

SATURN 2010 Panel on Architecture Certification

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

May 20, 2010

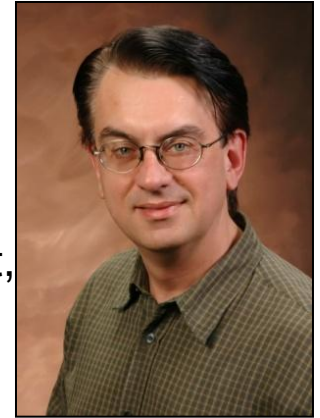


Our panelists



Rolf Siegers, Raytheon Company

Rolf Siegers joined Raytheon in 1984 and currently leads Raytheon's companywide Raytheon Mission Architecture Program (RayMAP), a set of initiatives addressing architecture governance, assessment, process, training & certification, collaborations, reference architectures, and tools. Rolf is an Engineering Fellow, a Raytheon Certified Architect, member and past Chair of Raytheon's corporate Architecture Review Board, and co-leader of the Raytheon Certified Architect Program.



Rolf has led several multi-disciplinary architecture teams for large-scale, software-intensive national and international systems since 1997. He is certified as a TOGAF-8 Architect (The Open Group), ATAM® Evaluator (SEI), Software Architecture Professional (SEI), and Master ITAC Architect (The Open Group). Rolf has presented at conferences for IEEE, U.S. Department of Defense, Object Management Group (OMG), International Council on Systems Engineering (INCOSE), Integrated Defense Architectures, The Open Group, and the Software Engineering Institute (SEI).

Rolf holds bachelor degrees in Computer Science and Mathematics from Huntingdon College and is a member of IEEE and INCOSE. He resides in Dallas, Texas with his wife and three children.



Don O'Connell, Boeing Company

Don O'Connell is a Technical Fellow working for the Boeing Company. His work includes software architecture and system architecture tasks for dozens of projects across all Boeing divisions (both commercial and military projects). Don is an SEI certified ATAM lead evaluator. He regularly performs architecture evaluations and a variety of architecture trade analyses for numerous Boeing programs. Don created the Boeing Software Architect Certificate (SAC) program, and has led it for about 3 years.



Title: software architect, systems architect

Counting today, he has worked for Boeing for more than 27 years

Has worked on a dozens of programs including AWACS, V-22, Mod5B windmill, Energy systems, 787 and 747 jet airplanes, P-8, FCS, Minuteman, and in Phantom Works.

Has worked in lots of locations, all over the US, Hawaii, Philly, England, France, Germany, Norway, Australia and even in Minneapolis.



Frances Paulisch, Siemens AG

Dr. Frances Paulisch works in the corporate technology division of Siemens AG in Munich, and is responsible for the Siemens System and Software Initiative, which addresses strategic software topics at Siemens and also enables the sharing of software-related best practices throughout Siemens worldwide. Frances is particularly interested in the combination of cutting-edge topics and their practical use. Her main current areas of interest are requirements engineering, software architecture, agile and lean software development, and global software development. She is responsible for a qualification and certification program on key roles in software development, in particular on software architecture.



She received her masters degree in computer science at Purdue University and her doctorate in software engineering from the University of Karlsruhe in Germany. She is the chair of the advisory board of the "IEEE Software" magazine.



Andy Ruth, IASA

Andy Ruth is the Vice President of Education for the International Association of Software Architects,, and is creating the learning elements to support lifelong career development for 60,000 IT architects around the world. The key elements of this effort are focused on creating a common body of knowledge, supported by training, certification, and community programs.



Prior to IASA, Andy was the architect role owner for Microsoft and creator of the Microsoft Certified Architect (MCA) program. When asked how long he has been in the industry, Andy suggested “long enough to remember when TCP/IP was being introduced as a new standard communications protocol”.

Andy is a published author and industry speaker with over 25 years experience in the IT field.



Linda Northrop, SEI

Linda Northrop is director of the Research, Technology, and Systems Solution Program at the Software Engineering Institute where she leads the work in architecture-centric engineering, software product lines, systems of systems, and ultra-large-scale systems.



She is coauthor of the book *Software Product Lines: Practices and Patterns* and led the research group on ULS systems that resulted in the book, *Ultra-Large-Scale Systems: The Software Challenge of the Future*.

Before joining the SEI, she was associated with both the United States Air Force Academy and the State University of New York as professor of computer science, and with both Eastman Kodak and IBM as a software engineer.



