

2009

Year in Review



**Software Engineering Institute** | Carnegie Mellon

The Software Engineering Institute (SEI) is a federally funded research and development center (FFRDC) sponsored by the U.S. Department of Defense and operated by Carnegie Mellon University.

The SEI mission is to advance software engineering and related disciplines to ensure systems with predictable and improved quality, cost, and schedule.

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## A Message from the Director



It has been a challenging year for government and industry organizations worldwide. With the slowing economy, organizations faced difficult decisions on products, revenues, and staffing. At the Software Engineering Institute, we were not immune to the economic pressures. Although we had a successful year, we empathized with many of our partners and customers as they worked diligently to maintain a competitive stance in the marketplace.

How did the SEI remain successful in the economic climate? We stayed true to our main mission of assisting the U.S. Department of Defense (DoD) and other key stakeholders on their software challenges.

Management, technical staff, and administrative staff focused on maintaining and enhancing our long-term competencies in software assurance, systems-of-systems architecture development, software engineering, and software-reliant acquisition to address the DoD customer gaps and needs. We also worked closely with our industry stakeholders to ensure that the best practices, technologies, and tools developed could be adopted in their organizations strategically, yet economically.

The SEI also began a renewed emphasis on research that will enable us to expand our legacy of network and systems survivability work. With an increased focus on the cyber environment and related technologies, the SEI will be uniquely positioned to help organizations worldwide address security and survivability, workforce development, defensive operations, cyber intelligence, and policies and plans.

Our work in FY2009 exemplifies the SEI technical staff's research efforts in meeting today's software and systems engineering problems, as well as identifying solutions for the future. For example:

- Working with the U.S. Army Software Engineering Center, the SEI used semi-automated content analysis to analyze requirements documents, test procedures, and problem and change reports (page 8).
- The Research, Technology, and System Solutions Program is leading efforts to create a concept lab to demonstrate how social networking technology and software engineering technology should be designed and operated (page 12).
- The Aerospace Vehicle Systems Institute reached a milestone in FY2009, with the successful completion of a proof of concept demonstration of technology for the System Architecture Virtual Integration initiative by modeling the use of the industry standard Architecture Analysis and Design Language (page 14).
- Northrop Grumman took advantage of the CERT Insider Threat team's expertise to understand short-term risks, address those risks, and develop a long-term strategy by applying the Insider Threat Assessment Tool (page 26).

As we approach our 25th anniversary, the SEI is committed to driving the future of complex systems. Our dedicated and experienced technical experts will continue to analyze, evaluate, and prioritize how SEI technologies, services, and initiatives can enable the DoD and commercial organizations to produce quality software on time and on budget, every time.

Sincerely,

A handwritten signature in black ink, appearing to read "Paul D. Nielsen". The signature is fluid and cursive, with a long horizontal stroke at the end.

Paul D. Nielsen  
Director and CEO

## Strategy

The SEI achieves its goals through technology innovation and transition. The SEI creates usable technologies, applies them to real problems, and amplifies their impact by accelerating broad adoption.

### Create

The SEI addresses significant and pervasive software engineering problems by

- motivating research
- innovating new technologies
- identifying and adding value to emerging or underused technologies
- improving and adapting existing solutions

SEI technologies and solutions are suitable for application and transition to the software engineering community and to organizations that commission, build, use, or evolve systems that are dependent on software. The SEI partners with innovators and researchers to implement these activities.

### Apply

The SEI applies and validates new and improved technologies and solutions in real-world government and commercial contexts.

Application and validation are required to provide

- effectiveness
- applicability
- transition potential

Solutions and technologies are refined and extended as an intrinsic part of the application activities so that government and commercial organizations can directly benefit from these engagements.

The SEI works with early adopters to implement the “Apply” activities.

### Amplify

The SEI works through the software engineering community and organizations dependent on software to encourage and support the widespread adoption of new and improved technologies and solutions through

- advocacy
- certifications
- communication and dissemination
- courses
- leadership in professional organizations
- licenses for use and delivery
- publications

The SEI accelerates the adoption and impact of software engineering improvements by engaging directly with the community and through its partners.

## Our Work and Our Solutions

The SEI works to maintain a long-term competency across the software engineering and cyber spectrum, and in technology transition to support U.S. Department of Defense (DoD) needs. By partnering with government and industry, the SEI enables them to make measured improvements in their software engineering, cyber environment, and management practices. The SEI conducts new and groundbreaking research in emerging software and systems engineering topics.

Quality software that is produced on schedule and within budget is a critical component to U.S. defense systems, which is why the DoD established the SEI in 1984. Since then, the SEI has advanced software and systems engineering principles and practices, while serving as a national and international resource for government and industry organizations worldwide. As an applied research and development center, the SEI brings immediate benefits to its partners and long-term benefits to the software industry as a whole.

The SEI offers solutions in the areas of

- acquisition
- security
- process management
- software development
- risk
- system design

Operated by Carnegie Mellon University—a global research university recognized worldwide for its world-class arts and technology programs—the SEI operates at the leading edge of technical innovation. The SEI’s core purpose is to help organizations improve their capabilities and to develop or acquire the right software, defect free, on time, and on budget, every time.



Because the archetypes are illustrated using actual acquisition programs, program managers and others readily identify with the stories' characters and conundrums, says William Novak, the archetypes' primary researcher and author.

**William Novak**

[www.sei.cmu.edu/acquisition/research/archetypes.cfm](http://www.sei.cmu.edu/acquisition/research/archetypes.cfm)



## Understanding Common Acquisition Problems

Understanding why acquisition programs fail—and sharing this knowledge with acquirers—is one of the SEI’s prime challenges. During 2009, the SEI’s Acquisition Support Program delivered the results of a unique exploration of patterns of failure to the acquisition community.

Called Acquisition Archetypes, the two-page analyses provide a quick, concise, and engaging look at a specific pattern of failure—such as “Firefighting”—discerned through SEI research into problematic acquisition programs. In addition to dissecting each pattern, each archetype provides simple, direct advice on how programs can break free from the patterns.

“We wanted these to be quick reads, not 20-page papers,” notes Linda Levine, part of the two-person team that developed the archetypes. “We wanted lessons told through real-life experiences—something that any member of any acquisition program would find both engaging and fun to read.”

Because the archetypes are illustrated using actual acquisition programs, program managers and others readily identify with the stories’ characters and conundrums, says William Novak, the archetypes’ primary researcher and author.

“Having readers say, ‘hey—that sounds just like what I’m going through’ is really an important factor in making the archetypes so successful and popular,” he adds.

Behind the “fast and breezy,” though, is a research and analysis program that stretches back nearly two years, and which employs the central tenets of the emerging systems thinking and system dynamics discipline. Every Acquisition Archetype from the SEI includes a systems-thinking analysis and diagram. “These publications really have their roots in the observations we’ve made over the years that mistakes in acquisition programs follow a pattern in and are repeated,” Novak explains. “Collecting the data, analyzing it, discerning the patterns, and recognizing the systems dynamics aspects—these are all things that are the SEI’s strong suit.”

During 2009 the Acquisition Support Program completed the first wave of the publication program, with a total of 12 issues of Acquisition Archetypes completed. Hundreds of copies of the issues are now circulating in the Department of Defense and civilian acquisition community, with requests from many readers for a second series.

“These have been enjoyable and eye-opening for us to write,” says Levine of the archetypes. “It’s gratifying to know that they’ve also opened the eyes of our readers.”

## Software Engineering, Extended

In fields as diverse as currency-exchange-rate forecasting and protein-folding simulations to better understand Alzheimer's and other diseases, computational engineering (CE) has demonstrated that high-performance computing can address difficult, large-scale, scientific and engineering problems—the kind the Department of Defense (DoD) faces in the acquisition of air vehicles, ships, and other major assets.

To realize the potential CE offers, the DoD knows it must overcome some challenges for using CE in acquisitions of software-reliant systems. In FY2009, the SEI began work that can lead to extending best software engineering practices to CE through a study and a workshop for the DoD-sponsored Computational Research and Engineering Acquisition Tools and Environments (CREATE) program.

CE often requires the development of sizeable amounts of complex software to accurately represent multi-dimensional mathematical models and physical phenomena. However, the scientists who are developing that software typically are not formally trained in software engineering. They develop application codes with an eye towards solving an immediate problem, but without a systematic approach to assuring critical quality attributes such as performance, portability, and robustness or to evolving codes over the 20- to 50-year life spans of major DoD assets.

“Computational engineering software development lacks investment in cost-effective infrastructure, doesn't use state-of-the-art development tools or best software engineering practices, and has not dealt with production quality issues,” says David Fisher of the SEI, who acted as the CREATE program's chief engineer in FY2009.

