development industries to work collaboratively with Army computer science experts in graphics, audio and artificial intelligence. This collaboration has been critical in improving the realism and usefulness of simulation for Soldier training and mission rehearsal.

The Institute for Soldier Nanotechnology, established with the Massachusetts Institute of Technology (MIT), performs research in nanotechnologies for Soldier protection and survivability applications. Nanotechnology is the design and creation of novel materials or devices at the nanometer scale, often at the level of individual atoms and molecules. Finally, the Institute for Collaborative Biotechnologies (ICB), established by the University of California-Santa Barbara, in partnership with MIT and the California Institute of Technology, researches the processes, structures and features found in nature and biology. ICB is developing revolutionary technological innovations in



bio-inspired materials and energy, biomolecular and infrared sensors, bio-inspired network science and biotechnological tools targeted to a broad spectrum of Army needs.

It is within the very nature of mankind to question how things are done and this natural curiosity is essential to the progress the S&T community continues to make. As technology becomes more and more advanced, it opens the opportunity to reassess how we go about making progress. The system-of-systems (SoS) approach to technology is one area that is challenging us to question how we are conducting technology development and ask the question, "How do we do this better?"

The initial Future Combat Systems versions will require approximately 33 million lines of software code, and subsequent systems will undoubtedly contain ever-more lines of code. While we can tweak our software development tools and methods, it is uncertain that they will be up to the task of developing future systems. Recently, Carnegie Mellon University's Software Engineering Institute (SEI) conducted a year-long study to investigate ultra-large-scale (ULS) systems software. This study addressed the question, "Given the issues with today's software engineering, how do we build future systems that are likely to contain billions of lines of code?"

SEI brought together engineering experts with software and systems expertise from various institutions and organizations across the country to participate. The study indicated something that we all knew, but didn't truly appreciate — the magnitude of the impact that our SoS would have on how we do business. That increased code size brings with it increased scale in multiple dimensions; number of people employing the system; amount of data stored, accessed and manipulated; even to the number of connections and hardware systems required. This poses challenges that strain the foundations of current software development. The sheer scale of ULS systems will change everything. People will not just be ULS system users, they will be elements of the system. Software and hardware failures will be the norm rather than the exception. ULS system acquisition will be simultaneous with its operation and will require new methods for control. A broad, multidisciplinary research agenda for developing the ULS systems of the future, like our SoS, is required and the S&T community has shouldered this challenge.

The U.S. Army is the most powerful land force on Earth. Still, there is no natural law that says that we will always remain that way. People will make that happen. People are central to everything we do in the Army. Institutions do not transform — people do. Platforms and organizations do not defend the Nation — people do. Units do not train, they do not stay ready, they do not grow and develop leaders, they do not sacrifice and they do not take risks on behalf of the Nation — people do. That is why each and every one of us has an important role in keeping the U.S. Army the most powerful, most capable and most respected land force in the world.

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