A. CANDIDATE'S STATEMENT

A-1 Professional Activities

I have made major contributions for the NPS mission and DoD needs in my research, teaching and service in the areas of system cost estimation, affordability and tradespace analysis, process modeling and simulation, systems engineering education, and integrating systems and software engineering disciplines.

My research progress includes definitive work in software cost estimation metrics for defense systems resulting in significant DoD policy changes, extending cost models for Total Ownership Cost (TOC) encompassing multiple engineering disciplines, and modeling systems and software engineering processes. Empirical-based research methods underpin all these.

My leadership in research communities is also evidenced by key conference tutorials, workshops I have led, invited presentations, expert panels, and major service for relevant journals and conferences. Within the DoD for example, ODASD/SE specifically asked me to advise them on methods and models for cost and schedule estimation.

As a primary go-to person for DoD system cost estimation at NPS, I have been expanding our teaching curricula and research in integrated systems, software and hardware cost aspects of systems. I have been a linchpin allying research communities and disciplines, and performing substantial internal and external service activities. I helped create a new master's degree curriculum at NPS, served as course coordinator, worked intimately with other department committees and Ph.D. students, and supported many Master's students theses. Externally I have served on journal editorial boards, peer reviewed numerous journal papers, and served on conference program committees for leading venues in my fields. I am also very active with the International Council on Systems Engineering (INCOSE) as a continuing chapter Board Member and Systems Engineering Handbook contributor.

Besides pure research I develop practical and widely used cost estimation tools for the DoD community and public. My web-based tools have real impact as tangible products used daily on DoD projects and others across the globe (typically several hundred or more estimates each day). The COCOMO Suite lowers barriers to parametric cost models and is used extensively in government, industry, and academia. Numerous users send acknowledgments representing DoD projects (government and contractors), other U.S. government agencies, foreign governments, commercial companies, professors, students, and consultants. It is the standardized tool in some organizations, many universities are teaching with it, and its usage has demonstrably continued to expand. Furthermore I developed many of the encapsulated cost/risk models in addition to the tool implementation.

Activities straddling research and service include 1) being a key researcher and very active collaborator with the DoD Systems Engineering Research Center (SERC), 2) spearheading our formal membership in the International Software Engineering Research Network (ISERN) for empirical-based research and continuing as the NPS representative working with the community, and 3) being a primary contributor to the definitive systems engineering references Systems Engineering Body of Knowledge (SEBoK), Graduate Reference Curriculum in Systems Engineering (GRCSE), and the INCOSE Systems Engineering Handbook (authoring chapters in each).

Shortly after arriving at NPS, I was instrumental aligning us with the SERC, working with OSD to conduct sponsored research and was the first funded. I continue to be one of the most active SERC researchers having performed on SERC Research Topics RT6, RT18, RT35, RT113 (previously RT46); and participate in other SERC meetings, workshops, and technical reviews representing NPS as a principal collaborator. I have been key to integrating systems and software engineering in research, service and our curriculum. I'm completing the textbook Systems Engineering Principles for Software Engineers to help strengthen interdisciplinary engineering practices. This thread is also exemplified by substantial service with the Software Engineering Ph.D. program in Computer Science, coordinating our software engineering course, subject matter contributions to the SEBoK, and integration of my parametric cost models of the respective disciplines to cover more of TOC. Since coming to NPS soon after publishing Software Process Dynamics, my peer reviewed publications include 3 books, 6 journal papers, 6 book chapters plus other topics in the SEBoK, and 15 conference papers. Currently I have over 4700 citations, h-index 20, and i10-index 31 per Google Scholar. The indices have been increasing at NPS.

Research

My significant research impact includes critical DoD policy changes with more coming. This sponsored research in software cost estimation metrics comprised multiple awards from the Air Force Cost Analysis Agency (AFCAA) as NPS PI in 2009-2012 (lastly as SERC RT6). I developed core metrics definitions that directly strengthened reporting requirements for DoD programs involving software development. OSD adopted and formally implemented changes to the mandated Software Resources Data Report based on our empirical analysis standardized to my metrics

definitions. This is quite significant because the incoming DCARC data is now more rigorous and consistent adhering to my standards, resulting in improved cost data, more stable models and insights for informed decision-making.

Other multi-award longitudinal research as PI includes SERC RT113 Ilities Tradespace and Affordability Program (ITAP) in 2013-2014, and this project is continuing into the next phase with further increased funding in 2015. I have enhanced cost models for operations and maintenance for TOC, and furthered their Monte Carlo simulation capabilities. The system cost model suite now covers systems engineering, software engineering, hardware development and production. It was demonstrated to be tailorable for DoD domains and initially converted to a web-based service.

I was PI for the Littoral Warfare Engineering Facility (LWEF) Business Case Analysis (BCA) for Naval Surface Warfare Center. The LWEF BCA has been instrumental at NAVSEA for strategic decision-making and planning. My economic analysis has been presented to the highest levels including Admirals across the Navy, Coast Guard, and High Energy Laser program for joint operations. Space and Naval Warfare Systems Command (SPAWAR) sponsored my PI research for systems cost estimation support in 2011, and was funded for SPAWAR PMS-485 cost estimation support in 2010-2012. These efforts investigated the sources of cost and risk for systems engineering on their programs.

Earlier on the SERC RT18 Valuing Flexibility research project in 2010-2011, I developed new models for total ownership cost of product lines. These provide unique capability for DoD program analysis and are being transitioned on the SERC RT113 ITAP program, and are the basis of parametric models used at NAVAIR summarized next.

My most recent PI research is cost and ROI modeling of avionics software product line development for NAVAIR on the Future Airborne Capability Environment (FACE) business model development. This will validate costing efforts across different airborne platforms, validate and refine effort drivers for a FACE model, modify current NAVAIR costing models to align with our NPS software cost models, and provide inputs to the FACE government team. Funded simulation research was for SERC RT35 Agile-Lean Software Engineering (ALSE): Evaluating Kanban in Systems Engineering. I performed hybrid modeling and simulation to assess agile systems engineering processes for complex DoD projects. I also initiated joint simulation research with AFIT and The Aerospace Corporation modeling the JCIDS weapon acquisition system to investigate DoD acquisition process policies.

I created an architecture for a web-based discrete-event simulation framework and led its implementation. This is planned to support an upcoming textbook. On another project I worked with international colleagues on a framework for generalized process simulation model descriptions that are independent of their implementation. This was the first concept demonstration for software process modeling.

Overall, my research funding has been increasing and research sponsors have been very satisfied with my results. This is exemplified by multiple continuations with AFCAA and OSD.

Teaching

My teaching record demonstrates sustained improvement and I am now consistently getting high SOFs. I primarily teach SE3011: Engineering Economics and Cost Estimation, and have created much new material for it. One unique asset is my web-based cost estimation tool that markedly improved the course and streamlines student homework logistics to focus on concepts enabling more complex assignments. I also supplemented topics for new systems, software, and hardware cost models. I have also taught SE4003: Software Systems Engineering and SE3250: Capability Engineering.

