SYSTEMS ENGINEERING Research Center

2009 ANNUAL REPORT

A US Department of Defense University Affiliated Research Center

SYSTEMS ENGINEERING
Research Center

2009 ANNUAL REPORT

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It is my very great pleasure to introduce the Systems Engineering Research Center (SERC) 2009 Annual Report.

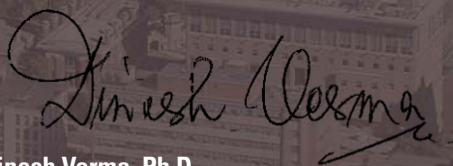I hope it will provide you with an understanding of our purpose, achievements and plans for the future.

Director's Message

It is my very great pleasure to introduce the Systems Engineering Research Center (SERC) 2009 Annual Report. Our first such report! I hope it will provide you with an understanding of our purpose, achievements and plans for the future.

The SERC, a US Department of Defense and intelligence community University Affiliated Research Center in systems engineering research, was competitively awarded to a team of 18 collaborating institutions led by Stevens Institute of Technology. Through its collaborative research concept, the SERC embodies the potential to radically improve the application of systems engineering to the successful development, integration, testing and sustainability of complex defense and intelligence systems, services and enterprises. In this first year, the SERC established an infrastructure, defined a research strategy and began critical research.

We collaboratively created our research strategy with the SERC sponsors and started research activities in the key areas of education and improved methods, processes and tools. Fifteen collaborators took part in this year's activities, and research in the planning stages will broaden the subject matter and take full advantage of the potent SERC collaborator resources.

I am proud of our progress and look forward to increasingly significant accomplishments in the coming years. The application of systems thinking and analysis is imperative to solving national and global challenges. Engaging the systems engineering community within the US and beyond, we will continue to support SERC sponsors and pursue our goal of transforming the systems engineering discipline to meet the needs of the 21st century.

Dinesh Verma, Ph.D.
Director, Systems Engineering Research Center

STEVENS
Institute of Technology

The Systems Engineering Research Center

As we enter the second decade of the 21st century, our ability to successfully build the complex defense systems we depend on for force multiplication, C4ISR, intelligence gathering and analysis, transportation, business information, safety and security is increasingly challenged. Our conceptual reach seems on the verge of exceeding our technological grasp.
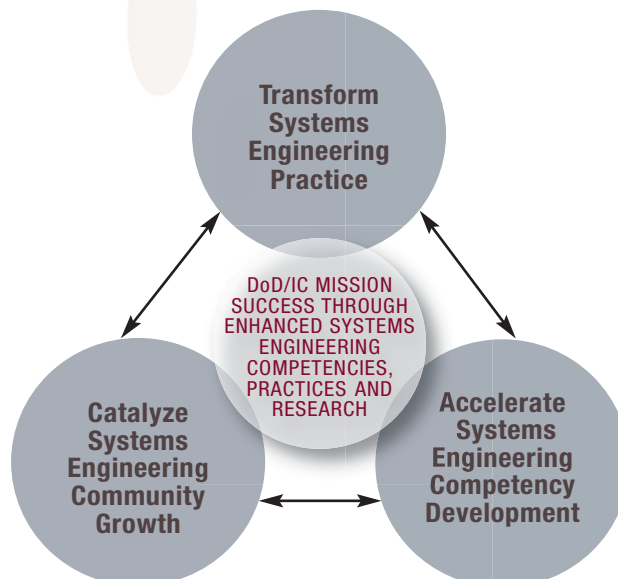
Trends in Systems Development

There are a number of trends that collectively accelerate this challenge. Growing system complexity and criticality raise vulnerability. The ascendancy of software as the preferred solution continues in the face of significant gaps in our ability to understand, validate and manage large evolving software ecosystems. The increasing speed of technological change, the rapid evolution of threats, and the decreasing schedules for development all lead to the sense that time itself is compressing. New systems envisioned by the defense and intelligence communities reflect, embrace and reinforce these trends. Finally, the engineers entering the workforce in the next decade—those responsible for creating these systems—are maturing in an environment with a radically different set of native skills and work styles from those in

To fulfill its mission, systems engineering must expand its capabilities and reinforce its relevancy; the methods, processes and tools applied must evolve to meet the needs of current and future systems. The Systems Engineering Research Center was created to solve this problem.