Panel Format

- Part 1: Each speaker will give a brief *two-slide* overview of his/her certification program using the following outline:
 - a) **Target candidate:** To whom are you targeting the program? What are the max/min qualifications?
 - b) **Description of program:** E.g., describe the courses; say how long completion takes; are there levels or stages? Is it available only within your organization or do you offer it to “outsiders”?
 - c) **Intended results:** Someone successfully completing the certification program should be able to...
 - d) **Testing:** Must a candidate pass an examination? If so, describe it.
 - e) **Number of people completing the program to date:** Obvious
 - f) **Costs and benefits measured/ observed:** To individuals, to your organization, to the community
 - g) **Overall / concluding observations:** E.g., what would you change about the program if you could?
- Part 2: Each speaker will present concluding thoughts about certification programs for architects.
- **Discussion and questions throughout**



Questions for the audience

- How many of you work for an organization that has its own architect certification program?



Questions for the audience

- How many of you work for an organization that encourages or supports architect certification?



Questions for the audience

- How many of you are holders of an architect/architecture certificate or certification?

Did your organization sponsor you or did you pay for it yourself?



Part 1



Raytheon Certified Architect Program

a. Target Candidate:

Senior systems and/or enterprise architect practitioner*

(minimum entry labor grade is one level below Engineering Fellow)



b. Description of Program:

Companywide initiative which formally identifies, instructs, and assesses Raytheon's top systems and enterprise architects

- Spans all Raytheon Businesses and includes participants from U.S., U.K, and Australia
- Program milestones: Raytheon Trained Architect, Raytheon Certified Architect
- Participants are Raytheon employees; Customer participation also permitted
- Recertification required every 3 years

c. Intended Results:

Establish a cadre of senior architects across Raytheon worldwide to develop architectures that support customer mission success, facilitate interoperability between highly complex systems, foster the expertise required for Raytheon to excel as a Mission Systems Integrator, and mentor our next generation of architects

d. Testing:

Certification requires fulfillment of several dozen criteria in the areas of...

- Professional Development, Core Skills, Practitioner Experience, Contributions to the Architecture Discipline

*other programs address junior and mid-level engineers

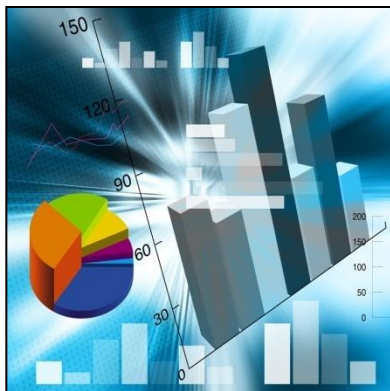


Raytheon Certified Architect Program

e. Number of People Completing Program to Date:

Over 360 participants in program, from U.S. and abroad

- 150+ fully certified
- 115+ others fully trained
- Remainder are at various stages of their training



f. Cost and Benefits Measured/Observed:

- \$400k start-up; ~\$1M annual
- **Measurement information is not releasable; general observations are...**
 - Large-scale pursuits are leveraging this expertise the most
 - Communication and collaboration across our 'architecture community' is greatly improved
 - Starting with a common foundation (process, training) enhanced our program and its results
 - Benefits are being realized outside of the Engineering organization
 - Junior, mid-level, and senior engineers are enthusiastic about an upper-level rung on the technical career ladder

g. Overall/Concluding Observations:

- Certification programs must support ongoing evolution after their deployment
- Certification is a mechanism to curtail 'business card architects'
- "What would I change?"*
 - Standardize some soft skills training, establish scale/scope 'levels' of architects, adapt program for next generation of architects



*a personal opinion



Boeing Software Architect Certification Program

a. What kind of person/qualifications to enter?

Software or System Engineer architect, seasoned veteran, 6000+ hours of proven, direct SW architecture experience

b. What does it include, how long does it take (work time, calendar time)?

Includes about 25 of 100 line items of study, content varies depending on domain of expertise. Takes 20+ hours for seasoned vet, takes > 100 hours for up and comer. Calendar time of months or many months.

c. What are the intended results? Someone with SAC can do what?

Refresh seasoned veterans in the state of art

Train upcoming architects in practices and in the state of art. SAC holders are referenced for SW arch jobs and arch analysis tasks

Mission is to improve SW architecture in Boeing. SW community significantly affected, some SE community affected



Boeing Software Architect Certification Program

d. What is the test to get the SAC?

Perform/complete 25 of the ~100 packet line items on your own time and schedule, fill out application packet along with reference details about SW arch experience. Lastly, interview with SAC holders/management.

e. How many have done it to date?