At NPS I have been the course coordinator for SE4003: Software Systems Engineering. This role includes continual monitoring, course improvements, and I helped support the successful ABET accreditations for the department. I have also worked closely with the Computer Science department in its Software Engineering program. Each year I write and administer the Software Engineering Ph.D. written exam in Software Management and Economics, and am on several of their student Ph.D. committees including co-advising.

Course Coordinator for SE3011 as of AY2017.

SE4003 major improvements

Thus far I have served as advisor, co-advisor or second reader for 50 students graduating in Systems Engineering on individual theses and group capstones. For the new Master in Cost Estimation and Analysis (MCEA) at NPS I developed the module on Software Cost Estimation and taught it to initial cohorts. This important degree program is being delivered jointly with AFIT students.

Service

A substantial service activity was contributing to the Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE) project creating the SEBoK and GRCSE. I was the lead author for the Systems Engineering Management chapter topics, subject expert for the thread of software engineering and its overlap with systems engineering concepts, and contributed to other sections for cost analysis, affordability, engineering use cases, integrating disciplines and terminology. On GRCSE I was lead author on the Entrance Expectations chapter.

I'm an Associate Editor on the board of the Journal of Cost Analysis and Parametrics (JCAP) and served on the editorial board of the International Journal of Information Technology and the Systems Approach (IJITSA). At NPS I have extensively reviewed at least 15 papers for top peer reviewed journals: IEEE Systems Journal, IEEE Transactions on Software Engineering, Journal of Cost Analysis and Parametrics, Empirical Software Engineering, Journal of Software Maintenance and Evolution: Research and Practice, IEEE Software, IEEE Computer, International Journal of Information Technology and the Systems Approach, ACM Transactions on Software Engineering and Methodology, Information and Software Technology, and the Journal of Computer Integrated Manufacturing.

External service also includes being on the program committees each year for the primary international conferences in my areas: the International Conference on Systems and Software Process (ICSSP) (including program co-chair), the Conference on Systems Engineering Research (CSER), the International Forum on COCOMO and Systems/Software Cost Modeling.

I also serve as the elected Treasurer of the INCOSE San Diego Chapter and am President Elect. Since instituting our membership in ISERN I have continued as the NPS representative.

A-2 Career Plans

I will continue developing new engineering knowledge in models, methods, and tools focusing on national security. This will help NPS become a more visible leader in empirical-based research because quantitative data from DoD projects is critical for building better models. Cost models and tools should continuously improve and adapt to new aspects which I will do. Intellectually I will continue broadening my areas across disciplines and DoD purview, such as moving towards a larger DoD enterprise-wide acquisition perspective in modeling and simulation.

Currently I have burgeoning new research ahead in 2015-2016 at increased funding levels (with OSD and NAVAIR). This and anticipated future sponsorship of foundational model-based systems engineering research will provide ample opportunities for NPS theses, capstones and Ph.D. dissertations. I will strive to keep producing high impact results, and optimally involve students with relevant topics.

Continuous improvements in our teaching curriculums and delivery methods are necessary to maintain our academic excellence at NPS. I want to develop new courses for important and emergent areas in model-based systems engineering and cost estimation. For example, system dynamics simulation is not adequately covered in our curriculum nor applied to systems of systems. I will continue updating course materials including tools and my cost estimation workbook. It will be enhanced, tailored and adopted in other NPS courses/departments including further supplementing the MCEA degree program. Other DoD universities are also interested in adopting my cost estimation metrics manual.

I will be actively involved with initiatives at SPAWAR in San Diego performing outreach and helping improve their systems engineering processes. This will connect us better with local Navy research, help enlist cohorts, and provide relevant applications for theses and capstone projects. Similar involvement will continue at NAVSEA Port Hueneme.

As a tenured professor I can and will participate more on NPS strategic and academic committees. I plan to increase my collaboration across other additional departments, and help lead joint research projects. External service for journals, conferences and professional organizations has been intensive and will continue. But I will keep a careful eye on the value-added for NPS to strike a balance with internal service efforts. Eventually I intend to serve on the Faculty Council in multiple positions.

There has been great interest in a 2nd edition of my book Software Process Dynamics. I will include new material for systems engineering processes. I will continue web-based simulation software development for hybrid modeling, and plan to co-author one or two books on engineering modeling and simulation. Eventually I will re-emphasize peer-reviewed journal papers vs. the near-term book contributions and achieve full professor.

NPS has provided me a most stimulating environment and challenging opportunities. There is much important work left and relevant contributions to make. I eagerly look forward to expanding my repertoire, and increasing my value to NPS and the DoD for a long time culminating my career.

B. FACTUAL INFORMATION

I. BIOGRAPHICAL INFORMATION

1. Demographic Information

Raymond J. Madachy, Ph.D.
Associate Professor
Department of Systems Engineering
Bullard Hall, Room 201J
(619) 847-0986
US citizen
Secret clearance

2. Education

University of Southern California
Ph.D. Industrial and Systems Engineering, 1994
Areas: systems engineering, systems architecting, computer science
Dissertation: "A Software Project Dynamics Model for Process Cost, Schedule and Risk Assessment", Advisor: Behrokh Khoshnevis

University of California, San Diego
M. S. System Science, 1983
Comprehensive exam covered digital signal processing and system dynamics
Research in bio-engineering, orbital mechanics and man-machine interface

University of Dayton
B.S. Mechanical Engineering, 1981
Minor: Aerospace Engineering
Magna Cum Laude

3. A chronology of professional history

4. Academic concentrations and research interests

Initially I chose mechanical engineering for a major because it was the broadest and most extensive engineering curriculum at my undergraduate school. It was also best suited for my chosen minor in aerospace engineering.

I became interested in a broader systems view (and study of systems themselves), and chose a masters in systems science at UCSD for a multidisciplinary approach to the analysis and solution of complex systems problems (there was no SE major). My exam was in digital signal processing and system dynamics; and I conducted research in bio-engineering, orbital mechanics and man-machine interfaces.

Finally I went for my Ph.D. in systems engineering with further concentrations in systems architecting, and computer science for software engineering aspects. My dissertation was A Software Project Dynamics Model for Process Cost, Schedule and Risk Assessment.

I have continued in these areas of cost estimation and process simulation of systems and software engineering, and now broadening into hardware cost modeling.

Current research interests include total ownership cost modeling; affordability and tradespace analysis; modeling and simulation of systems and software engineering processes, and the DoD acquisition process; integrating systems engineering and software engineering disciplines, and empirical-based research with process simulation.

> Recently I have expanded into other areas of Model-Based-Systems Engineering (MBSE). I'm developing new methods and approaches for incorporating affordability and tradespace analysis in a more automated fashion in conjunction with other MBSE methods (e.g. integrated systems architecting/design and cost analysis derived from common model artifacts).