In addition, CE scientists need to become software developers for DoD asset design engineers, rather than being solely user-developers, according to Lisa Brownsword of the SEI, who conducted the study with colleagues Jim Smith and Phil Boxer. “Although developing for users with a different background is the typical case for most professional software developers, it is a new paradigm for scientist-developers,” Brownsword says.

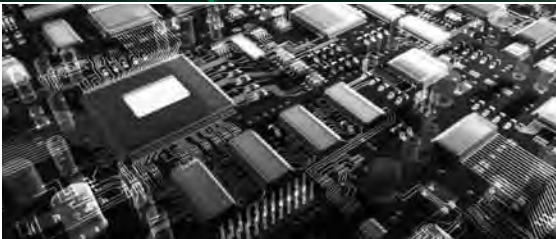
In its study, the SEI looked into existing CE software development capabilities, current and potential uses of CE for engineering decisions across the acquisition life cycle of DoD assets, and the gaps between current capabilities and the future needs of DoD asset design engineers. In the workshop, the SEI gathered 18 experts to develop a strategy and define software engineering practices for CREATE products.

“Our work with CREATE provides a unique opportunity for the SEI to engage with a community that is moving from developing and using complicated software as tools to support its own science agenda to providing tools to design engineers trying to solve complex DoD asset design and analysis problems,” says Brownsword.



Reliable





[www.sei.cmu.edu/interoperability/](http://www.sei.cmu.edu/interoperability/)

**Lisa Brownsword**

### **CE Closer to Home**

The use of CE in modeling climate change, processing seismic data for oil and gas discovery, simulating aero-acoustic effects in defense and aerospace work, and the like is somewhat remote for most people. But CE also predicts behavior for more common things, such as the tires on the family car or diapers on the baby riding in the back seat of that car.

Tires are made of composite materials (rayon, steel, nylon) that react differently to temperature and load conditions among other factors. Predicting how a composite “system” of materials will behave requires complex modeling. And computational fluid dynamics can model how well a diaper’s absorbent material will wick moisture away.

### **The More FLOPS the Better**

Today’s fastest supercomputers can process more than 1 petaFLOPS (quadrillion Floating Point Operations per Second). That’s a 1 followed by 15 zeroes—1,000,000,000,000,000. With that power and the right software, computational engineers can build high-resolution models and perform advanced data management in fields such as medicine, defense, and energy. But there’s even greater power on the way. U.S. national labs at Sandia and Oak Ridge are collaborating on an HPC system that will process at 1,000 petaFLOPS. That speed,  $10^{18}$  or exaFLOPS, is the equivalent processing power of about 1 billion PCs.



# Structured

## Improving Requirements Through Automation

Good information is critical for making good decisions, but few of us feel smarter as the piles of paper on our desks get higher. Instead, we become less and less likely to have time to read it all and pick out the parts that relate to our concerns. The volume of information grows as we look beyond our desks to our electronic documents and stuffed email inboxes. And all of this is eclipsed by the voluminous amounts of information locked up in people's heads.

"A big part of our job as engineers is structuring knowledge," says Dennis Goldenson. "How do you abstract out what is really important when you're structuring an unstructured problem?" Goldenson and Ira Monarch of the SEI have been researching the use of semi-automated content analysis to do just that.

Working with a U.S. Army Software Engineering Center (SEC) that maintains and develops software for automated weapon-equipped vehicles and weapons systems, Goldenson and Monarch analyzed requirements documents, test procedures, and problem and change reports. The text analysis was done using a tool that analyzes the co-occurrence of terms in blocks of text and extracts concepts and themes. Concepts are lists of terms used similarly in the blocks of text, and themes are collections of concepts whose meanings are closely associated with each other.

The tool then produces a concept map that uses overlapping colored circles and dots to present visually the main ideas of the documents, their prevalence, and the connections between them. "You might start out with free-form textual information that reads very well, but it can't be

reduced to numbers and labels in a database. And we aren't going to know what's important just by magic," says Monarch. "Tools help to reduce all this to something that is much closer to a structured model to help people see the trends and patterns."

Because the systems maintained by the SEC are used in the heat of battle, both security and accuracy are discussed, as expected, in the requirement specifications. But in analyzing the problem reports, researchers noticed that usability was coming up again and again, and they decided to go back and see if that was handled appropriately in the requirements.

For example, Goldenson and Monarch estimated that in under a half hour of perusing the concept map, someone who knows how to use the text analysis tool would be able to identify two kinds of usability issues: first, identifying and characterizing data entry errors and providing appropriate feedback, and second, proper layout and operability of soft buttons on a small PDA screen because the software was adapted from a system using a desktop computer with a larger screen and keyboard.

They concluded that while the SEC has established exemplary processes to handle usability-related issues when they arise, some issues might be mitigated earlier or prevented. "This research identified underlying patterns SEC staff members were not aware of. If you go back and analyze all the data at once and try to see what is occurring again and again, you save time. This is the kind of thing that might make their jobs easier in the future," says Goldenson.


## Data Management Maturity Model

The SEI and the Enterprise Data Management (EDM) Council are creating a Data Management Maturity (DMM) model for the financial industry. A difficult year for financial markets reinforced the importance of data content management as both a mechanism for market oversight and as a strategic business priority.

Michael Atkin, managing director of the EDM Council, says that efficient business operations and effective oversight are compromised when data management processes are managed on a manual and reactive basis. “All too often, data exists in unconnected spreadsheets using multiple formats and inconsistent definitions—and integration is frequently done tactically in response to immediate business requirements,” explains Atkin. “As a result, data quality varies widely among business units, data failures occur with regularity, and cross-functional views of risk are difficult to obtain.”

One problem addressed by the model is the difficulty in gaining an accurate, organization-wide view of performance and risk. Data management is no longer just a technology problem; it now encompasses business, organizational, and cultural issues that can have cascading consequences because of the interconnectedness of financial processes.

The DMM creates a framework and assessment methodology for evaluating the efficiency of data management practices, measuring the maturity of operational integration, and establishing best practices that can be adopted by financial organizations worldwide.



But what about the knowledge that never makes it into documents or reports? “Whenever you have different stakeholders with different goals interacting, they often speak past each other,” says Monarch. While text analysis on written documents is a good starting point, says Goldenson, researchers still need to get the different groups of people together—users, developers, testers—and try to tease out what they really wanted.

“The results of the analysis can show what themes or issues stakeholders are not aligned on,” adds Monarch, “and this can even help them understand what they wanted in the first place.” Future research will build on this aspect of the tool by combining it with market research techniques designed to identify customer wants and needs in an effort to reduce the rework and costs caused by unstated needs and poor requirements.

**More information about this work can be found in the technical report *Requirements and Their Impact Downstream: Improving Causal Analysis Processes Through Measurement and Analysis of Textual Information* (CMU/SEI-2008-TR-18).**

[www.sei.cmu.edu/library/abstracts/reports/O8tr018.cfm](http://www.sei.cmu.edu/library/abstracts/reports/O8tr018.cfm)





In addition to supporting investigations, the SEI also lends its expertise to support the agency's responsibility for protecting the nation's critical financial infrastructure from electronic theft, disruption, and attack.

**Cal Waits**

[www.cert.org/forensics/](http://www.cert.org/forensics/)



## CERT Forensics and Law Enforcement Benefit from Ongoing Collaboration

Continuing an ongoing, effective, and symbiotic partnership, the CERT Forensics team worked with CERT's resident law enforcement liaisons on a number of successful projects in 2009. These projects involved a wide range of activities, including password cracking, hard-drive analysis of evidence forwarded to the liaisons by law enforcement agents in the field, and on-site technical support to law enforcement during the execution of search warrants across the country. Collaborations with the CERT Forensics team allow law enforcement to tap CERT's technical expertise on cases with a cyber component. In turn, the CERT team learns firsthand what challenges confront law enforcement and what technical gaps must be bridged to effectively address computer-based crimes.

"CERT Forensics' collaboration with law enforcement enables it to draw from a variety of perspectives to identify emerging trends and build solutions," notes CERT Forensics team member Cal Waits. "Our collaborative efforts with law enforcement agencies have been instrumental in bringing a successful conclusion to some of the country's largest identity theft and credit card theft cases." The kind of real-world experience that only comes from working side-by-side with law enforcement is what drives and informs the CERT Forensics team's research and development efforts. The goal of this research and development is to produce state-of-the-craft tools and practices to provide an immediate positive impact on the ability of agents to carry out their mission in the field.