> 100 are finished/in work, > 1000 have examined it

f. What benefits have been observed?

Common terminology and understanding of SW architecture

Network with SW arch peers

Architecture repositories

g. What are the overall observations on the program?

The definitions of what SW architecture includes (and excludes) is all over the board as you look widely. This program helps fix that

Volunteer to certify works, funding would probably work faster

Modifiability of the SAC works fine



Siemens: Curriculum for Software Engineers

- a) Target candidate: The program is a whole SET of roles, initial focus and main topic addressed today is on “senior software architects”, experienced software architects of our most complex (class “A”) systems. Requires at least 5 years experience as architect of “class B” systems and similar length of experience as a technical team lead, must currently be responsible for architecture of class A project during the qualification program (and apply the techniques there).
- b) Description of program: Role-based qualification program, architecture driven but content addresses many topics beyond architecture (requirements, business understanding and strategy, testing & quality, leadership). Is structured as a series of 4 training units (14 days) over 9 month timeframe, between training units apply knowledge to own real project and pass the relevant certification gates.



Siemens: Curriculum for Software Engineers

- c) Intended results: reduction in non-conformance costs
- d) Testing: must pass a series on “knowledge gates” (not multiple choice, but open questions on applying what they learned to their projects) and at end a “capability gate” demonstrating social/leadership skills.
- e) Number of people completing the program to date:
50 completed, 15 in the “pipeline”
- f) Costs and benefits measured/ observed: Large initial investment in developing the program. Cost per person for the training also high as very training-intensive and with our top experts as trainers and assessors. Feedback of participants *and their managers* excellent, a real change in how they think and act. Is a key way to influence whole organization
- g) Overall / concluding observations: it is so work-intensive that it is difficult to scale, to make much faster progress



IASA CITA-P

a. Target candidate: Practicing IT architects

b. Description of program:

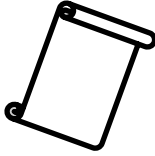
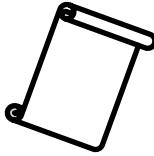

- The IASA CITA-P program is the 3rd level of certification for measuring an architect's career progression. The prerequisite is experience successfully delivering value through IT.
- The CITA-P measures a candidate's knowledge and experience using the skills in the IT Architect Body of Knowledge (ITABoK) in order to deliver business value through the use of IT with predictable and repeatable success on IT projects.
- The ITABoK is based on qualitative and quantitative analysis of the day-to-day skills that make today's worldwide community of top architects successful in their practice.



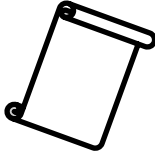
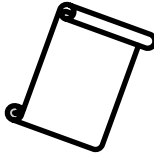

IASA CITA-P

- c. **Intended results:** Provide predictable and repeatable results in delivering business value through the use of IT
- d. **Testing:** Candidate submits a brief on experience and then stands for an interview with four senior architects, CIOs, or CTOs. Prereq is exp
- e. **Successful candidates to date:** 31 (program launched Dec '09)
- f. **Cost/benefit assessment:**
 - Individual gets validation of skills and growth roadmap
 - Organization gets reliable measure of architectural skills
 - Community get another member of the community and view on current business challenges and best practices in architecture
- g. **Conclusions:** Owned by the community of architects. As it needs to change and grow, it will.



SEI	Software Architecture Professional 	ATAM Evaluator 	ATAM Leader 
Mission	Provides software architects needed depth and breadth in architecture concepts and practices	Qualifies software architects to participate in SEI-authorized ATAM evaluations	Certifies software architects to lead SEI-authorized architecture evaluations using the ATAM
a. Ideal Candidates	Practicing software architects, designers, and developers of software-reliant systems	Those involved in the evaluation of software architectures, such as software and system architects and designers	Practicing software architects with superior communication, interaction, and facilitation skills
Minimum Qualifications	NA	NA	<ul style="list-style-type: none"> • five years experience in software engineering • two years experience developing software • BS degree in Computer Science or related discipline
b. Requirements	Complete four SEI courses: <ul style="list-style-type: none"> • SAPP • DSA • SADA • SPL 	Complete two SEI courses: <ul style="list-style-type: none"> • SAPP • ATAM Evaluator 	<ul style="list-style-type: none"> • ATAM Evaluator Certificate • Completion of three additional SEI courses (DSA, SADA, ATAM Leader) • ATAM Leader application • recommendation from an ATAM Leader • signed code of conduct