2015-Present	Tenured Associate Professor, Department of Systems Engineering, Naval Postgraduate School
2008-2015	Associate Professor, Department of Systems Engineering, Naval Postgraduate School
2005-2008	University of Southern California Research Assistant Professor and Interim Director of Systems Architecting and Engineering Program, Department of Industrial and Systems Engineering, 2007-2008 Research Scientist, Departments of Industrial and Systems Engineering and Computer Science, 2005-2007
2001-2005	Chief Science Officer, Cost Xpert Group Inc.
2001-2005 (part-time)	Research Associate, University of Southern California, Department of Computer Science
2000-2001	Chief Scientist, C-bridge Internet Solutions, C-bridge Institute
1992-2000	Litton Systems Manager, Software Engineering Process Group, Litton Guidance & Control Systems, 1997-2000 Senior Engineering Specialist, Litton Data Systems, 1992-1997
1988-1992	Librascope Corporation Staff Engineer, 1991-1992 Lead Software Engineer, 1989-1991 Programming Research Specialist, 1988-1989
1987-1988	Laboratory Manager, University of California, Los Angeles
1985-1986	Independent Contractor, TRW Electronics and Defense, Advanced Programs Division
1982-1985	Member of Technical Staff, Hughes Aircraft Co., Radar Systems
1981-1982	Aerospace Engineer, General Dynamics, Convair

5. Professional certifications or registrations

II. INTERNAL NPS ACTIVITIES

1. Internal Teaching Activities

a. Course and laboratory development

Considerable effort went into updating, reformatting and improving the SE3011 course material for cost estimation of software-intensive systems to better reflect most DoD projects. Procured a number of professional estimation tools for SE3011 educational use by working with vendors and introduced these into the classroom.

It was found that the SE3011 vendor tools provided were overly cumbersome for the students, given their computer platforms and NMCI constraints. Thus I went further on improving the COCOMO Suite Tool and more recently the System Cost Model Suite so that students could use them instead for all of their assignments. Submission of assignments with their work was streamlined via URLs of the data files.

> In 2017 I added file saving in the cloud, which also allows for updating of previous estimates. Previously it functioned as a calculator providing one-off estimates in a browser. Now the cost estimates can be developed, saved, and shared online with no other installations or accounts required.

New written material for instruction was also created. I have evolved a new systems cost estimation workbook with the adjunct tools for use in SE3011.

I developed materials for the software cost estimation modules for the new M.S. Cost Estimation and Analysis (MCEA) curriculum.

Minor refinements were made to SE4003 materials, and some new readings were added.

- SE4003 revamp

b. DoN/DoD applications

I developed the MCEA materials described in section a. above and taught them jointly with AFIT to focus on defense project applications.

I'm continuously adapting cost estimation material for DoD environment contexts, striving to mirror the actual types of projects students will encounter.

c. Teaching techniques developed

The unique web-based tools for teaching and adjunct workbook are summarized above in Section a. Course and laboratory development. These are new capabilities in the classroom.

d. Thesis supervision

(i) advisor

In August 2017 I began an SE5805 Directed Study course for new Ph.D. student Socrates Frangis supporting his advancement to candidacy, and expect to become his main advisor in the area of embedded firmware and software security research. Expected graduation is June 2019.

Since tenure I advised the following matriculated students:

Cutting, Alexander, "Analysis of Electromechanical Actuators Used to Move Jet Blast Deflectors on Aircraft Carriers", MS Systems Engineering Management, September, 2016

Edwards, Dennis, "Exploring the Integration of COSYSMO With a Model-Based Systems Engineering Methodology in Early Trade Space Analytics and Decisions", MS Systems Engineering, June 2016

Previous students I advised include:

Peter P. Labbe, "Standardization of Software Application Standards and Governance", MS Systems Engineering Management, December 2014

Nam H. Tran. "Integrating Information Assurance with Systems Engineering to Improve Security and Interoperability of the Warfare System on USS George H. W. Bush (CVN 77)", MS Systems Engineering, September 2013

(ii) co-advisor

I'm Ph.D. co-advisor for:

LT Rollie Wicks, "User Centric Cloud", Ph.D. Software Engineering, expected graduation 2018

Previous students and teams I co-advised include:

Alan Philpott, "Benefits of Design Budget Approach to New Ship Construction", MS Systems Engineering Management, April 2015

Nicole Becker, Timothy Byram, David Frank, Kevin Hogan, Richard Kim, Glenna Miller, Shane Schonhoff, Scott Myers, Heather Whitehouse, "Application of Model-Based Systems Engineering (MBSE) To Compare Legacy And Future Forces In Mine Warfare (MIW) Missions", Master's Degree in Systems Engineering Capstone Project, Naval Postgraduate School, January 2015

Clayton Bennett, Christopher Farris, Paul Foxx, Hughlyn Henderson, Stacy Himes, Corey Kennington, Matthew Mussman, Michael Newman, Maysam Sarfaraz, Brandon Harwood, "Operational Energy/Operational Effectiveness Investigation For Scalable Marine Expeditionary Brigade Forces In Contingency Response Scenarios", Master's Degree in Systems Engineering Capstone Project, Naval Postgraduate School, December 2014

Khoa Pham, "An Investigation of the Benefit of Applying the Dual-Vee Systems Engineering Model to a Software Product Line", MS Systems Engineering, December 2014

(iii) second reader

Since tenure I was second reader for the following matriculated students:

Theresa L. Thomas, "Requirement Verification And Systems Engineering Technical Review (Setr) On A Commercial Derivative Aircraft (Cda) Program", MS Systems Engineering Management, September 2017

Terwilliger, Katherine, "Investigating Outfitting Density as a Cost Driver in Submarine Construction Costs", MS Systems Engineering Management, October, 2015

Previously I was second reader for the following students and teams:

Steven A. Newton, "A Construct for Governing and Evaluating Platform Cyber Infrastructure at the Enterprise Level", MS Systems Engineering Management, September 2014

Jacob M. Hempen, Examination of On-orbit Solar Array Data to Determine GPS Satellite Reliability and Lifetime, MS Systems Engineering Management, September 2014

Linda Banner-Bacin, Tim Carpenter, David Chacon, James Chandler, James Childs,Tuyen Hoang, Robert Howard, James Isaian, Seung Kang, Michael Kinberg, James Kong, Jeremy Manz, Ruth Matela, Jonathan Mendiola, John O'Neil, Leonard Oriz, Tan Pham, Jamal Rayshouny, Eric Sarabia, Kihoon Sung, Heng Sysavath, Caleb Vajdos, Armando Valdez, Armando Vasquez, Alan Wellesley, Mindy Wentland, "Application of Model Based Systems Engineering Methods to Development of Combat System Architectures", MS in Systems Engineering Capstone Project, Naval Postgraduate School, March 2009

(iv) Ph.D. dissertation committee member [1]

Since tenure the new Ph.D. committees I'm serving on include:

John Quartuccio, "Identification of Behavior Patterns in Systems of Systems Architecture", Ph.D. Systems Engineering, expected graduation June 2018

Curtis Adams, "Agent and object oriented model based concept design for mobile cyber physical systems", Ph.D. Systems Engineering, expected graduation December 2017

I'm also on the following Ph.D. committees:

Rollie Wicks, "User Centric Cloud", Ph.D. Software Engineering, expected graduation 2018 (as co-advisor per section II.1.d.ii)

Donna Dulo, "A Knowledge-Based Framework for the Development of Safe and Resilient Aircraft Software", Ph.D. Software Engineering, expected graduation March 2018

e. Self-improvement efforts

continued ... My self-directed learning of net-centric software development provides a more informed perspective for modern project cost estimation, creating better cost modeling and simulation tools including service-oriented ones. It also allies with integrating engineering disciplines.