CERT is building on the field success of tools like LiveView (a tool for examining disk images or physical drives using virtualization technology), Crypto Hunter (a screening tool that will alert the user to the presence of whole-disk encryption and/or volume-based encryption on live systems), and Aperio (a tool used to scan a hard drive for the presence of "wiped files" and which has identified unique signatures left behind by counter-forensics tools). Currently, the Forensics team is at work on SPIDA, a system of hardware acquisition drones that allow parallel acquisition of suspect drives. SPIDA represents the CERT Forensics team's effort to tackle quantities of digital evidence collected during search warrants that exceed current law enforcement processing methods. SPIDA is currently being field tested by law enforcement.

Tom Dover, United States Secret Service liaison to CERT, appreciates the interactions that lead to these advances. "Through its resident affiliates at the SEI, the Secret Service has continually endeavored to take advantage of the breadth and depth of technical talent, expertise, and experience that resided within the SEI," says Dover. Its collaborative relationship with the Forensics team and other CERT and SEI teams has allowed the Service to bridge gap areas in its ability to successfully investigate highly complex and technically challenging electronic crimes.

In addition to supporting investigations, the SEI also lends its expertise to support the agency's responsibility for protecting the nation's critical financial infrastructure from electronic theft, disruption, and attack. Dover adds that "the SEI continues to be an integral partner in the Secret Service's efforts to combat cybercrime and protect the nation's critical financial infrastructure."



## Lab Will Test New System Concepts

Kurt Wallnau, a senior researcher in the SEI's Research, Technology, and System Solutions (RTSS) Program, believes that systems that combine social intelligence, computational intelligence, and pervasive sensing will define the field of software and systems engineering for decades to come.

As evidence of this, he points to news reports indicating that in June the Obama administration asked the social networking site Twitter to delay scheduled maintenance of its global network which would have disrupted service to Iranians in the immediate aftermath of disputed elections. Twitter delayed the upgrade. Had it not, Wallnau explains, the disruption would not only have cut off an important means of communication for Iranians, but a critical source of intelligence data for social network analysis.

"It shows the kind of profound but seldom anticipated impact that social networking technology can have on world affairs," Wallnau explains.

To keep the SEI at the forefront of this field, Wallnau is leading an effort to create a concept lab to demonstrate such systems, among others, and the software engineering technology needed to design and operate them.

Construction on a concept lab began at the SEI's Pittsburgh headquarters late last year. The physical space will include fixed and mobile sensors, robots, simulators, displays, and other apparatus. The lab will also be networked to collaborating laboratories, starting with researchers at the Naval Postgraduate School, with whom the SEI has partnered on previous experiments using market mechanisms to allocate tactical network bandwidth.

"The goal of the concept lab is to encourage the development of engineering prototypes that further our understanding of new system capabilities, and help us explain these capabilities to our stakeholders," explains Wallnau, who says the lab will further the work of the RTSS Program, which works to enable cost-effective development, evolution, and recomposition of high-quality systems of all scales.

SEI researchers will use the concept lab to explore the combination of social decision making with autonomous and self-organizing sensor networks. Examples include those networks that allow human teams to use market rules to allocate portions of a swarm of sensors or unmanned aerial vehicles to different targets of interest, and allow teams to change their preferences in real time in response to changes in mission or environment.

SEI researchers will also use the lab to develop the next generation of new software and systems engineering technologies. Examples would be the SEI's work in model-based engineering, which uses rigorous, formal descriptions of architectures and systems and interactions to analyze and predict system behavior before it is built and tested, and the SEI's work in multi-core optimization, which helps organizations understand and adapt to this new hardware environment.

"It represents a new strategy for us, a new way of trying to connect our research to potential users who are operational-focused or engineering-focused," explains Wallnau. "They care about what's in the field, the systems, and how you built them."







**Kurt Wallnau**

[www.sei.cmu.edu/about/organization/rtss/conceptlab.cfm](http://www.sei.cmu.edu/about/organization/rtss/conceptlab.cfm)

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[www.sei.cmu.edu/library/abstracts/reports/O9tr017.cfm](http://www.sei.cmu.edu/library/abstracts/reports/O9tr017.cfm)

# EXPERIMENTAL

## Making Virtual Integration Real

Begun in FY2008, the SEI's participation with the Aerospace Vehicle Systems Institute (AVSI) reached a milestone in FY2009, with the successful completion of a proof of concept demonstration of technology for the System Architecture Virtual Integration (SAVI) initiative.

AVSI is a global cooperative of aircraft manufacturers (also called airframers), government organizations, and academic institutions that launched SAVI as an international, industry-wide program to pilot new technology and a new acquisition process based on architectural models rather than paper documentation, with multiple dimensions of analysis used throughout the life cycle, including aircraft virtual integration early in the development process.

SAVI was initiated because airframers know that increasing reliance on embedded software is perhaps the only way to deliver on requirements by airlines for aircraft with greater range and comfort, more seats, and lower seat-mile costs—features that give the airlines more capacity on fewer, more economical flights.

But airframers see that the cost of developing and testing the software needed is increasing exponentially. Over the past 20 years or so, industry figures imply that the size of aircraft software, measured in source lines of code (SLOC), has doubled every four years. For the next decade, the projected 27.5 million lines of code required are estimated to cost in excess of \$10 billion. With more SLOC come greater complexity, for not only does the software need to perform vital dedicated functions such as power distribution or navigation, but also it must deliver a host of critical non-functional qualities, including safety.

“The current development process is reaching the limit of affordability for building safe aircraft,” notes Peter Feiler of the SEI. “The increase in functionality is supported by embedded software, and its deployment on integrated modular avionics (IMA) platforms that leverage distributed computing has led to a new class of problems not addressed by traditional system development and testing,” Feiler observes.

For the SAVI proof of concept (PoC), an aircraft system architecture was modeled using the industry standard Architecture Analysis and Design Language (AADL). A key concept of virtual integration is the use of an annotated architecture model as the single source for analysis; an independent study identified AADL as closely fitting that concept and other needs of the PoC. Also, as part of the PoC demonstration, the AADL architectural model was analyzed using a resource consumption check that is part of the Open Source AADL Tool Environment (OSATE), a toolset made available by the SEI.

Feiler, along with Jörgen Hansson, Lutz Wrage, and SEI resident affiliate Bruce Lewis, headed the SEI's contribution to the PoC. Over two months, the international PoC team demonstrated the effectiveness of

- multi-tier modeling and analysis of an aircraft and its subsystems
- support for the needs of both system engineers and embedded software system engineers
- propagation of changes to the model across multiple analysis dimensions
- maintenance of multiple model representations in a model repository
- auto-generation of analytical models
- interfacing of multiple tools
- distributed team development via a model repository





After the PoC demonstration, the SAVI management team authorized the next three phases of the project, with continuing involvement by the SEI that will take the virtual integration technology to technical readiness level 9, which designates a technology as proven by application.

### Modeling and Standards

Critical to virtual integration is the ability to exchange architecture models between an organization and its suppliers in a standard format and to interface tools through standard formats for analytical models. As modeling use has increased in aerospace and other sectors, industrial standards for architecture modeling technology have emerged. Two examples are OMG SysML for system engineering and SAE International AADL for embedded software systems. Both focus on static and dynamic analysis of the integrated components of a system from a single-source reference model. SysML is a graphical modeling language in the form of an extensible Unified Modeling Language (UML) profile to represent the requirements, structure, behavior, and parametrics to address multiple aspects of a system. AADL is an extensible textual and graphical architecture modeling language for embedded software systems that introduces concepts with well-defined semantics for modeling the static and dynamic software architecture, the computer system, and the physical mission system; it also defines a standardized XML interchange format.

### Does Virtual Integration Deliver ROI?

Coinciding with the PoC demonstration of technology for virtual integration, the SAVI effort sponsored a study on the return on investment (ROI) for this new practice. The study calculated the expected cost avoidance resulting from less rework (due to early identification and removal of defects), factoring in the cost to implement the SAVI approach. It determined that on a new aircraft development, as much as 52 percent of rework would be eliminated with this approach, which would yield \$0.7 billion to \$2.4 billion in cost avoidance, depending on the size of the system and the amount of new development—even assuming lower than anticipated fault discovery and SLOC growth and higher than historically experienced cost overruns.

## SEI Continues Collaboration with Air Force on Migrating Legacy Systems

In the shift to net-centric systems, the Department of Defense has countless legacy systems that must be evaluated and migrated to new environments. The U.S. Air Force's Electronic Systems Center (ESC) is working with the SEI to adopt the SEI Service Migration and Reuse Technique (SMART), which helps organizations to make initial decisions about the feasibility of reusing legacy systems within an SOA environment.