SERC Vision

Transform Systems Engineering Practice

Catalyze Systems Engineering Community Growth

Accelerate Systems Engineering Competency Development

DoD/IC MISSION SUCCESS THROUGH ENHANCED SYSTEMS ENGINEERING COMPETENCIES, PRACTICES AND RESEARCH

previous generations. They are more collaborative, net-centric, multitasking, and accustomed to instant and continuous communication in a distributed and multicultural world.

The multidiscipline scope of evolving, complex systems of systems and the rapid capability delivery required to adapt to accelerating change are central characteristics of 21st century systems. One result of the speed of technological change is a narrowing of focus and a growing separation of concerns in the development environment. Engineering is increasingly practiced in highly technical specialty areas that interact in subtle and often unpredicted ways.

The Need for Systems Engineering

The responsibility for integrating disciplines, balancing conflicting attributes, and delivering capabilities when needed has been traditionally

allocated to systems engineering. However, developers and management are raising concerns that systems engineering as currently practiced is less capable of handling the complexity, collaboration and pace required; it is increasingly considered a barrier to success rather than an enabler. As the critical need for a broad systems viewpoint grows, the traditional means of assuring that viewpoint is losing practitioner confidence.

The discipline of system engineering, then, is both a critical success factor for system development and evolution and a perceived impediment. To fulfill its mission, systems engineering must expand its capabilities and reinforce its relevancy; the methods, processes and tools applied must evolve to meet the needs of current and future systems. The Systems Engineering Research Center was created to solve this problem.

Viable, long-term solutions are not going to be found by tweaking the current systems engineering process. Solutions require a fundamental rethinking of systems engineering—building on its fundamental principles, concentrating on the necessary flows of information, and stripping away nonessential activities. We must re-examine the core definition of system, the role of the system engineer, the approach to systems specifications, the management of risk during the development phases, and integration of both systems and system of systems. Security, pace, complexity—all the trends described above—will drive a new systems engineering paradigm.

It is daunting to consider the technical issues involved in transforming systems engineering as a discipline. But changing the culture, revitalizing the workforce, and accelerating the growth of new systems engineers to apply the revised approaches is even more challenging. As Machiavelli wrote in a far slower paced but no less turbulent era, "there is nothing more difficult to plan, more uncertain of success, nor more dangerous to manage than the creation of a new order of things. For the initiator has the enmity of all who would profit by the preservation of the old institutions, and merely lukewarm defenders in those who would gain by the new order."

Answering the Call

Successful technical and cultural change requires recognition, reach and relevance. Because no one university has the depth and breadth for this complex task, the SERC provides a critical mass of researchers drawn from

What is a UARC?

A University Affiliated Research Center (UARC) is a strategic United States Department of Defense (DoD) research center associated with one or more universities. UARCs were established to ensure defense-critical engineering and technology capabilities are maintained and advanced. Collaboration with university educational and research resources is essential to their mission. These not-for-profit organizations maintain long-term strategic relationships with their DoD sponsors and operate in the public interest, free from real or perceived conflicts of interest.
Although UARCs receive sole source funding, they may also, in some circumstances, compete for science and technology work.
There are currently 13 DoD UARCS.

Characteristics of the UARC-DoD Relationship:

- **Responsiveness to evolving requirements**
- **Comprehensive knowledge of sponsor requirements and problems**
- **Broad access to information, including proprietary data**
- **Broad corporate knowledge**
- **Independence and objectivity**
- **Quick response capability**
- **Current operational experience**
- **Freedom from real and/or perceived conflicts of interest**

Photo of Kelly Miller

Kelly Miller, *Deputy CIO, National Security Agency*

"Establishment of the SERC fills a fundamental gap in the Department of Defense and Intelligence Community's ability to implement systems engineering processes, techniques and tools relevant to future mission needs, that incorporate advancing technologies, and that support tomorrow's evolving systems, services and net-centric environments."

its 20 highly respected collaborators. The SERC comprises a significant part of systems engineering research and educational programs in the United States. Such pervasive access to the next generation of systems engineers provides enormous leverage for change. Each collaborator has significant experience with military, intelligence, and executive agencies and understands their unique cultures, languages and missions. The SERC also maintains close ties with INCOSE, IEEE and ACM—professional organizations that cross domain and national boundaries. These existing relationships secure the ability to translate new ideas into relevant actions for practitioners.