I attended all sessions of the course Foundations of Teaching and Learning (FTL) in 2012. Some of the assignments were done, but research and service commitments prevented me from completing them all.

f. Reading courses taught

g. Instructional materials

Since 2015 several major improvements were made to materials for SE3011 and SE4003. The cost modeling tools were updated for various features including the capability to save/modify estimates in the cloud. The *Systems Engineering Cost Estimation Workbook* was also updated and refined for additional problems and model details.

In SE4003 major revisions were made to materials for incorporating software development homework assignments. The students were taught fundamentals of the Python programming language (relevant to DoD) with new materials, programming resources and tutorials that I developed.

[1] This subsection was added to the standard NPS outline.

Instructional materials are also discussed in sections a. – c. above. These include creating new material for the Master of Cost Estimating and Analysis (MCEA) degree with the Graduate School of Operational and Information Sciences (GSOIS), cost modeling tools and systems engineering cost estimation workbook for the SE3011 classroom.

In 2013 instruction materials were further updated for TOC integrated estimates covering multiple disciplines. I supplemented the SE3011 course for new systems, software and hardware cost models incorporating maintenance. I further elaborated hardware cost modeling in course teaching and tools, with examples for specific DoD domains. Monte Carlo analysis was expanded into additional cost factors.

My *Systems Engineering Cost Estimation Workbook* for SE3011 and other cost estimation courses was continuously improved along these lines. I strove to become more effective teaching online with assisted and self-study in 2011. I supplemented the SE3011 course for updated cost models and the new workbook. By updating the curriculum material, replacing the prior textbook with my own workbook, and improving the course delivery my SOFs increased dramatically starting in Q1 2011. Students have concurred the more comprehensive TOC view was relevant for their programs. Materials for the software cost estimation portion of the MCEA were also completed as an inter-school effort with GSOIS. Improvements in the COCOMO Suite toolset also support the classes and new MCEA degree. Some minor refinements were made to the SE4003 materials, and some new readings included.

h. Mentoring

N/A

i. Course coordination

I have been the SE4003 course coordinator since 2010. This activity has included supporting the successful ABET preparations and assessment process.

Course Coordinator, SE4003 : Systems Software Engineering Course Coordinator. (January 2009 - Present). Continual monitoring of course deliveries, review and approval of course journals, course improvements, approvals of student course credit requests (ensuring same topics were adequately covered), and supporting ABET accreditation.

> I started as Course Coordinator for SE3011 as of AY2017. This also includes continual monitoring of course deliveries, review and approval of course journals, course improvements, approvals of student course credit requests (ensuring same topics were adequately covered), and supporting ABET accreditation.

j. Other instruction information

> Since tenure I have taught SE4003: Software Systems Engineering and made major changes. I revamped the course with substantial new assignments and material. The primary change was the introduction of software development exercises with the traditional high-level overview of software engineering methods and issues. Programming gives the students an important complementary bottoms-up view of software engineering. With this broader exposure they can understand better how the devils are in the details with practical hands-on experience. Other SE4003 instructors have subsequently incorporated the changes in their classes.

Substantial effort has gone into supporting the Software Engineering (SWE) Ph.D. committee since 2010. I have written and graded the PhD Written Qualifying Exam in Software Engineering Management and Economics each year. This includes giving SW4936 lectures for the Ph.D. seminar, writing and administering the SWE Ph.D. written exam, and supporting students throughout. This has also lead to being on several of their Ph.D. dissertation committees and involved with their research as listed in subsection d.

Presented recurring guest lectures in SE3011 for other NPS instructors.

Presented SE4003 guest lectures previous to becoming the coordinator.

I have developed a semi-automated course journal creation program. This can be nearly fully automated, linked to Sakai and used by other faculty. I have a coded a database of the SE courses.

k. Other information on evaluation of instruction

Evidence includes follow-up emails from past students using cost estimation methods from my class and my tools on DoD projects. Several have also followed up for advising on capstone projects related to cost. E.g. a student group from NAVSEA Port Hueneme division are planning this as a follow-on of my LWEF BCA research there.

2. Internal Research Activities

a. Summary of internal research projects

None. I did not participate in the NPS Research Initiation Program (RIP) because I had my own external funding.

b. Thesis Contributions

My support and collaboration with Monica Farah-Stapleton who matriculated with her CS Ph.D. was essential in demonstrating that software size measures could be measured from Monterey Phoenix architectural behavior models. This was the another major aspect of integrating MBSE approaches to support automatic cost estimation for tradespace analysis. 2 refs

In Nam Tran's thesis my contribution was a direct application of my cost model/tool for his core quantitative assessment and conclusions.

Rob Hall's thesis (as co-advisor) for product line strategy cost analysis

c. Contributions to interdisciplinary NPS research projects

I initiated and led an interdepartmental ONR proposal, recruiting colleagues from other NPS departments and schools on "Integrated Total Ownership Cost Assessment and Simulator" in 2011.

d. Visiting researchers attracted

N/A

e. Other contributions

3. Internal Administrative and Service Activities

A timeline of post-tenure major internal administrative and service activities is in Figure 1. Supporting details in the sub-sections below are roughly sized by the relative efforts involved.