After a successful pilot of SMART for a small subset of services in 2008, Tim Rudolph, technical adviser, Systems of Systems Networking and Interoperability, Electronic Systems Center (Hanscom Air Force Base, Mass.) recognized that his organization needed this capability on a larger scale. ESC became an SEI Partner—an organization licensed by the SEI to provide official SEI services—for SMART, marking the first time the SEI has launched a new licensed product with a government organization.

Staff members at ESC have already completed most of the training for the SOA SMART Team Lead Certification, which will allow them to lead SMART engagements within their own organization rather than rely solely on the SEI for direction. This arrangement provides ESC with in-house expertise and cost savings and enables the SEI to further advance the SOA practice and refine the SMART methodology.

"This is the model we like to see with other DoD organizations—one where they develop their own organic capability for delivering SMART," says the SEI's Dennis Smith.

## New SEI Website Focuses on Solutions

The SEI in 2009 launched a newly redesigned website that focuses on solutions for software engineering problems. The new site provides visitors with significant improvements in navigation, accessibility, and appearance.

The new site is the result of extensive analysis of surveys, web data, and searches. Gary Snodgrass, manager of the SEI web communication team, says that the analysis, coupled with feedback from focus groups, revealed that the previous site's navigation made it difficult to find information.

Leaner and easier to navigate, the new site is organized around areas of SEI technical work and solutions areas that include case studies describing how the SEI has helped organizations solve particular problems. Each page of a technical area includes related information about that topic, including reports and courses. Technical reports, presentations, webinars, and other SEI-related materials are now housed in a central library.

Snodgrass adds, "We developed an information framework that can be used across all areas of work. That framework enables users to readily find information on the website."

Visit the new SEI website for information about SEI areas of work, solutions, products and services, and much more at [www.sei.cmu.edu](http://www.sei.cmu.edu).



Service organizations already using CMMI-SVC cover a broad range of businesses, including training, logistics, maintenance, human services, lawn care, book shelving, research, consulting, auditing, human resources, financial management, health care, and IT services.

**Eileen Forrester**

[www.sei.cmu.edu/cmmi/tools/svc/](http://www.sei.cmu.edu/cmmi/tools/svc/)







## CMMI for Services: Not Just for Software

Educational consultant Betsey Cox-Buteau notes a shift in attitude toward education: It is no longer about simply teaching the curriculum, but rather about ensuring that all students learn and apply the curriculum. Teachers, parents, and students are coming to grips with the notion that education is a service industry.

“We are in an age of new accountability where we truly need to examine our processes and services to make sure we are doing everything we can to use tax dollars wisely, to collect data, to make sure that our decisions are data driven and we are giving the customers—who are, of course, the parents and society—the greatest return in the most efficient manner,” says Cox-Buteau, a former principal and school district curriculum and grants administrator.

To address the need for performance improvement in the services sector, the SEI in 2009 released a new Capability Maturity Model Integration (CMMI) constellation, CMMI for Services (CMMI-SVC). It helps organizations increase the capability and effectiveness of their service processes and thereby reduce costs, raise quality, and improve the predictability of schedules.

Service organizations already using CMMI-SVC cover a broad range of businesses, including training, logistics, maintenance, human services, lawn care, book shelving, research, consulting, auditing, human resources, financial management, health care, and IT services. These organizations are using CMMI-SVC to improve their service processes and overall organizational performance.

Asked about the development effort that led to the creation of CMMI-SVC, Eileen Forrester, SEI leader of the constellation, says “One driver to develop CMMI for Services was the recognition that the world economy is moving towards a more service-oriented environment. Organizational processes have to be measured and constantly improved for businesses to remain competitive. Basically, you can think of CMMI for Services as an enabler for the world economy. And the uptake has been broad and immediate.

“We are seeing,” she continues, “that almost every service category can be improved by the careful application of the basic principles. Since it covers the activities required to manage, establish, and deliver services, it is broadly compatible with service sectors ranging from defense, IT, health care, and finance to transportation, education, retail, and more. For instance, Northrop Grumman told us that they have many business units that provide services. Since the company was already successfully using CMMI for Development, it was a natural step for them to extend the benefits of CMMI by applying CMMI for Services. They were the industry sponsor for the model and completed the first SCAMPI A appraisal using CMMI-SVC.”

CMMI-SVC provides a valuable roadmap for organizations to create consistent, disciplined, and predictable service processes. “The architecture sets up excellent scaffolding for examining the processes that should be in place in education,” says Cox-Buteau. “For so long education has been in the hands of those who feel that they do it naturally; it’s never been broken down and examined. But once you have the use of data and the processes improvement methodology embedded in the culture of the educational institution, it just becomes part of what you do in all aspects of education—from constructing a building to delivering a curriculum.”

## SATURN Conference Expands in Size and Scope

What began five years ago as a small workshop centered on software architecture methods broadened last year into a successful conference covering technologies and practices in systems, enterprise, and system-of-systems architecture. That broadening of the 2009 SEI Architecture Technology User Network (SATURN) Conference was designed to help practitioners address the growing complexity of today's systems and the increasing importance of their architecture. Ipek Ozkaya, SEI researcher and conference co-chair, says, "Even if it's not explicitly designed and shared, every system has an architecture, and it's not just important to architects. It also matters to implementers, requirements engineers, product marketers, testers, and high-level managers. All stakeholders must get the most out of their architecture."

In addition to broadening to cover many types of architectures, the 2009 conference included sessions, presentations, and tutorials designed for architects at all levels of experience—from beginner to seasoned. Ron Koontz, Apache Block III software architect at Boeing and two-time attendee of the conference, says, "SATURN is an open forum for putting ideas and problems out on the table and getting feedback. It can lead to diverse solutions and innovative ideas from multiple viewpoints that reinforce your thinking."

Attending can also add customer value, according to Koontz. "Because my customers know that I've attended and contributed to the SATURN Conferences, they have more confidence in me. They know that I'm using the latest available information and technologies and applying them to their projects."

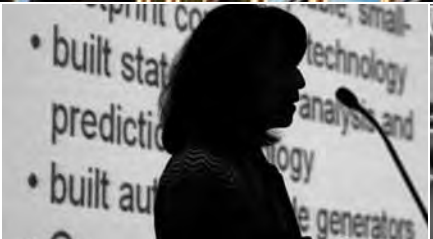
Besides showcasing the latest technologies, SATURN Conferences give all attendees the chance to contribute and be heard. Koontz says, "The birds-of-a-feather (BoF) sessions encourage people like me to come up with pressing architecture challenges and concerns and discuss them in a small-group setting. Gaining insights and sharing information with others facing similar issues adds tremendous value. It's a unique conference from that standpoint. Everyone has a voice."

In addition to BoF sessions, two courses from the SEI's Software Architecture curriculum were collocated with SATURN 2009, so attendees could get even more out of their trip to the conference. Similar courses will also be offered at SATURN 2010, which will focus on "architecting for change." The 2010 conference, which will go on the road to Minneapolis, Minnesota, from May 17 to 21, 2010, also marks an important milestone for the conference: it will be held in collaboration with *IEEE Software*, which plans to publish select conference papers in an upcoming special issue.

"Organizing and running this practitioner conference is just one part of the picture for the SEI. According to Ozkaya, "We started a LinkedIn network for architects and a blog that focuses on architecture-centric engineering. Along with the yearly SATURN Conferences, these two components give architects a special connection to each other. They offer two more ways for them to share ideas and learn from each other throughout the year."

Amplified





[www.sei.cmu.edu/saturn/2010/](http://www.sei.cmu.edu/saturn/2010/)

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# Expert

## Army Requires PEOs to Appoint Chief Software Architect

The significant role that architecture plays in system success is receiving new attention from the U.S. Army. In May 2009, a new policy mandated that every Program Executive Office (PEO) appoint a chief software architect to oversee software development within the program.

Robert Schwenk, the Army's senior software acquisition manager, explained that PEOs had already held expansive responsibilities to implement sound software engineering practices. "Given that the complexity of systems is increasing exponentially, Lt. Gen. Ross Thompson, principal military deputy to the assistant secretary of the Army for acquisition, logistics, and technology, decided to make sure we can maintain these systems. The chief software architect (CSWA) will manage the software architecture to ensure best practices are being followed. This gives the PEO a better chance of overcoming system risks."

Over the past several years, the army's interest in architecture has received considerable support. For example, the Army Strategic Software Improvement Program (ASSIP) is dedicated to bringing significant improvement to the acquisition of software-reliant systems. Activities have included funding architecture evaluations—the SEI Architecture Tradeoff and Analysis Method (ATAM)—for selected programs. The evaluations pinpointed risk and demonstrated architecture's impact on software and system qualities, and these benefits spurred an interest in sound architecture practices. The bi-annual Software Architecture Workshop also encourages best practices through

sharing of lessons learned and surveying of attendees on specific integration problems. Cecilia Albert, who heads Army programs in the SEI Acquisition Support Program, explains, "The SEI has been laying the foundation for architecture-centric engineering practices to become the way for army people to get the benefit in the context of their programs."