The SERC comprises a significant part of systems engineering research and educational programs in the United States. Such pervasive access to the next generation of systems engineers provides enormous leverage for change.

The SERC—its leadership, researchers and transition resources—is uniquely qualified to renew systems engineering at this 21st century crossroad. Although focused on the future, the SERC will also respond to the current needs of our defense and intelligence community sponsors. SERC research will always be guided by the challenges our sponsors have identified and is coordinated with them through both the research strategy and the tasking infrastructure. Systems engineering research has a new nexus, the work has begun, and the potential benefit to the systems engineering community is immense.

The SERC Collaborators

	University or Research Organization	Lead Senior Researcher	Contributions to Systems Engineering (SE) Research & Education
1	Stevens Institute of Technology	Dinesh Verma, Ph.D.	Systems thinking, architecture, systems of systems acquisition
2	University of Southern California	Barry Boehm, Ph.D.	Life cycle models, cost modeling
3	Air Force Institute of Technology (AFIT)	David Jacques, Ph.D.	Primary institution responsible for educating Air Force officers on SE
4	Auburn University, Auburn, AL (AUB)	Alice Smith, Ph.D.	Aerospace quality, information assurance
5	Carnegie Mellon University (CMU)	William Scherlis, Ph.D.	Architecture, very large-scale software-intensive systems
6	Fraunhofer Center at University of Maryland (FCMD)	Forrest Shull, Ph.D.	Empirical studies SE methods, practices and tools