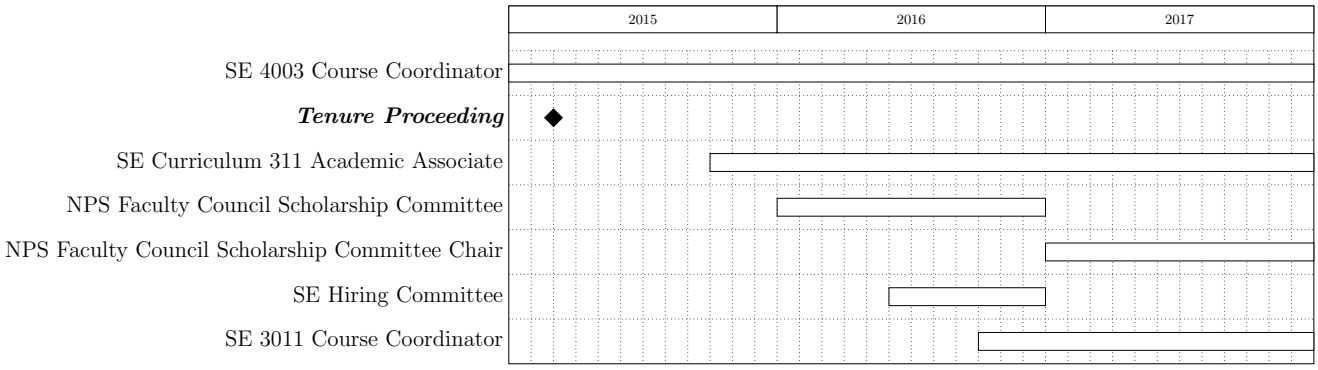

Figure 1: Internal Administrative and Service Activities Timeline

a. Committee Service

Committee Member, Faculty Council. (January 1, 2016 - Present). Scholarship Committee Member
I began serving on the NPS Faculty Council Scholarship Committee. The committee was already producing a major report on SOF process recommendations, and I will continue for at least two more years.
Committee Member, Systems Engineering Dept. Hiring Committee. (March 2016 - June 2016). Screen, interview and recommend new SE hire

Member of the Systems Engineering Curriculum committee.
Member of the Software Engineering (SWE) Ph.D. committee.

b. Service as Academic Associate

Academic Associate, SE (DL) Curriculum 311 Academic Associate. (July 1, 2015 - Present). As the 311 Academic Associate I review student records, support the selection process, maintain program integrity, assess and approve ABET equivalencies, address student concerns, approve capstones and theses, and support graduation award selections. I regularly present at cohort introductory sessions to overview the program and explain the role of Academic Associate. I have helped improve communications and processes with the NPS Admissions office by clarifying degree requirements and acceptance of previous credits in Engineering and Science. Previously it was ill-defined in Admissions about what constituted valid classes in the areas.

Curriculum 311 is by far the largest degree program in the Systems Engineering Dept. During my tenure, 258 Curriculum 311 students have graduated from September 2015 to June 2017 (not including SEP students). Currently there are 242 students enrolled in 15 cohorts.

III. EXTERNAL ACTIVITIES

1. External Teaching Activities

a. Courses

My MCEA software cost estimation lectures are conducted jointly with AFIT students. Have presented several invited guest lectures for Software Engineering and Management, and Software Cost Estimation at USC.

b. Course materials

The COCOMO Suite tool is used at many universities though the exact number is indeterminate. See a partial representative list in section 3.c. totaling 28 known universities. It's used for both a required tool for homework in academic curriculums; and a teaching aid to demonstrate cost modeling and project management concepts.

c. Other significant products

In wide external use, the COCOMO Suite web-based tool improves accessibility and usability of parametric cost models. It reduces the effort for estimation, ensures correct and repeatable estimates with known models, and allows for increased sophistication of analyses and student problems. Parametric models can be selected in different combinations by the user and it includes Monte Carlo simulation. See a partial representative list in section 3.c. of known academic users.

System Cost Model Suite is the new and upgraded program that covers a larger perspective in engineering disciplines, lifecycle phases and associated parametric models for TOC. It also has an improved new-look user interface with Monte Carlo simulation capability.

The SEBoK has already become a widely used reference in systems engineering curricula.

d. Short course initiation, coordination and participation

e. Distance Learning course initiation, coordination and participation

In 2009 I supported initial SPAWAR classes and helped plan their classroom buildup in San Diego. The classes have been primarily on-line since then.

Other

Support and guidance of Ph.D. research for USC students Doug Buettner (matriculated), Gustavo Perez (matriculated, on Ph.D. committee) Jo Ann Lane (matriculated), and Dan Ingold. Buettner's dissertation research was an extension my Ph.D. simulation model.

2. External Research Activities

a. Summary of externally funded research projects

I was PI on the following research projects.

SOFTWARE COST ESTIMATION METRICS, U. S. Air Force Cost Analysis Agency, $75,000 FY09-FY10; $65,000 FY10-FY11; $25,000 FY11; $15,000 FY11-FY12 (4 awards, total $180,000)

I was PI for this ongoing research that met its objective to establish a robust and cost effective software metrics collection process and knowledge base that supports the legitimate data needs of the DoD, while imposing minimal

burdens on the Acquisition Workforce, and its industry partners. Further objectives met were to enhance the utility of the collected data to oversight and management entities, and to academic and commercial research into improved cost estimation of future DoD software-intensive systems, as well as to the DoD cost community.

We used data submitted to DoD in the Software Resources Data Report (SRDR) forms to provide guidance in estimating software costs for future DoD projects. In analyzing the data, we found variances in productivity data that made such SRDR-based estimates highly variable. We performed additional analyses that provided better bases of estimate, but also identified ambiguities in the SRDR data definitions that enabled us to help the DoD DCARC organization develop better SRDR data definitions.

I developed the consistent metrics definitions used in the research and subsequently implemented in DoD contractual reporting criteria, serving as a cornerstone for current and future data analysis. This has directly impacted the DoD data collection process. These improvements have strengthened the SRDR reporting. They has been reflected in improved, more consistent and complete data in the Defense Automated Cost Information System (DACIMS).

After the change incorporation by DCARC, this continuing research furthered prior empirical data analysis with specific advancements in DoD domain analysis. A wiki representation of the material was created; and workshops were conducted to coordinate the SRDR database analysis. SRDR data was further analyzed for influences on activity distribution variations by domain, size, and requirements volatility. We integrated the costing benchmarks with MIL-STD-881B WBS categories.

The results have been used for documenting metrics guidance for practitioners in a manual. The Software Cost Estimation Metrics Manual for Defense Systems has now been thorough external peer reviews during and after this research.

Publications:

B. Clark and R. Madachy (Eds.), Software Cost Estimation Metrics Manual for Defense Systems, Software Metrics Inc., Haymarket, VA, 2014.

W. Rosa, R. Madachy, B. Boehm and B. Clark, "Simple Empirical Software Effort Estimation Model", Proceedings of 2014 Empirical Software Engineering and Measurement International Symposium, IEEE, September, 2014

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(viii) Refereed Technical Reports

(ix) Non-Refereed Technical Reports

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serc reports

[146] Tradespace and Affordability – Phase 2 A013 - Final Technical Report. Technical Report SERC-2013-TR-039-2, Systems Engineering Research Center, December 2013.

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[154] R. Madachy. Risk Model Report and Demonstrations. Technical report, submitted to NASA AMES, 2007.

[155] R. Madachy and B. Boehm. Detailed Plans for CY 2008: Software Risk Advisory Tools Enhancements. Technical report, submitted to NASA AMES, 2007.