Also fortifying architecture's position is the Army's Senior Leader Education Program (SLEP). Three meetings per year focus on providing for needed software learning. During the April 2009 SLEP, Lt. Gen. Thompson heard Linda Northrop, director for the SEI Research, Technology, and System Solutions Program, speak on the importance of architecture-centric practices. "When attendees were asked to name their main software challenges, almost all named integration or interoperability," states Albert. "That was when Lt. Gen. Thompson responded by declaring that appointment of a CSWA would be mandatory for every PEO."

The policy further mandates that the CSWA ensure consistent implementation of appropriate standards and processes: "The CSWA must also complete a Software Engineering Institute software architecture course series for certification as professional architect or equivalent." The series mentioned here promotes architecture-centric engineering, wherein architecture drives the design process. The series comprises the courses Software Architecture Principles and Practices (SAPP), Documenting Software Architectures, Software Architecture

## SEI Director and CEO Reappointed

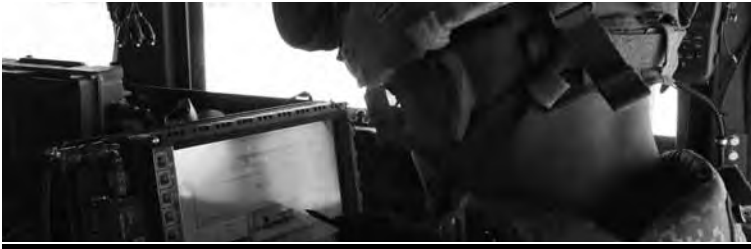
In July 2009, Carnegie Mellon University Executive Vice President and Provost Mark Kamlet announced the reappointment of Paul D. Nielsen to a second five-year term as director and chief executive officer of the SEI.

Kamlet says, "Paul has been instrumental in expanding the SEI's impact in both the commercial and government software engineering communities. Through his steady leadership, the SEI remains a premier institution for developing best practices in software engineering and computer security."

During his tenure, Nielsen has overseen the development and expansion of the CMMI Product Suite, greater outreach to the software engineering community, and new research initiatives in ultra-large-scale systems, computer security, and software architecture. He has led the growth of the SEI to an organization of more than 500 staff members with operating revenues of \$140 million annually.

Nielsen stated that he is honored to be part of a world-class university and the SEI.

"The strength and influence of the SEI comes from the men and women who dedicate themselves to resolving the challenges to our evolving software-intensive systems," he says. "Their research, their dedication, and their commitment have made it a privilege to serve as the leader of this organization."



[www.sei.cmu.edu/architecture/](http://www.sei.cmu.edu/architecture/)

**Design and Analysis, and Software Product Lines.**  
To earn the professional architect certificate, the candidate must pass the exam for the SAPP course.

Given the Army's wide range of software-reliant systems, the benefit of the mandate is obvious. Architecture, the plan for system components and their interactions, is where engineers mitigate system risks and build in qualities such as security, reliability, and modifiability. Albert explains, "Building on the 2009 mandate for trained chief software architects, the SEI's first priority in FY2010 is to make those chief architects successful. It's important that they are able to put the training into operation in their programs. If appropriate, the SEI will offer them direct assistance to do so."

### **Far-Reaching Impact**

The impact of software architecture across Army systems is far-reaching. Albert states, "While software on the brakes of the tank might work fine, it's likely that those brakes are sharing hardware with other parts of the system and that major integration problems could thus arise elsewhere. And not too far downstream, the software in a tank and the software in a helicopter will be impacting each other in ways not anticipated."

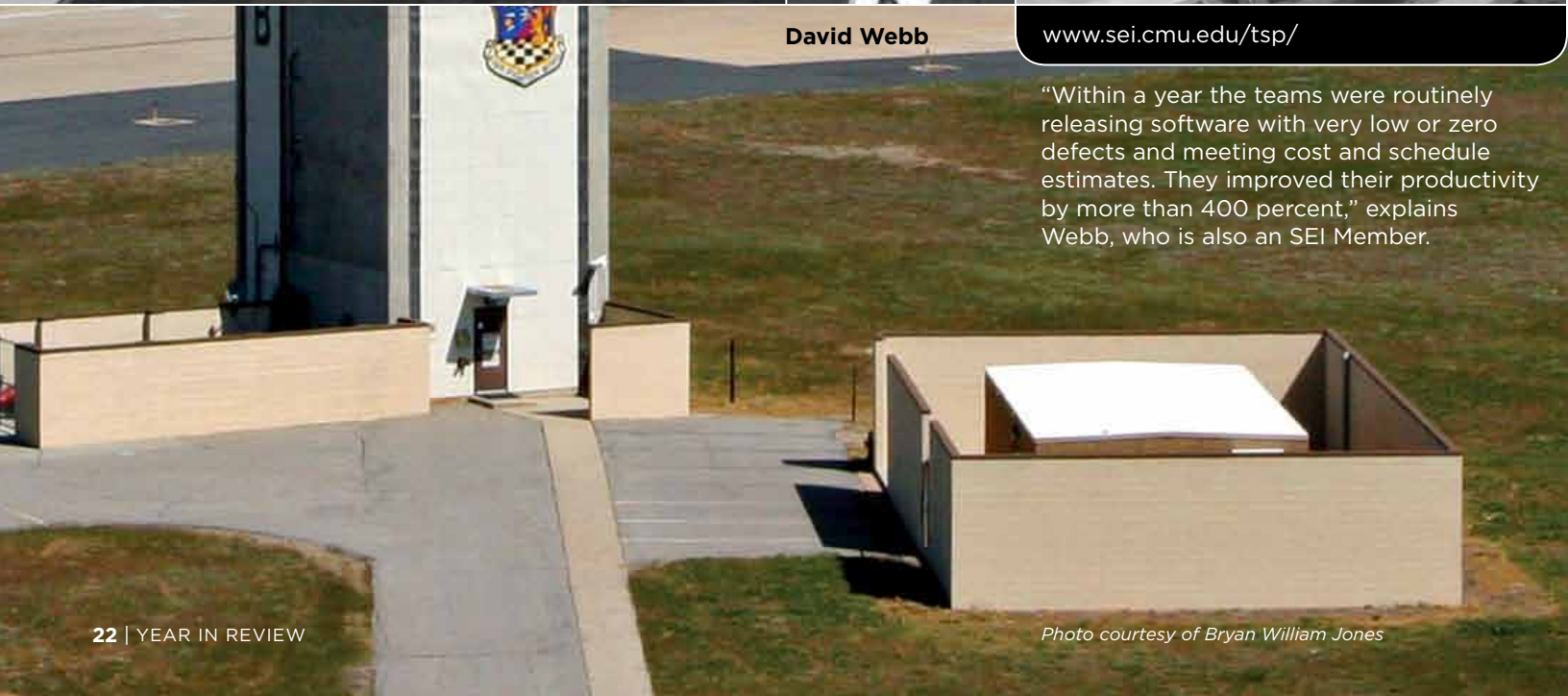




**David Webb**

[www.sei.cmu.edu/tsp/](http://www.sei.cmu.edu/tsp/)

“Within a year the teams were routinely releasing software with very low or zero defects and meeting cost and schedule estimates. They improved their productivity by more than 400 percent,” explains Webb, who is also an SEI Member.





## Hill AFB Teams See Improvement with TSP

Initially, the 520th Software Maintenance Squadron of the 309th Software Maintenance Group of Hill Air Force Base in Utah used the SEI's Team Software Process (TSP) to manage the software maintenance for a large, embedded weapons system for the U.S. Air Force.

But in 2009, David Webb, a senior technical program manager with the project, says his team has expanded the use of TSP to the software testing team, the documentation team, and the support team for the Ground Theater Air Control System (GTACS), a deployable ground-based computer network that coordinates radar and communications data signals for ground, airborne, and naval elements. The team's sustainment of more than 3 million lines of GTACS code requires them to change software, hardware, test environments, and documentation.

TSP provides a framework designed to build and maintain more effective teams. The recent additions to the GTACS TSP teams—documentation, tool support, and test engineering teams, as well as the software team—held a launch in September, and Webb says they are now tracking their time and producing both team and personal schedules, employing an earned-value tracking system. The teams are using TSP as they prepare to make the latest update to the GTACS system, which includes a major update of both outdated hardware and programming language.

The 520th Software Maintenance Squadron initially began work on the GTACS project in 1999, supporting the primary contractor. In 2007, the squadron took over as the lead contractor for software maintenance of the 30-year-old system.