7	Georgia Institute of Technology	William Rouse, Ph.D.	Strategic systems engineering, human/technology interaction in complex systems
8	Massachusetts Institute of Technology (MIT)	Donna Rhodes, Ph.D.	SE leading indicators, cost modeling
9	Missouri University of Science and Technology (Missouri S&T)	Cihan Dagli, Ph.D.	Network-centric systems
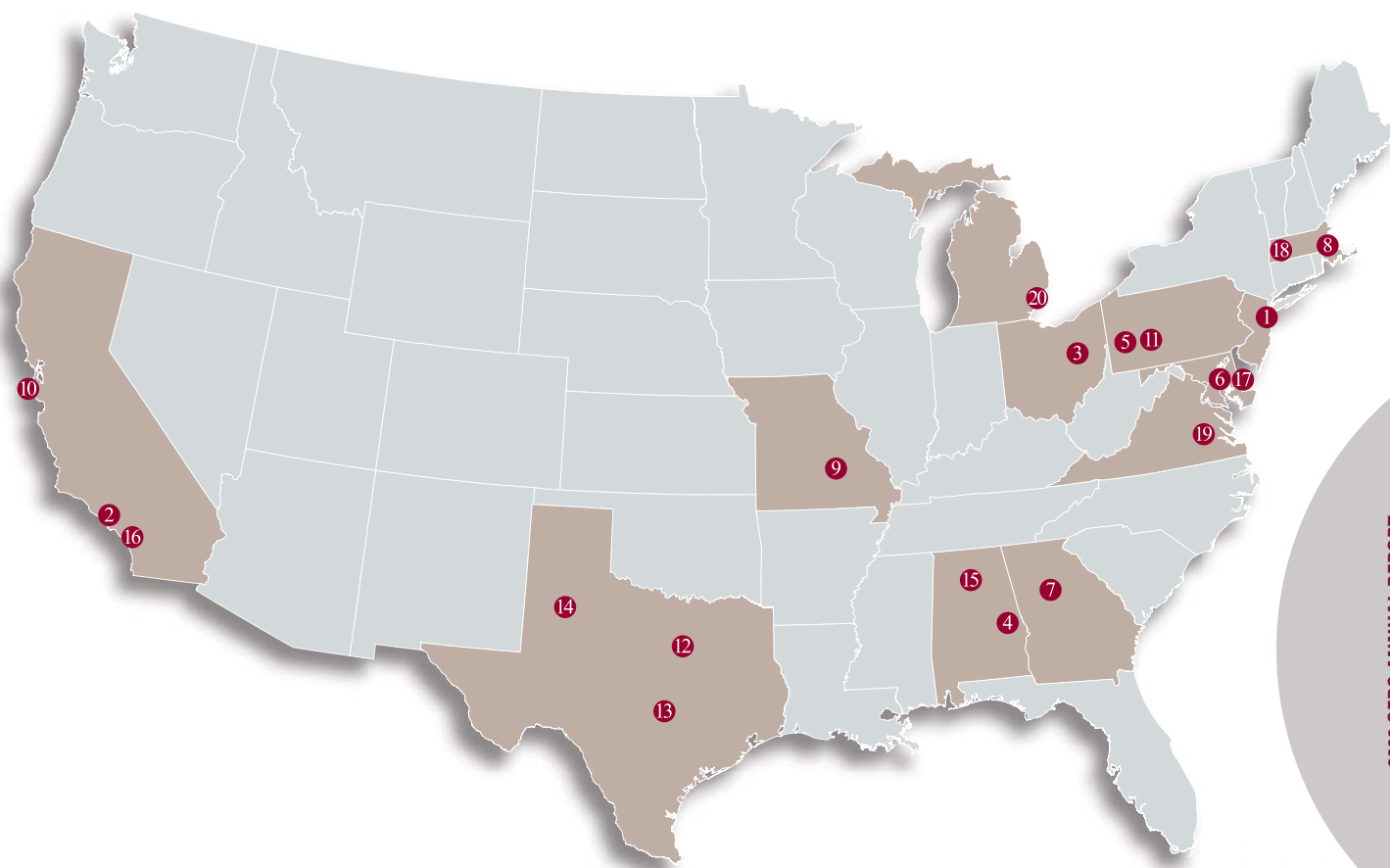
10	Naval Postgraduate School (NPS)	James Kays, Ph.D.	Primary institution responsible for educating Navy officers on SE
11	Pennsylvania State University (PSU)	Allan Sonsteby, Ph.D.	Enterprise integration and informatics
12	Southern Methodist University (SMU)	Jerrell Stracener, Ph.D.	Aerospace and defense systems development
13	Texas A&M (TAM)	Abhi Deshmukh, Ph.D.	System complexity, predictive models of evolving complex systems
14	Texas Tech University (TTU)	Mario Beruvides, Ph.D.	Modeling complex systems, complex system qualitative/human aspects
15	University of Alabama - Huntsville (UAH)	Paul Componation, Ph.D.	Tailoring SE processes to meet project characteristics
16	University of California - San Diego (UCSD)	Harold Sorenson, Ph.D.	Architecture-based enterprise systems engineering
17	University of Maryland - College Park (UMD)	Rance Cleaveland, Ph.D.	Verification and validation, formal modeling and simulation
18	University of Massachusetts - Amherst, (UMAS)	Leon Osterweil, Ph.D.	Precise visual process definition, rigorous process analysis
19	University of Virginia (UVA)	Barry Horowitz, Ph.D.	Rapidly reconfigurable systems
20	Wayne State University (WSU)	Walter Bryzik, Ph.D.	Linking technical baselines to design architecture