SEI	Software Architecture Professional 	ATAM Evaluator 	ATAM Leader 
c. Expected Outcome	Ability to <ul style="list-style-type: none"> • apply architecture-centric practices throughout life cycle • produce and understand documentation for software architecture Understanding of <ul style="list-style-type: none"> • quality attributes and their relationship to architecture • relationship of architecture to business goals • s/w product line approach 	Ability to <ul style="list-style-type: none"> • evaluate a software architecture • execute the steps of the ATAM 	Ability to <ul style="list-style-type: none"> • lead the evaluation of a software architecture using the ATAM
d. Testing (exam begun in 2008)	<ul style="list-style-type: none"> • SAPP exam: $\geq 75\%$ score 	<ul style="list-style-type: none"> • SAPP exam: $\geq 75\%$ score 	SAPP exam: $\geq 75\%$ score ATAM leader observation
e. Awardees	1140	521	11 (9 are SEI staff members)
f. Benefits	<p>Community level: focus on quality attributes and connecting business goals to architectural decisions corporate-level architecture initiatives and programs; SATURN</p> <p>Organization level: improved architecture practices and improved architectures; 10 of 11 US Army programs recognized significant or very substantial improvements from the use of the ATAM (Impact of Army Architecture Evaluations, CMU/SEI-2009-SR-007).</p> <p>Individual level: improved understanding of architecture concepts; greater confidence in using effective architecture-centric practices; enhanced technical credentials</p>		



Questions for discussion

- How well would the programs that you just heard about work in *your* organization? Would people sign up? Would the organization lend its support? Why or why not?



Questions for discussion

- Is software architecture as a topic well-founded/well-agreed upon enough to warrant certification?



Questions for discussion

- Do you think architecture certification primarily benefits the individual, the employer, the customer, or the community?



Questions for discussion

- How can certification address the broad range of application areas? Can an architect of a web-based non-mission critical application, an architect of a business-critical financial application, an architect of a highly-complex, life-critical embedded application be “equally” certified?



Questions for discussion

- Should we be certifying *organizations* instead of individuals?



Questions for discussion

- What is the appropriate role in certification of examining architecture *results* as opposed to architectural *knowledge*?



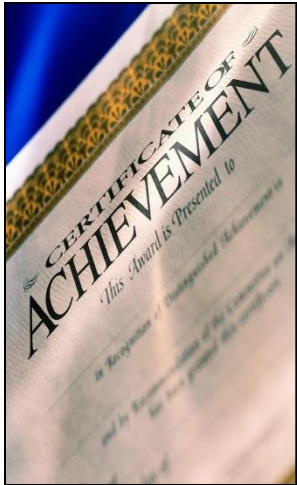
Part 2



Rolf Siegers, Raytheon Company



Raytheon Certified Architect Program



Role of Certification:

- To ensure (minimal) competencies of individuals carrying the 'architect' title (important both to a company and to its customers)
- To level-set to a common foundation of architecture knowledge across an organization
 - Facilitates communication across a community-of-architects (best practices, lessons learned, techniques & tools, etc)
 - Facilitates reuse (reference architectures, product line architectures, & other enablers)



Changes to the Architecture Discipline:

- A formalized, documented process continuum is needed – integrating enterprise, system, & sw architecture (framed through metamodels, IMHO)

Company Culture Change:

- Culture change is accelerated when confronted with explicit business value
 - We need more independent research quantifying the positive/negative impacts of the architecture practice



Raytheon Certified Architect Program

Key elements of RCA certification requirements include...

- **multiple architecture engagements** (support and/or leadership)
- **standards-based architecture training** (approximately 5 weeks)
 - Raytheon Enterprise Architecture Process (REAP)
 - U.S. Department of Defense Architecture Framework (DoDAF)
 - The Open Group Architecture Framework (TOGAF)
 - Zachman Framework for Enterprise Architecture
 - U.S. Federal Enterprise Architecture
 - SEI's Software Architecture Principles & Practices + SEI's ATAM®
 - RCAP Capstone
- **full system lifecycle experience**
- **leadership, communication, & core skills**
 - ConOps, architecture decision-making, governance, assessment, ...and the list goes on
- **external certifications:** TOGAF-8, ATAM® Evaluator
- **contributions to the architecture discipline**
(both within Raytheon and outside the company)
- successful completion of RCAP's *Skills Assessment* and *Architecting History* templates plus a **series of 1-on-1 and panel oral certification board reviews**



Don O'Connell, Boeing Company



Boeing: Philosophically Speaking

Is this certification worth it?