Cost and schedule overruns soon followed, some portions taking more than four times what was planned, which Webb attributes to his team's initial lack of planning and inexperience with the system. For an organization with a maturity level 5 rating on the Capability Maturity Model Integration (CMMI) framework, it proved a concern.

"To achieve better planning and execution, we instituted TSP," Webb says, explaining that the approach allowed software engineers to plan, track, and thoroughly inspect their own work for quality purposes. Webb says that while each member of the team instituted the SEI's Personal Software Process (PSP), the team overall became more rigorous about inspections.

"Within a year the teams were routinely releasing software with very low or zero defects and meeting cost and schedule estimates. They improved their productivity by more than 400 percent," explains Webb, who is also an SEI Member.

The 520th Software Maintenance Squadron decided to expand the use of TSP beyond the GTACS software team because, according to Webb, it is an ideal framework for project planning and tracking and because it is the fastest way to train a new team unfamiliar with CMMI in high maturity concepts.

"It encapsulates everything you need to plan and track your project with TSP scripts, forms, and practice," Webb says.

## Smart Grid: Empowering Utilities

The power grid that delivers electricity from suppliers to consumers is the largest and most complex interconnected machine in the world. While currently meeting energy needs in America, today's power grid, much of which was designed well before 1970, must be modernized to accommodate changing energy and environmental requirements and to be more secure, reliable, efficient, affordable, and interoperable. The SEI is working to modernize power grids through its smart grid initiative.

The Department of Energy (DoE) has found that if the North American grid were just 5 percent more efficient, the energy savings would equate to eliminating the fuel consumption and greenhouse gas emissions from 53 million cars. The savings and improved efficiency from making power grids smarter are so significant that the U.S. government is making smart grid technologies a priority.

Since 2007 the SEI has supported the DoE's Office of Electricity Delivery and Energy Reliability (OE) in its mission "to lead national efforts to modernize the electric grid, enhance the security and reliability of the energy infrastructure, and facilitate recovery from disruptions to the energy supply." The SEI has supported this mission through an initiative that spans the SEI's technical programs. This initiative is part of a public-private partnership with government and industry to address cybersecurity, architecture, interoperability, and other challenges of building the smart grid.

As part of this strategic initiative, in March 2009 the DoE's OE sponsored the SEI to become the steward of the Smart Grid Maturity Model (SGMM) in order to maintain and evolve it as a resource for the community. Originally developed by IBM and the Global Intelligent Utility Network Coalition, the SGMM is a management tool that allows utilities to plan, quantifiably measure progress, and prioritize options as they move toward the realization of a smart grid. The ultimate goal of the SGMM is to help advance the adoption and deployment of smart grids across the industry and around the world. As of November 2009, more than 60 utilities worldwide have participated in the model.

"The software development industry is a prime example of how maturity models have moved entire industries forward," says Guido Bartels, general manager, Global Energy & Utilities Industry at IBM. "We selected the SEI [for stewardship of the SGMM] because of its demonstrated success in providing frameworks that enhance business and technical processes, security, resiliency, and interoperability—all critical elements in responding to opportunities driving the sustainable supply and use of energy essential today."

"We are excited to be part of this new frontier technology," says Paul Nielsen, CEO and director of the SEI. "The Smart Grid Maturity Model developed by IBM creates a roadmap of activities, investments, and best practices that leads to creating a smart grid. Utilities using the model will be able to establish the appropriate development path, communicate the strategy and vision, and assess current opportunities."



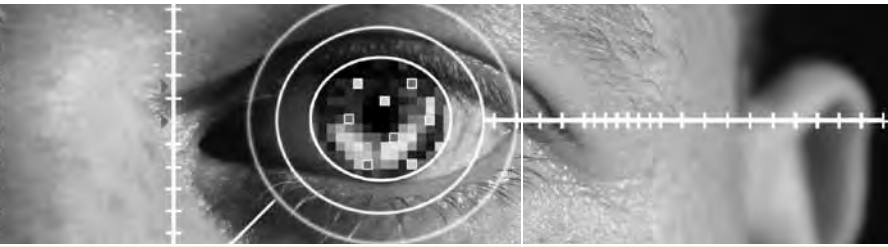
Smart





[www.sei.cmu.edu/smartgrid/](http://www.sei.cmu.edu/smartgrid/)

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[www.cert.org/insider\\_threat/](http://www.cert.org/insider_threat/)

# SECURE

## New Tool Helps Prevent Threats from Within

The Federal Bureau of Investigation (FBI) in 2008 arrested a former loan officer suspected of downloading nearly 20,000 customers' personal data and selling that information to third parties for approximately \$70,000. In 2009, news media reported that a former product engineer with an automobile manufacturer in the United Kingdom was arrested for stealing proprietary design documents worth millions of dollars.

More frequently, media outlets are reporting the loss of proprietary information, customer personal identification, and financial information at the hands of current or former employees, contractors, or business partners who have or had authorized access to their organizations' systems and networks. These individuals are most familiar with internal policies, procedures, and technology, and can exploit that knowledge to bring down an organization.

Northrop Grumman Corporation (NGC) is a global security company with 126,000 employees. As a system integrator of global security solutions, NGC takes security seriously. Responding to the question of how he perceives the risk of insider threats, Tim McKnight, NGC's chief information security officer notes, "We know it's important. It's a significant threat to the nation and our industry. The nation is bleeding intellectual property; the U.S. dollar is suffering. We must avoid the short-term mindset in evaluating these threats and the risks they present. The cumulative impact to our economy will not fully materialize for years; therefore, we don't recognize it in quarterly market reports."

When NGC wanted to benchmark where the information security business unit was in the prevention of insider threat, the company turned to CERT and its Insider Threat team for guidance.

Christopher Barnett, cyber threat manager in NGC's information security business unit and the company's technical liaison, says that NGC wanted to understand short-term risks, address those risks, and develop a long-term strategy: "NGC wanted to take advantage of CERT's expertise and its insider threat vulnerability assessment tool to help us safeguard our critical infrastructure and data."

Dawn Cappelli, technical lead for insider threat at CERT, says the assessment tool was created because organizations were looking for a quick solution—a checklist—on what to do to prevent insider threat. "But insider threat is a much more complex issue. There is no equivalent to a vulnerability scanner for insider threats. We needed to provide something that would help organizations take a comprehensive look at the tools, policies, and practices they are using to determine how they could best prevent and detect threats," she says.

CERT has researched hundreds of insider threat cases since 2002. The team has worked with the U.S. Secret Service, the U.S. Department of Defense, and corporations on activities that include interviewing white-collar criminals and victim organizations. The culmination of their work to date is an insider threat vulnerability assessment tool. The tool comprises six workbooks developed and organized based on hundreds of cases. Using the workbooks, CERT conducted confidential, scenario-based interviews over three days with NGC staff and management exploring six areas of concern: physical security, software engineering, IT/information security, data management, human resources, and legal.

Barnett says the assessment provided NGC with the areas of concern, responsible personnel, policy and security measures, policy-practice gaps, and suggested countermeasures. The report also mapped





the risk areas to actual cases in terms of scale of damage and scope of threat. Based on the findings, NGC is taking a range of important steps from developing a more comprehensive insider threat strategy to augmenting its defenses by leveraging existing technology with very little investment. “CERT provided us with realistic and achievable security goals to protect those assets deemed critical to our mission from both external and internal threats,” says Barnett.

Barnett says that NGC’s highly skilled information security staff, which uses the latest enterprise security management tools, is only one piece of the puzzle. He says the company learned that while information security in NGC is efficient and proactive, effective information sharing among the various components of a large enterprise is critical to identify and prevent illicit or illegal activity within a company.

“We need to detect the release of proprietary information as it happens so that it can be recovered, and we need to detect malicious code as it is planted on our network, not after,” says Barnett. “CERT’s assessment enabled us to configure tools and address organizational policy measures to better mitigate those risks.”

Cappelli also learned from the assessment, and she plans to incorporate those lessons into future research. “Gaps in existing technology are better understood by our team now,” says Cappelli. “That knowledge will enable us to work with other organizations and solutions providers to improve the state of the practice of insider threat mitigation.”

## CERT Provides Cybersecurity Support for G-20

When the G-20 Summit—a national security special event protected by the U.S. Secret Service—came to Pittsburgh in September 2009, it brought dignitaries, demonstrators, and members of the media. While law enforcement personnel from across the nation offered additional physical protection for the event, the Secret Service called on CERT to provide cybersecurity support. Previously CERT has assisted the Secret Service with several national security special events, including the Salt Lake City Olympics in 2002 and the Republican and Democratic National Conventions in 2008.