Research Vision

Skating to Where the Puck is Going

The SERC Research Vision reflects the vision of its sponsors' leadership in focusing on transformational ways to address DoD's future systems engineering (SE) challenges, or in the words of hockey star Wayne Gretzky, "skating to where the puck is going, compared to where it is or has been." The table below summarizes a SERC gap analysis between the systems engineering capabilities implied by DoD futures studies and current capabilities.

Barry Boehm

Future DoD SE Needs vs. Current Capabilities

Future DoD SE Needs	Current SE Capabilities
Rapid, concurrent exploration of solution options and tradeoffs	Largely sequential, one-size-fits-all SE and SE-related acquisition MPTs
Rapid adaptation of solutions to changing threats, opportunities and priorities	Largely hardware-based, functional, one-to-many models, and WBSs vs. hardware-software-human factors-based service-oriented, many-to-many models
Need to involve multidiscipline stakeholders in rapid collaborative SE and acquisition	Shortage of MPTs for rapid mutual learning, option exploration, solution negotiation
Ability to accommodate unpredictable, emergent requirements that result from field use via evolutionary development	MPTs that assume system requirements are specified up front and frozen into build-to-spec contracts
Need to balance rapid systems acquisition with high assurance of critical properties (e.g., security, safety, scalability)	Agile approaches that often fail to scale and can't provide high assurance levels
Seamless net-centric systems of systems interoperability across numerous complex, independently-evolving systems	Numerous cross-system incompatibilities; weak MPTs for scalable change impact analysis and evolving-solution negotiation
Warfighter-tailorable system capabilities for future Web-literate forces	Largely fixed-option, one-size-fits-all warfighter-system interfaces
Well-populated, versatile, adaptable DoD SE and acquisition workforce	Major DoD SE and acquisition workforce shortfalls in quantity, versatility and adaptability

Michael W. Wynne, *Chairman of the SERC Advisory Board and 21st Secretary of the Air Force*

"It is exciting to be a part of the SERC. This growing organization enhances systems engineering— a true need in America—in the very best way: bringing together talented researchers throughout our country."

To address these challenges, the SERC and its sponsors have developed a SERC Research Strategy whose major thrusts address these needs-capabilities gaps.

It is clear from the overlaps in these thrusts that having them operate like narrowly focused specialty areas would run the risks of creating incompatible solutions sub-optimized on single-discipline solution approaches. The SERC technical management plans address such risks via continuing coordination activities among the research tasks, such as monthly SERC-wide status and plans telecons, cross-task workshops, and preparation activities for integrated SERC annual research reviews.

As the SERC grows, it will extend these coordination activities to include cross-discipline Principal Investigator (PI) meetings addressing not only the progress of each individual research task, but also implications for and synergies with overlapping research tasks. It has and will pro-actively engage DoD organizations needing improved SE capabilities by piloting not only individual research task results, but also increasingly by combinations of SERC and external capabilities addressing the full range of the organization's mission needs. And it will use these and related experiences to build a knowledge base of lessons learned and empirical data that can serve as the foundations for future research on more fundamental improvements in SE principles, reasoning frameworks, and associated future MPTs that continue to enhance future DoD mission effectiveness.

SERC Strategic Thrusts

- **Thrust 1, Enterprise Responsiveness**, *addresses transforming SE and SE-related acquisition capabilities to more strongly support rapid fielding and continuing SE of evolutionary development. It currently includes three small studies to build the foundations for a major SE Transformation initiative.*

- **Thrust 2, Systems Science and Complexity**, *recognizes that both rapid, partial capabilities and a robust, high-assurance infrastructure are key to addressing time-critical threats to complex systems of systems. The need to resolve conflicts among key performance parameters (KPPs) such as rapid response, security, scalability and interoperability are part of this thrust. It currently consists of exploratory and roadmapping studies focused on security and its KPP tradeoffs, and interoperability of SE MPTs. These will build foundations for major initiatives.*

- **Thrust 3, Systems Engineering Workforce**, *addresses the gaps between needs and capabilities in the DoD SE workforce. It currently includes a large-scale, forward-looking initiative to rebaseline the core body of SE knowledge needed to develop future systems and systems of systems. It also includes early studies in accelerating SE competency and leadership development.*

- **Thrust 4, Program and SE Integration**, *addresses the gaps between the critical-mass, continuously adapting SE needed for evolutionary acquisition and current SE-related practices that assume pre-specifiable fixed-price, build-to-spec contracting. It currently comprises early analyses of SE effectiveness and the implications of evolutionary acquisition for SE. These studies will build the foundation for a more value-based approach to SE that better reflects mission effectiveness and supports business case development for SE-related decisions, such as the return on investment of adaptability and other systems engineering approaches.*

- **Thrust 5, Life-Cycle Systems Engineering Processes**, *addresses the gaps between current over-specialized process-oriented or product-oriented SE approaches and future needs for balanced, concurrent, integrated product and process engineering. As such, it provides a holistic function in integrating product, process, human, mission and economic aspects of the other four thrusts. It will consider approaches that address mission effectiveness aspects through the full system life cycle and that evolve as needs and opportunities emerge.*
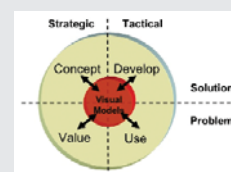
Systems Engineering Methods, Processes and Tools (MPTs)

Forrest Shull

The Intelligence Community applies systems engineering in a challenging environment. Events around the world can lead to demands for new system functionality in a very short time. System development teams must maintain high standards of security and performance while working with limited access to other system components and their developers. Understandably, emerging requirements, multiple strong and possibly inconsistent stakeholders, and complex integration issues are common. To address these problems, the SERC was tasked to examine methods, processes and tools to make the system engineering process more agile and recommend improvements to current practice.