- Yes, but have to balance the amount of effort for certification to the actual benefits

What does the future look like

- Domain specific arch certificates
- Academic credentials
 - Industry and Academia align for SW architecture
- More Agile practices
 - Not a one size fits all

Can anybody be an Architect?

- Anybody can call themselves an architect, (i.e. George Castanza who often pretended to be an architect)



Frances Paulisch, Siemens AG



Siemens: Curriculum for Software Engineers

Key success factors

- **The holistic architecture-driven (but content not only architecture) approach**
- **Being able to apply the techniques immediately in current project is an important success factor, in particular so that the key architects can participate in the qualification program**
- **Connection to the “expert career” path at Siemens and top-management attention to the program**
- **Certification not based on presence or multiple-choice**



Siemens: Curriculum for Software Engineers

12 Guiding principles of Siemens Curriculum for Software Engineers

1. **Architecture** is the key throughout the whole lifecycle as well as across releases
2. Build on **existing basis** where feasible (from technical and business perspective) and be able to recognize when such **reuse** is not suitable
3. **Avoid unnecessary** technological **platform development** by using technical standards and products available on the market
4. In product and system business the **product (lifecycle) manager** / In project and solution business the **project manager** is and must act as **owner of the main requirements**.
5. Pay particular attention to non-functional requirements (**NFRs**), often overlooked but are extremely important
6. Be prepared and able to **handle changing** requirements, but be aware about the **risk of late changes**
7. **Synchronize** well across the **technical disciplines**: software, mechanics, electronics, mechatronics, systems engineering
8. **Work together** truly as a team, avoid “silo” thinking, be willing and able to speak and understand the other roles and disciplines
9. **Work iteratively** (no 100% definition of all up-front), strive to identify and resolve technical and business risks early
10. **Structure** the system to **avoid unnecessary complexity**, and to actively enable and support multi-site development
11. Strive for **transparency** and base **decisions** on clear business / technical reasons, not political ones
12. Do not underestimate the importance of **soft skills**, these can be particularly important for convincing and motivating

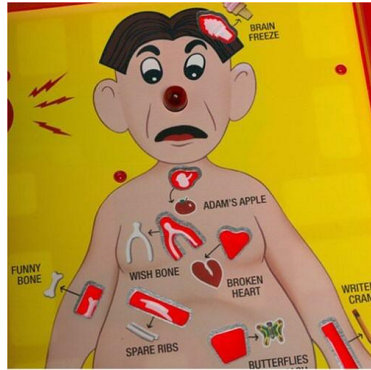


Andy Ruth, IASA



IASA CITA-P

Before...



<http://blogs.ajc.com/jeff-schultz-blog/files/2009/02>



<http://web.gcpower.net/wp-content/>

After...



Linda Northrop, SEI



SEI Software Architecture Certificate and Certification Program

About the SEI

- federally funded research and development center (FFRDC) whose research has identified and influenced best practices in architecture-centric engineering
- has disseminated these best practices through widely cited publications and professional training programs
- does not certify software architects
- certifies leaders of the SEI Architecture Tradeoff Analysis Method[®] (ATAM[®]) for evaluating software architectures
- offers two certificate programs in software architecture
 - Software Architecture Professional Certificate
 - ATAM Evaluator Certificate
- established these certificate and certification programs in 2003



SEI Program in Context

SEI architecture-centric engineering

- Foundations
- Methods
- Practices

Quality attributes,

ATAM, ADD, QAW, AADL,

Views and Beyond, ARID, CBAM, software product lines

Books



Course

- Software Architecture: Principles and Practices (SAPP)