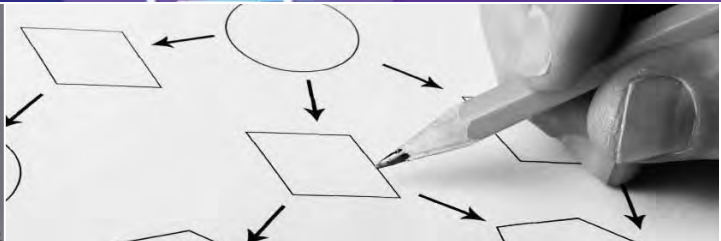
Months before the G-20, CERT assisted the Secret Service with critical infrastructure assessments: evaluating and securing any IP-based system that could be vulnerable to intruders and disrupt the event. During the event, CERT provided the Secret Service with incident-response and cyber-forensics support.

## CERT Analyst Among Federal 100

Martin Lindner, principal analyst for the CERT Program, was recognized by *Federal Computer Week* magazine in February 2009 as a Federal 100 Award recipient. The Federal 100 award recognizes individuals in government and industry who have made significant contributions to the information technology community in the United States.

Lindner was selected as recipient for his work in establishing the U.S. Department of Defense’s (DoD) Defense Industrial Base (DIB) Collaborative Information Sharing Environment in the fall of 2008. The DIB is a critical national infrastructure comprising networks of the DoD, the U.S. government, and thousands of private-sector companies.

In partnership with the National Computer Security Division’s US-CERT and the Defense Cyber Crime Center, Lindner led the creation of the environment with the goal of securing critical programs and technology by protecting controlled unclassified information on unclassified DIB networks, which include those of private contractors.



Mission area components are carefully defined and then mapped to SEI technologies, services, and initiatives that effectively address, resolve, or contribute to that mission area.

**Terry Roberts**

[www.sei.cmu.edu/acquisition/](http://www.sei.cmu.edu/acquisition/)



The graphic features a dark purple background with a grid of perspective lines. Several white gears of different sizes are scattered across the scene. Light blue arrows point in various directions, including upwards and downwards. The word "Targeted" is written vertically in a white, sans-serif font, centered on the page.

# Targeted

## SEI Maps Mission Areas

The Software Engineering Institute in 2009 embarked on a study to review the unique contributions the SEI provides against the current and future demands of the Department of Defense, the Intelligence Community, and the rest of the federal government.

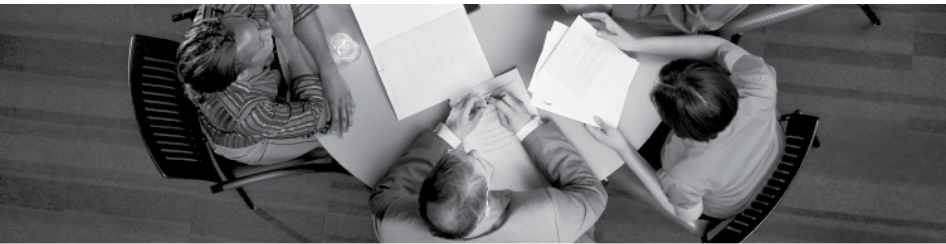
“The SEI Roadmap Team was established to provide a forum to develop one compelling and clear voice across the SEI with our government customers,” says Terry Roberts, executive director, Acquisition Support Program/ Interagency & Cyber. “As we strive ultimately to enable the warfighter with cutting edge technologies, services, and initiatives, we want to ensure that we continuously evaluate their priority software and cyber challenges.”

As a result of the review, the SEI identified four mission areas that align with the priority needs of its government customers and that the SEI uniquely and powerfully contributes to:

- cybersecurity and assurance, comprising defensive operations and security management, cyber intelligence, secure software and systems engineering, policies and plans, and offensive operations
- acquisition excellence for software-reliant systems, comprising preparation for acquisition, execution and validation, governance, and the enterprise environment
- assured and flexible system capabilities, comprising science of systems, engineering at all scales, and tools and technologies
- acquisition and engineering management, comprising capability development, implementation practices and guidance, and performance metrics and benchmarking

Mission area components are carefully defined and then mapped to SEI technologies, services, and initiatives that effectively address, resolve, or contribute to that mission area; all mission areas also contain a workforce development component. For example, instead of offering customers the opportunity to pick from a list of computer security technologies, the cybersecurity and assurance mission area details all the concerns a customer needs to think about to begin to address this complex problem.

“This holistic approach also allows the SEI to identify key gaps in our own current body of work, which will allow us to refocus, refine, and research to ensure we are targeting our government customers’ priority software and cyber issues,” says Roberts. “It also gives us a more comprehensive view of our current portfolio, which enables us to better define, describe, and deliver the right technologies, services, and initiatives to the right customer at the right time.”



# Transition

## **SEI Membership**

SEI Membership is a business and knowledge network that connects the SEI and leaders in software and systems engineering worldwide. SEI Membership is designed for those professionals who are interested in priority access to SEI technologies and events. Individuals can use the SEI Membership program as a means of networking with other professionals to discuss adoption, implementation, and challenges of software and systems engineering.

SEI Members include small-business owners, software and systems developers, security professionals, CEOs, directors, and managers from business, industry, and government organizations in 44 countries around the globe. The SEI is the only federally funded research center that offers membership to the public.

*For more information about SEI Membership, visit [www.sei.cmu.edu/membership/](http://www.sei.cmu.edu/membership/).*

## **SEI Affiliate Program**

Through the SEI Affiliate Program, sponsoring organizations contribute technical staff members to the SEI's ongoing effort to define superior software and systems engineering best practices. Affiliates lend their technical knowledge and experience to SEI teams investigating specific technology domains.

Affiliates are immersed in the inquiry and exploration of new tools and methods that promise to increase productivity, make schedules predictable, reduce defects, and decrease costs.

*For more information about the SEI Affiliate Program, visit [www.sei.cmu.edu/careers/affiliates/](http://www.sei.cmu.edu/careers/affiliates/).*





### SEI Conferences & Events

The SEI offers conferences, workshops, and user-group meetings to educate and inform professionals about its latest research. These events represent technical work and research performed by the SEI and its collaborators in the areas of acquisition, interoperability, process improvement, software architecture and product lines, and security.

Individuals from around the world attend SEI conferences and events to

- connect with industry leaders
- share best practices
- network with peers
- find potential solutions
- gather the latest research and trends in software and systems engineering

Some of the events that the SEI sponsored and co-sponsored are

- Army Senior Leadership Education Program
- FloCON
- SATURN 2009
- SEPG Conference Series
- Software Product Lines Conference (SPLC) 2009
- TSP Symposium
- SEI Webinar Series

*For more information about SEI conferences and events, visit [www.sei.cmu.edu/events/](http://www.sei.cmu.edu/events/).*

### SEI Professional Development Center

The SEI Professional Development Center incorporates education, training, and credentialing, all of which enable individuals to benefit from the SEI's research.

The center provides continuing education for software and security professionals in government, industry, and academia. The SEI addresses professional development needs by

- designing and developing training that is accessible and effective, including classroom, blended, and distance learning
- encouraging and recognizing individual accomplishments in various disciplines through certificate programs
- enhancing individual career opportunities through SEI Certification

In FY2009, the SEI delivered 259 courses, trained 4,664 individuals, and awarded 350 certifications.

*For more information about SEI training, visit [www.sei.cmu.edu/training/](http://www.sei.cmu.edu/training/).*

*For information about SEI Certification, visit [www.sei.cmu.edu/certification/](http://www.sei.cmu.edu/certification/).*

### SEI Partner Network

The SEI Partner Network is an elite group of SEI-trained organizations on the leading edge of software engineering processes and technologies. SEI Partners are licensed to deliver SEI services in the following areas

- Architecture Tradeoff Analysis Method
- CERT Information Security
- Capability Maturity Model Integration
- People Capability Maturity Model
- SCAMPI Appraisals
- Software Architecture
- Service-Oriented Architecture
- Software Engineering Measurement & Analysis
- Team Software Process

By delivering services worldwide, the SEI Partners provide a critical distribution channel for accomplishing the SEI mission. In FY2009, the SEI Partner Network consisted of 433 partner organizations.

*For more information about the SEI Partner Network, visit [www.sei.cmu.edu/partners/](http://www.sei.cmu.edu/partners/).*



## SEI Board of Visitors

The SEI's Board of Visitors advises the Carnegie Mellon University president, provost, and the SEI director on the SEI's plans and operations. The board monitors SEI activities, provides reports to the president and provost, and makes recommendations for improvement.