Historically, recommended solutions for these challenges offer anecdotal evidence or individual experiences, not the specifics necessary for practical application. More useful information was needed. Dr. Forrest Shull (Fraunhofer Center) and Dr. Richard Turner (Stevens) gathered a team experienced in defense system engineering and MPT evaluation from the Fraunhofer Center at the University of Maryland, Missouri University of Science and Technology, Stevens Institute, the University of Alabama in Huntsville, the University of Massachusetts at Amherst, and the University of Southern California.

First, the team identified current industry best practices for sponsor-like environments. A methodology for mining best practices was used on data from an industry survey of over 100 practitioners from a wide range of organizations citing similar challenges. Interviews with practitioners identified critical success factors for organizations working in this rapid/agile environment.

Second, we developed the "bridge diagram," an example of which is shown, to help organizations strategize solutions and assess their current practices. The diagram links three kinds of information: a theme from the survey responses, the specific elements of that theme, and the methods, processes and tools that have proven effective in achieving those elements.

Third, the team successfully piloted describing an MPT (Scrum) in a formal process modeling tool (Little JIL from UMass). By applying additional tools, single point of failure and finite state verification analyses were performed on the model.
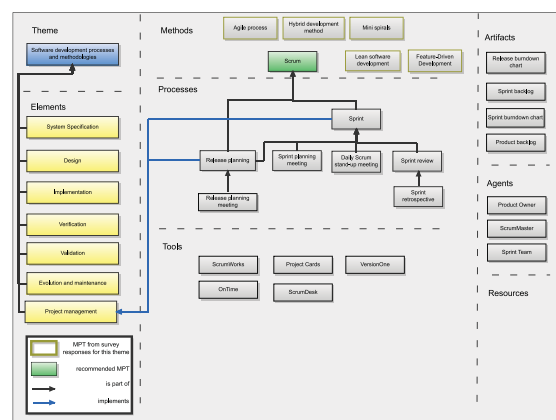
Finally, the team developed implementation guidance for three MPTs based on the bridge diagram. All the research led to the conclusion that there simply were not good tools for rapid/agile systems engineering in use. Tools that have been applied were drawn mainly from agile software development and resulted in mixed success. However, the results will form a solid baseline for future work, including defining new SE approaches and validating their effectiveness before costly piloting.

For further information, contact:
Dr. Shull (fschull@fc-md.umd.edu)
or Dr. Turner (rturner@stevens.edu)

Pat Hale, _President, INCOSE 2008-2009_

"Systems Engineering research is vital to advancing the state of the art in our profession, and the SERC is the most promising and sustainable systems engineering research initiative in America today—INCOSE is proud to support the goals of the center and its sponsors."

Systems Engineering Effectiveness Measures

Dan Ingold

One SERC approach to help the DoD community enhance its systems engineering (SE) effectiveness is to develop extendable baseline tools for project use and enhancement. Initial examples are the SE Performance Risk Tool and the SE Competency Risk Tool developed on one of the SERC's first-year tasks, Measuring SE Effectiveness.

The task, led by Professor Barry Boehm and Mr. Dan Ingold of the University of Southern California, was performed by a team of researchers from USC, the Fraunhofer Center at the University of Maryland, Stevens Institute, and the University of Alabama in Huntsville. First, the team prepared a coverage matrix of the prime sources of DoD guidance on early SE effectiveness. The matrix included the National Research Council Early SE study, the National Defense Industry Association-Software Engineering Institute SE effectiveness study, the DoD Services' Probability of Project Success assessment frameworks, the INCOSE SE Leading Indicators framework, and the Defense Acquisition Program Support assessment guide, along with counterpart assessment frameworks for SE personnel competency. The matrix and documents were used to develop frameworks of project SE goals, critical success factors, and questions for projects to use in assessing SE performance and personnel competency effectiveness risk.