[156] D. Ingold and R. Madachy. NASA Macro Risk Model Detailed Case Study. Technical report, submitted to NASA AMES, 2007.

[157] R. Madachy and B. Boehm. Detailed ODC COQUALMO and Accuracy Analysis. Technical report, submitted to NASA AMES, 2007.

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[160] R. Madachy. 6G Software Cost and Defect Data Collection Form. Technical report, submitted to NASA AMES, 2006.

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[163] R. Madachy. JPL Delphi Survey for V&V Defect Detection Efficiencies. Technical report, submitted to NASA JPL, 2006.

[164] D. Ingold and R. Madachy. Risk Model Calibration Report. Technical report, submitted to NASA AMES, 2006.

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[166] R. Madachy and B. Boehm. MOCA Final Report. Technical report, submitted to the NASA/USRA MOCA project, March 2006.

[167] R. Madachy. Using ODC COQUALMO to Quantify Risk Exposure for AUTONOMO: Approach and Example. Technical report, submitted to the NASA/USRA MOCA project, 2005.

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[169] R. Madachy. Incremental COCOMO II and Initial System-of-Systems Common Operating Environment (SOSCOE) Sensitivity Analysis. Technical report, submitted to the Army/DARPA Future Combat Systems (FCS), 2005.

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[171] B. Boehm, L. Huang, A. Jain, and R. Madachy. The Nature of Information System Dependability: A Stakeholder/Value Approach. Technical Report USC-CSE-2004-520, University of Southern California, 2004.

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[173] R. Madachy. FCS Software Cost and Schedule Data Collection. Technical report, prepared for contractors on the Army Future Combat Systems (FCS), 2002.

[174] R. Madachy and B. Boehm. MDS software adoption cost analysis. Technical report, submitted to NASA-JPL, 2002.

[175] R. Madachy, D. Reifer, and B. Boehm. FCS software cost estimation initiative plan. Technical report, submitted to Boeing for the Army/DARPA Future Combat Systems (FCS), 2002.

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(x) Published Computer Programs

add github programs
System Cost Model Suite (v. 2.0 with file saving)

(xi) Book Reviews

(xii) Other

c.Reviews or other indicators of quality or significance of items listed in (a)

My citation indices from Google Scholar as of 9/7/2017 are in Table 1.
add URL

Table 1: Google Scholar Citation Data

Citation indices	All	Since 2012
Citations	6063	2022
h-index	23	14
i10-index	38	24

My h-index and i10-index have both been continually rising while at NPS, and I am fourth among all NPS researchers for citations on Google Scholar.

Invited by the DoD-sponsored Software Tech News to write an article on software quality modeling.

The OSD Cost Analysis and Improvement Group (CAIG) implemented our recommended changes to the mandated Software Resources Data Report Form. This will allow better visibility into software size and cost factors, and enabling more precise measurements for effort models and productivity based on our empirical research.

Included on DoD's DACS list of software quality and reliability experts

Partial Representative List of Tool Users

The significance of my cost modeling tools is evidenced by the widespread user base. The COCOMO Suite cost model users listed in this section are almost all harvested from a quick email search (except where noted). Not all email was found. These are only the users who explicitly send acknowledgments and/or have questions. Indications are these represent a very small minority of users. Almost all users do not report back per the data files and general common sense.

This list does not include organizational usage due to any NPS students (during or after my class). There are many instances of students using them after NPS. Inclusion would be a counting bias for external impact and their locations would be added to this list. Also not shown are many small consultancies and individuals.

Many organizations in the list below are using the tool on multiple programs and/or have standardized its usage.

Book Reference

C. Ebert, Global Software and IT: A Guide to Distributed Development, Projects, and Outsourcing, IEEE/Wiley, 2011

Also not shown are technical reports, blogs and links referring to the tools.

3. External Professional and Service Activities

A timeline of post-tenure major external professional and service activities is in Figure 2. Supporting details in the sub-sections below are roughly sized by the relative efforts involved.

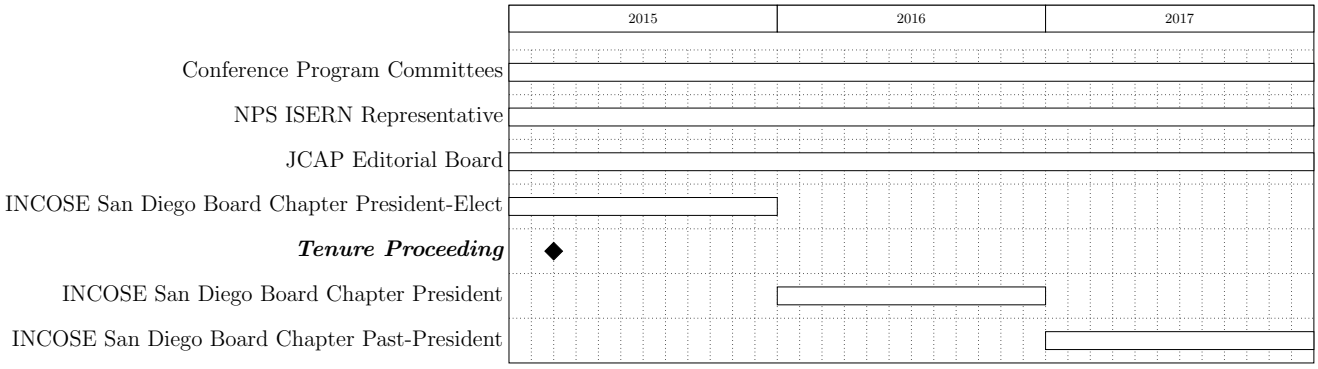

Figure 2: External Professional and Service Activities Timeline

Activities performed since my tenure proceeding are dated after February 2015 in the sections below.

a. Navy/DoD Activity

Served on Advisory Panel to ODASD/SE and presented "Simulation of Processes for Developing Complex Systems" at the DoD Schedule Assessment Workshop" in Crystal City, VA in 2011. This was in response to ODASD/SE asking for my advice on methods and models for schedule estimation.

Invited by OSD-ATL and presented "Simulation of Processes for Developing Complex Software-Intensive Systems" at the SSA Software Collaborator Teleconference in 2010.

Invited by OSD-ATL and presented "Systems Engineering Management and the Relationship of Systems Engineering to Project Management and Software Engineering" at the SSA Software Collaborator Teleconference in 2011.