**Alan J. McLaughlin**

Chair, Board of Visitors; Consultant; Former Assistant Director, MIT Lincoln Laboratory

**Barry W. Boehm**

TRW Professor of Software Engineering, University of Southern California; Director, University of Southern California Center for Software Engineering

**Claude M. Bolton**

Executive-in-Residence, Defense Acquisition University; Former Assistant Secretary of the Army for Acquisition, Logistics, and Technology

**William Bowes**

Aerospace Consultant; Vice Admiral, U.S. Navy (Ret.); Former Commander, Naval Air Systems Command, and Principal Deputy Assistant Secretary of the Navy for Research, Development, and Acquisition

**Christine Davis-Dittrich**

Consultant; Former Executive Vice President, Raytheon Systems Company

**Gilbert F. Decker**

Consultant; Former President and CEO, Penn Central Federal Systems Company; Former President and CEO of Acurex Corporation; Former Assistant Secretary of the Army/Research, Development, and Acquisition

**Philip Dowd**

Private Investor; Former Senior Vice President, SunGard Data Systems; Trustee, Carnegie Mellon University

**John M. Gilligan**

President, Gilligan Group; Former Senior Vice President & Director, Defense Sector of SRA International; Former CIO for the Department of Energy

**Tom Love**

Chief Executive Officer, ShouldersCorp; Founder of Object Technology Group within IBM Consulting

**Donald Stitzenberg**

President, CBA Associates; Trustee, Carnegie Mellon University; Former Executive Director of Clinical Biostatistics at Merck; Member, New Jersey Bar Association



Leadership Management





# SEI Management

**John Bramer**

Director, Program Development and Transition

**Anita Carleton**

Acting Director, Software Engineering Process Management

**Peter Menniti**

Director, Financial and Business Services

**Linda Northrop**

Director, Research, Technology, and System Solutions

**Richard Pethia**

Director, Networked Systems Survivability





**Terry Roberts**

Executive Director, Acquisition Support Program/Interagency and Cyber

**David Thompson**

Director, Information Technology



**Paul D. Nielsen**

Director  
Chief Executive Officer

**Clyde G. Chittister**

Chief Operating Officer

## SEI Director's Office

The SEI Director's Office ensures the smooth, efficient operation of the SEI. Director and Chief Executive Officer Paul Nielsen and Chief Operating Officer Clyde Chittister build strong, collaborative relationships with leaders in government, industry, and academia, communicating the SEI's vision for software engineering.



# KEY PUBLICATIONS

## SEI Reports

Christopher J. Alberts & Audrey J. Dorofee. *A Framework for Categorizing Key Drivers of Risk*. [www.sei.cmu.edu/library/abstracts/reports/09tr007.cfm](http://www.sei.cmu.edu/library/abstracts/reports/09tr007.cfm)

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Dennis Smith & James Smith. "Ten Changes to Acquisition and Engineering Practice Required to Successfully Acquire Systems of Systems," Proceedings of the 21st Annual Systems & Software Technology Conference (SSTC 2009). Salt Lake City, UT, April 20–23, 2009.

James Smith. "Systems of Systems and Software Radios: Impacts on Acquisition." Proceedings of the 9th Annual International Software Radio Conference (ISR 2009). London, UK, June 8–9, 2009.

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Carol Woody, Lisa Brownsword, Christopher Alberts, & Andrew Moore. "The Landscape of Software Assurance—Participating Organizations and Technologies," 2009 AIAA Infotech@Aerospace Conference, Seattle, WA, April 6–9, 2009.

Kurt Wallnau. "Developing Multicore Software," Systems and Software Technology (SSTC 2009) Conference, Salt Lake City, UT, April 23, 2009.

## Keynotes

### Julia H. Allen

"Making the Business Case for Software Assurance," SecureIT, Los Angeles, CA, March 2009

### Len Bass

"Eliciting the Unmentioned," Lockheed Martin Architect's Summit, Bethesda, MD, July 8, 2009

"Exploring the architecture of Ultra Large Scale Systems," Brazilian Symposium on Components, Architecture, and Reuse held, Natal, Brazil, September 9, 2009

"Exploring the Relationship Between Governance and Architecture in Ultra Large Scale Systems," Software Product Line Evolution Workshop of the Indian Software Engineering Conference, Pune India, February 24, 2009

"Making Software Quality Attributes First Class Entities," Conference on Software Engineering Education and Training, Hyderabad, India, February 2009

"Software Architecture Design," Academy for Software Engineering Educators and Trainers, February 20, 2009

### Anita Carleton

"Recognizing Quality Work," Systems & Software Technology Conference 2009, Salt Lake City, UT, April 2009

### Bill Curtis

"The SEI: A Focus on Process," 4th Annual TSP Symposium, New Orleans, LA, September 22, 2009.

### Peter Feiler

"Validation of Safety-Critical Systems with AADL," 14th International Conference on Reliable Software Technologies—Ada Europe 2009, June 2009

### Watts S. Humphrey

"Faster, Cheaper, Worse!" World Software Quality Congress, Crystal City, Washington, DC, October 17, 2008

"The Large System Problem," 4th Annual TSP Symposium, New Orleans, LA, September 22, 2009.



**Nancy R. Mead**

“Uses of Threat Modeling in Software Development,” Bright Talk Threat Management Summit, September 2009

**Paul D. Nielsen**

“CMMI for Services (CMMI-SVC): An Overview,” SEPG Europe Conference, Prague, Czech Republic, June 9–12, 2009

“Many Paths to Progress: Process Models at the SEI,” SEPG Asia-Pacific 2009, Osaka, Japan, September 16–18, 2009

“TSP—The SEI: A Focus on Process,” 4th Annual TSP Symposium, New Orleans, LA, September 21–24, 2009

“¿Por qué usar CMMI en Software?” I Conferencia Internacional de CMMI en Perú, Lima, Peru, July 16, 2009

“Software Architecture: Principle, Process, and People,” Ground System Architectures Workshop, Torrance, Calif., March 25, 2009

**Linda Northrop**

“Architecting High Quality Software: The Role of Software Architecture in System Development and Evolution,” Software Process Symposium, October 14, 2008

“The Impact of Scale,” Software Engineering for Adaptive and Self-Managing Systems (SEAMS) Workshop held in conjunction with the International Conference on Software Engineering (ICSE), Vancouver, BC, May 18, 2009

“Software Needs Today and in the Future,” ABET Annual Meeting, Louisville, Kentucky, October 30, 2008

“Software Product Lines: Today’s Impact and Tomorrow’s Potential,” Siemens Product Line Engineering Day, Erlangen, Germany, June 17, 2009

“Ultra-Large-Scale Systems,” Socio-Technical Systems Engineering (STSE) 2009, St. Andrews, Scotland, September 17, 2009

**James Smith**

“Network-Centric Acquisition for SDRs,” 7th Annual Software Radio Summit, Vienna, VA, February 23–26, 2009

# Opportunities

## **Work with the SEI**

Congress established the SEI in 1984 because software is vital to the national interest. By working with the SEI, organizations benefit from 25 years of government investment and participation from organizations worldwide in advancing the practice of software engineering.

The SEI creates, tests, refines, and disseminates a broad range of technologies and management techniques. These techniques enable organizations to improve the results of software projects, the quality and behavior of software systems, and the security and survivability of networked systems.

As an applied research and development center, the SEI brings immediate benefits to its research partners and long-term benefits to organizations that depend on software. The tools and methods developed by the SEI and its research partners are applied daily in organizations throughout the world.

## **How the SEI Works with Government and Industry**

SEI staff members help the U.S. Department of Defense (DoD) and other government agencies solve software engineering and acquisition problems. SEI direct support is funded through task orders for government work. Engagements with the SEI are of particular benefit to government program managers, program executive officers, and senior acquisition executives, particularly those with long-range programs that will benefit from strategic improvements that the SEI fosters.

The SEI has a well-established process for contracting with government agencies and will work with an organization to meet its needs.

The SEI works with commercial organizations that want to develop a strategic advantage by rapidly applying improved software engineering technology. The SEI works with organizations that want to combine their expertise with the SEI's expertise to mature new technology for the benefit of the entire software industry. The SEI also supports a select group called SEI Partners, which are organizations and individuals that are trained and licensed by the SEI to deliver SEI products and services.

To determine how to put the SEI to work for your organization, contact SEI Customer Relations at [info@sei.cmu.edu](mailto:info@sei.cmu.edu).

## **SEI Solutions Guide**

The SEI Solutions Guide is a summary of the SEI's tools and methods, services, courses, conferences, credentials, books, and opportunities to collaborate with the SEI on research. To receive a copy of the guide, please contact SEI Customer Relations at [info@sei.cmu.edu](mailto:info@sei.cmu.edu).

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