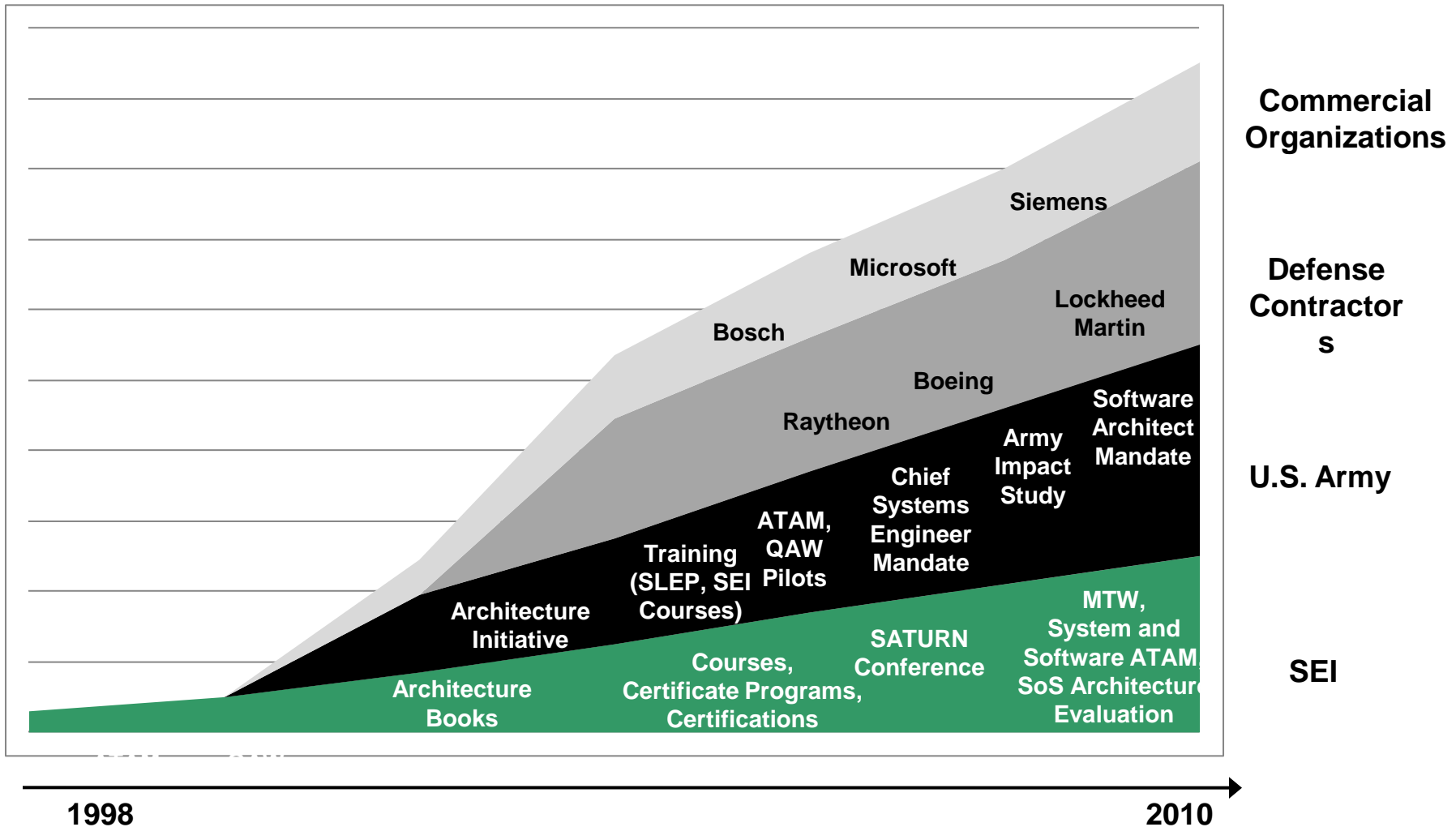
- Documenting Software Architectures (DSA)
- Software Architecture Design and Analysis (SADA)
- Software Product Lines (SPL)
- ATAM Evaluator
- ATAM Leader

Certificate Programs and Certification

- Software Architecture Professional
- ATAM Evaluator
- ATAM Leader



SEI: Trends in Institutionalizing Architecture Practices



SEI: Benefits Accrued

Community level

- focus on quality attributes and connecting business goals to architectural decisions
- corporate-level architecture initiatives and programs
- SATURN

Organization level

- improved architecture practices and improved architectures
 - 10 of 11 US Army programs recognized *significant or very substantial* improvements from the use of the ATAM (*Impact of Army Architecture Evaluations*, CMU/SEI-2009-SR-007).

Individual level

- improved understanding of architecture concepts
- greater confidence in using effective architecture-centric practices
- enhanced technical credentials



SEI: Observations

- Certificates have been very popular.

Issue	Solution
Scaling to meet demand	On-line courses; licensing external course instructors
Pressure to make certificate programs into certification programs	Begin by instituting evaluative component: SAPP exam
Backlash against SAPP exam	Lowered the minimum score

- ATAM Leader certification has not been popular.

Issue	Solution
Process is onerous	Beginning in September 2010, streamlined observation process

- Technical currency is key.

Issue	Solution
Keeping pace with changes in software architecture technology	Courses are continually updated.