A series of DoD community workshops and tool pilot exercise was held to refine the frameworks, develop spreadsheet-based tools (an example of the Performance Risk Tool is shown here), and establish concepts of operation for their use. The workshops and pilots also produced a quantitative business case showing that the return on investment for tool use was proportional to a project's size and criticality. The tools were piloted on a mix of large and small, DoD and non-DoD, and hardware- and software-intensive projects. Evaluation results were consistent with the initial project objective of focusing on early SE in Major Defense Acquisition Programs and the business case analysis. All of the pilots indicated that the tools were highly applicable to early SE. Their degree of effectiveness was very high for large, critical DoD projects,

but less so for smaller or non-DoD projects. The pilots also provided valuable feedback on needed tool enhancements and extensions, such as risk scale recalibration and usage features, which have been incorporated in the current set of tools.

Based on the workshops, initial pilots and SE conference presentations, considerable interest has been expressed in further piloting and application of the tools. Organizations expressing interest include DoD organizations such as NAVSEA and the F-35 program; DoD research centers such

as Mitre and the Software Engineering Institute at Carnegie Mellon University; and aerospace companies such as Lockheed Martin, Northrop Grumman and Rockwell Collins. For versions of the tools, a pilot users' guide and descriptive technical report, or for additional information, contact Mr. Dan Ingold (dingold@usc.edu) or Prof. Boehm (boehm@usc.edu).

Operations

Art Pyster

The SERC is a highly distributed organization. Its small management team leads a network of hundreds of researchers—faculty, staff and students—from 20 collaborating universities and institutes. Operations focus on performing high-impact research, building the community of researchers and putting research results to work.

Management

The SERC reports to the Stevens Vice President for Academic Affairs and Provost. Four people manage the SERC with additional technical and administrative help as required: Executive Director **Dr. Dinesh Verma**, Deputy Executive Director **Dr. Art Pyster**, Director of Research **Dr. Barry Boehm**, and Director of Operations **Doris Schultz**. Everyone except Ms. Schultz is part-time in their management role, reflecting our philosophy of lean operations.

Every research project relies on the expertise of collaborating researchers and is carefully staffed. A senior researcher from one of the collaborators is chosen by SERC management to be Principal Investigator. The Principal Investigator is usually supported by researchers from two or three different collaborators bringing specific expertise for the task at hand. Having multiple collaborators working together on a single project offers two important advantages: It enables the SERC to staff projects with the best possible researchers from any-

Having multiple collaborators working together on a single project offers two important advantages: It enables the SERC to staff projects with the best possible researchers from anywhere in the collaboration, and it builds the sense of community among the researchers and encourages sharing of ideas and results among the collaboration.

The management team is responsible for the success of the SERC mission. Externally, it aligns the SERC strategy and execution with government sponsors, funders, and users. Internally, it ensures research quality, manages SERC resources, and meets all contractual requirements.

Performing High-Impact Research

The SERC research strategy, first created in 2009, is tuned each year by interaction between the SERC, its government sponsors and an array of advisors. All research projects must fit within the strategy.

where in the collaboration, and it builds the sense of community among researchers and encourages sharing of ideas and results among the collaboration.

Funding for each project is provided through a task order contract. During 2009, the first year of operations, most projects were small with short durations, reflecting SERC startup. Beginning in 2010, we expect project size and duration to grow, enabling us to tackle higher risk, higher impact research.

Accomplishments

Work on first two
research projects
(EM and MPT)
begins

Contract award

Tenth research project launched:
Software Intensive Systems Data
Quality and Estimation Research
In Support of Future Defense
Cost Analysis

Naval Postgraduate
School joins SERC

Annual Research Review held

SEPTEMBER 2008	OCTOBER 2008	NOVEMBER 2008	MAY 2009	JULY 2009	AUGUST 2009	SEPTEMBER 2009	OCTOBER 2009	DECEMBER 2009

Regular collaborator
net meetings begin

Inaugural Ceremony

Fifth research project launched:
MPT Phase Two

EM and MPT research
projects successfully
completed

Georgia Tech
joins SERC

Developed in late 2009, one operational strategy is to use pathfinder projects to create research roadmaps for very hard, very important problems. A roadmap identifies promising research to be conducted over three to five years that will have a major impact on the problem. A current pathfinder project will create a roadmap to systematically transform systems engineering into a more agile and responsive discipline consistent with short timelines and uncertain requirements. That roadmap will spawn a number of research projects of varying size and duration involving most of the collaborators.