Workshops I led or co-led for AFCAA include:

- latest workshops

Table 2: System Cost Modeling Tool Users - Partial List of Reporting Organizations

DoD and FFRDCs
· SPAWAR 1.6, Washington Navy Yard
· SPAWAR - Atlantic
· US ARMY AMRDEC Software Engineering Division
· Defense Acquisition University - West Region
· Software Engineering Institute
· USAF, Space and Missile Systems Center
· Naval Surface Warfare Center Port Hueneme Division
· Naval Undersea Warfare Center NWPT
· Navair PMA 281
· Naval Sea Systems Command SEA 04
· Navy Airborne Instrumentation Division, Point Mugu
· Naval Surface Warfare Center, Panama City Division
· DAU
· AFIT
· Cyber Security and Information Systems Information Analysis Center (CSIAC)
· US ARMY RDECOM CERDEC, Space & Terrestrial Communications Directorate

Other US Government
· U.S. Department of Agriculture
· Federal Communications Commission (FCC) (from web)

DoD contractors
· Lockheed Martin
· General Atomics Aeronautical Systems
· IBM
· Northrop Grumman Electronic Systems, ISR&TS Div.
· SAIC, Airspace Mission Planning Division
· iAccess Technologies, Inc.
· Aerojet
· ThalesRaytheonSystems, Missile Defense Business Unit
· Booz Allen Hamilton

Universities
· University of Southern California
· Stevens Institute of Technology
· MIT
· University of Wisconsin (from web)
· Humboldt State University
· Lund University (from web)
· Iowa State University (from web)
· University of Wisconsin
· Clemson University
· Carnegie Mellon University
· University of Arizona
· University of Houston
· Boise State University (from web)
· Kansas State University
· University of Alberta in Canada.
· University of Michigan

Universities (Cont.)
· University of Tartu (from web)
· Tampere University of Technology (from web)
· TU Munich
· York University
· University of Chicago.
· University of Western Ontario Canada
· University Putra Malaysia
· DAU
· AFIT
· University of Ecuador
· Slovak University of Technology (from web)
· France, unstated schools
· India, unstated schools
· Mexico, unstated schools

Other U.S companies
· Hewlett Packard Enterprise Services
· PNC Bank
· SPi Global
· Mib Software
· Walgreens Health Services
· Total Administrative Services Corporation (TASC)

Foreign
· Fujitsu
· Brazil, Federal Bank
· Aero Engine Controls
· Tieto Poland, Industrial R&D
· ThyssenKrupp AG
· MEI Technologies, Inc.
· ATECH Negócios em Tecnologias SA
· ITK Engineering AG

B. Clark, R. Madachy, "DoD Software Resource Data Reports (SRDRs) and Cost Data Analysis Workshop", Proceedings of the 27th International Forum on COCOMO and Systems/Software Cost Modeling, Pittsburgh, PA, 2012

B. Clark and R. Madachy, "Air Force Estimation Guidebook Workshop", Proceedings of the 26th International

Forum on COCOMO and Systems/Software Cost Modeling, Los Angeles, CA, 2011

B. Clark and R. Madachy, "SRDR Data Analysis Research Workshop", Proceedings of the 25th International Forum on COCOMO and Systems/Software Cost Modeling, Los Angeles, CA, 2010

B. Clark and R. Madachy, "Software Metrics Unification & Software Productivity Domains", Proceedings of the 24th International Forum on COCOMO and Systems/Software Cost Modeling, Cambridge, MA, 2009.

NDIA expert panelist on "Panel: Systems Engineering Management and the Relationship of Systems Engineering to Project Management and Software Engineering" in 2011.

b. External Professional Activities

Professional Organization Board

Past-President, INCOSE San Diego Chapter, San Diego, CA. (January 2017 - Present).

President, INCOSE San Diego Chapter, San Diego, CA. (January 2016 - January 2017). Responsible for leading the INCOSE San Diego Chapter

- Preside at Board and Chapter meetings
- Act as an ex-officio member of all Chapter committees and working groups
- Recommend Nominations and Elections Committee members
- Nominate Audit Committee members
- Represent the Chapter at the annual International Workshop (IW) and International Symposium (IS)
- Participate in INCOSE Region II meetings (internet and telecon)
- Support or lead and plan joint-chapter events; assist other INCOSE chapters
- Act as INCOSE Member Board interface
- Prepare annual submission for Chapter Award

Under my leadership as President we accomplished the following:

- Held 8 Chapter meetings (providing Professional Development Units (PDUs) for Systems Engineering Professional (SEP) certification)
- Conducted a Tutorial (providing PDUs for SEP certification)
- Held a Mini-Conference (providing PDUs for SEP certification)
- Raised $12K worth of STEM funds and awarded 9 STEM grants to local schools for science projects based on their competitive STEM proposals
- Hosted a STEM event and Geek Night on the Midway ship in San Diego

These are beyond the normal expectations for a chapter of our size. For these accomplishments we were awarded the INCOSE Gold Chapter Award based on a scale of absolute points for activities. The other Chapters receiving this award are far larger.

President-Elect, International Council on Systems Engineering (INCOSE), San Diego Chapter, 2015 President-Elect, INCOSE San Diego Chapter. (January 2015 - January 2016). Responsible for the organization of a Chapter program of meetings and events. Enlist a committee to assist in the program responsibility. Succeed to the position of the President for the year following the term as President Elect.

I served as President-Elect of the INCOSE San Diego Chapter through 2015, and then served as President in 2016. The Chapter supports extensive professional activities via monthly meetings, tutorials and mini-conferences with continuing education credits. The Chapter also provides local STEM education awards for the community by raising funds, assessing school proposals, and distributing the funds. For my tenure based on our contributions and accomplishments, were are on track to receive the prestigious Gold Chapter Circle Award from INCOSE. It is a recognition for "reaching the highest goals and standards established by our organization".

list duties, activities, events, outputs as president and ref. newsletter articles

Treasurer, International Council on Systems Engineering (INCOSE), San Diego Chapter, 2014 Treasurer, INCOSE San Diego Chapter. (January 2014 - January 2015). Manage the finances of the Chapter. Receive all funds paid to the Chapter and makes payment of all bills incurred by the Chapter as approved by the Board. Make monthly reports to the Board as well as an annual report to INCOSE on the finances of the Chapter.

Professional Organizations

Institute of Electronic and Electrical Engineers (IEEE) (Senior Member) International Council on Systems Engineering (INCOSE) Association for Computing Machinery (ACM)

Journal Editorial Boards

Editorial Board, Journal of Cost Analysis and Parametrics (JCAP), 2012 – 2017

Editorial Review Board, International Journal of Information Technology and the Systems Approach (IJITSA), 2007-2009

Journal Reviewer

- several new reviews 2 or 3

Active reviewer for top refereed journals including: *IEEE Transactions on Software Engineering, IEEE Systems Journal, IEEE Software, IEEE Computer, Journal of Software: Evolution and Process, Information and Software Technology, Journal of Systems and Software, System Dynamics Review, ACM Transactions on Software Engineering and Methodology, Empirical Software Engineering, Information and Software Technology, International Journal of Computer Integrated Manufacturing, others*, 1996-2017

Recent reviews are recorded at https://publons.com/author/1228440. Some manuscripts reviewed while at NPS since 2008 are shown below, though the list is incomplete.

- System Dynamics Review, 2017 (SDR-17-0015)
- Journal of Software: Evolution and Process, 2017 (JSME-16-0191)
- IEEE Transactions on Software Engineering, 2009, 2010, 2011, 2014
  - TSE-2014-34-0054
  - TSE-2012-04-0093
  - TSE-2011-03-0066
  - TSE-2009-12-0406
- IEEE Systems Journal, 2013 (ISJ-RE-13-02596)
- IEEE Software, 2009
- Empirical Software Engineering, 2010, 2014
  - EMSE-D-14-00093
  - EMSE430 2010
- Journal of Software Maintenance and Evolution: Research and Practice, 2009
- Journal of Cost Analysis and Parametrics, 2013 (UCAP-2013-0001)
- ACM Transactions on Software Engineering and Methodology, 2011 (TOSEM-2011-0093).
- Information and Software Technology, 2010, 2014
  - INFSOF-D-10-00109
  - INFSOF-D-13-0044
- International Journal of Computer Integrated Manufacturing, 2009 (TCIM-2010-IJCIM-0105)

- International Journal of Information Technologies and Systems Approach, 2009

Conference Chairmanship

Program Co-Chair for International Conference on Software Process (ICSP), 2009
Publicity Chair for International Conference on Software Process (ICSP), 2008
Registration Chair for International Symposium on Empirical Software Engineering (ISESE), 2004
Program Chair for International Forum on COCOMO and Systems/Software Cost Modeling, 1998-2001

Conference Program Committee Member

Program Committee for Actionable Analytics Workshop, co-located with IEEE Automated Software Engineering (ASE2015), 2015

Program Committee for International Conference on Systems and Software Process (ICSSP), 2011-2015, 2017
Program Committee for Conference on Systems Engineering Research (CSER), 2012-2015
Program Committee for International Forum on COCOMO and Systems/Software Cost Modeling, 1994-Present Program Committee for International Conference on Software Process (ICSP), 2007-2010 Program Committee for Software Process Simulation Modeling Workshop, 1998-2000, 2003, 2005-2006
Program Committee for International Symposium on Empirical Software Engineering (ISESE), 2004
Program Committee for International Conference on COTS-Based Software Systems (ICCBSS), 2004
Program Committee for Feedback and Evolution in Software and Business Processes (FEAST) Workshop, 2000
Program Committee for California Software Symposium, 1997-1999

Conference - Other
Reviewer for several papers submitted to the Barry W. Boehm Symposium, 2011 Reviewed a conference paper for Engineering Education and Educational Technologies (EEET 2010), 2010

Conference Tutorials Organized
D. Houston and R. Madachy, "Tutorial: Understanding the Dynamics of Software Projects: An Introduction to Software Process Modeling and Simulation", Proceedings of the 2014 International Conference on Software and System Process, IEEE, Nanjing, China, 2014
R. Madachy and R. Valerdi, "Tutorial: Systems Engineering and Total Ownership Cost Estimation", Proceedings of the 22nd Annual INCOSE International Symposium, Rome, Italy, July 2012

Workshops and Panels Organized

new workshops

B. Boehm and R. Madachy, "Workshop: Empirical Specification and Evaluation of the Ilities", Proceedings of the 2013 International Software Engineering Research Network Meeting, Baltimore, MD, 2013 B. Clark, R. Madachy, "DoD Software Resource Data Reports (SRDRs) and Cost Data Analysis Workshop", Proceedings of the 27th International Forum on COCOMO and Systems/Software Cost Modeling, Pittsburgh, PA, 2012 R. Turner, R. Madachy, "Improving Systems Engineering Effectiveness Using Kanban-based Scheduling and a Service-oriented Approach", Proceedings of IEEE SysCon, March 2012 R. Madachy and R. Valerdi, "Estimation Curriculum Development Workshop", Proceedings of the 26th International Forum on COCOMO and Systems/Software Cost Modeling, Los Angeles, CA, 2011 B. Clark and R. Madachy, "Air Force Estimation Guidebook Workshop", Proceedings of the 26th International Forum on COCOMO and Systems/Software Cost Modeling, Los Angeles, CA, 2011 B. Clark and R. Madachy, "SRDR Data Analysis Research Workshop", Proceedings of the 25th International Forum on COCOMO and Systems/Software Cost Modeling, Los Angeles, CA, 2010 B. Clark and R. Madachy, "Software Metrics Unification & Software Productivity Domains", Proceedings of the 24th International Forum on COCOMO and Systems/Software Cost Modeling, Cambridge, MA, 2009 Organized NDIA panel "Panel: Systems Engineering Management and the Relationship of Systems Engineering to Project Management and Software Engineering", 13th Annual NDIA Systems Engineering Conference, 2010 Organized and led expert panel on "Comparisons of Estimation Tools for Next-Generation Processes" at the 23rd International Forum on COCOMO and Systems/Software Cost Modeling, 2008 Organized and led workshop to refine and extend automated risk mitigation

advice for Expert COSYSMO framework at the 24th International Forum on COCOMO and Systems/Software Cost Modeling, 2009 Invited as an expert panelist on a literature review for the software process modeling field for the 2009 International Conference on Software Process.

Other Professional Service

Representing NPS for the International Software Engineering Research Network (ISERN), 2008-2017

Co-chairman of Los Angeles Software Process Improvement Network steering committee 1996-1998

Expert Witness

I serve as expert witness for selected cases including court deposition involving software Intellectual Property Theft and Breach of Contract. These are applications of software measurement, forensic analysis and project cost/schedule estimation. Recent cases include:

- OK case

  Ticket Innovations, Inc. v. Ticketmaster
  Los Angeles County Superior Court, Case No. BC 327228, 2008

  Business to Business Markets, Inc. (B2B) v. Kshema Technologies Ltd.
  Los Angeles County Superior Court, Case No. BC280932, 2009-2010

  Can-Auto Inspections Inc. and Can-Auto Services Inc. v. Vascor, Ltd.
  S.C.B.C Action No. S-073725, Vancouver Registry, 2010

Other Invited Talks, Honors and Recognitions

- lifetime Achievement Award

Invited talk to International Council on Systems Engineering (INCOSE), Quick Engineering Cost Estimates and Trades using Coconomography, San Diego Chapter, February 2011

Invited talk on Coconomography at the 25th International Forum on COCOMO and Systems/Software Cost Modeling.

Nomograph design used for special occasion mouse pads printed for the 25th International Forum on COCOMO and Systems/Software Cost Modeling, and others sold with proceeds donated to graduate student organizations.

Biography selected for inclusion in the Marquis Who's Who, listed as an engineering educator at NPS in the premier biographical listing.

c. Other external service activities

The INCOSE San Diego Chapter is heavily involved in local STEM activities. In 2014 we raised funds and provided 15 awards to local schools totaling about $16K for educational projects. I serve as Treasurer and am President Elect for next year.

digress in detail