Building the Community

The existence of the SERC as a stable, inclusive research organization devoted to systems engineering research presents a unique opportunity to nurture and grow the systems engineering research community to the benefit of SERC sponsors. In the first year of SERC operations, we encouraged and enabled that community growth in several ways: (1) having nearly every project include multiple collaborators, (2) periodically holding project workshops to which all collaborators were welcome, (3) providing information technology

Frank Anderson, *President, Defense Acquisition University*

"The Defense Acquisition University is committed to improving the core technical capabilities of DoD's acquisition workforce. The SERC gives us access to world-class Systems Engineering expertise that supports this objective, and will help us accomplish this mission…we look forward to this collaborative partnership!"

Operations *(continued)*

infrastructure for collaboration, (4) adding two collaborators – the Naval Postgraduate School and Georgia Tech, and (5) holding the first annual SERC research review at the Pennsylvania State University Malvern campus, bringing together 70 people from both the collaboration and the government. Community efforts will expand significantly in 2010.

Putting Research Results to Work The first research projects will deliver substantial results in 2010 and later. At this early point, there has been little opportunity for the SERC to directly impact either DoD and IC programs or to see research results flow into the classroom. In 2010, research projects should begin to have some impact, with substantial impact in 2011 and beyond.

Sources and Funding for the period ending December 31

SPONSOR	2008	2009
Department of Defense	$849,637	$2,888,459
Defense Acquisition University		$430,000
National Security Space Office		$39,000
National Polar-orbiting Operational Environmental Satellite System		$39,000
Air Force Cost Analysis Agency		$255,000
Naval Sea Systems Command		$250,000
	$849,637	$3,901,459

A total of $3,901,459 was awarded in 2009, of which $255,000 was sent to NPS for research done in cooperation with SERC.

Stephen P. Welby, *Director of Systems Engineering, Office of the Under Secretary of Defense*

"Today's Systems Engineers confront a number of issues that challenge the traditional practice of systems engineering, from the growing complexity and criticality of our systems, to our increasing need to provide robust and agile solutions to urgent and changing needs. The SERC is an important asset to the Department of Defense as we seek to advance the state of systems engineering practice, and as we move to grow our national engineering competencies to meet these emerging challenges and produce the military systems our nation needs."

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Engaging the SERC for Leading-edge Systems Engineering Research

Through the SERC, US Government organizations can easily engage more than 150 thought leaders at 20 leading research and academic institutions to solve complex, contemporary systems engineering problems. The process begins when an organization identifies a problem requiring SE research. They should contact the SERC to discuss the problem and determine if it is within the scope of the SERC's mission. If it is, then the organization refines the research need and the SERC responds with its technical approach, cost estimate and potential value for the research. The SERC then selects a Principal Investigator and a team of the most appropriate researchers to perform the research and deliver the results and value to the funding organization. Unless specifically limited, the results are published and available for inclusion in education and transition activities across the systems engineering community.

Leadership

- **Executive Director:**
  Dr. Dinesh Verma
  Dean and Professor
  School of Systems and Enterprises
  Stevens Institute of Technology

- **Deputy Executive Director:**
  Dr. Arthur Pyster
  Distinguished Research Professor
  School of Systems and Enterprises
  Stevens Institute of Technology

- **Director of Research:**
  Dr. Barry Boehm
  Director Emeritus
  USC Center for Systems and
  Software Engineering,
  and TRW Professor of Computer
  Science at the University of Southern California

- **Director of Operations:**
  Ms. Doris Schultz
  Stevens Institute of Technology

Contact:

The SERC offices are located at Stevens Institute of Technology, The Babbio Center, Hoboken, NJ 07030

Phone: 201-216-8300

For more information about the SERC, please visit the SERC website at
www.stevens.edu/SERC

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Lead University

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Principal Collaborator

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