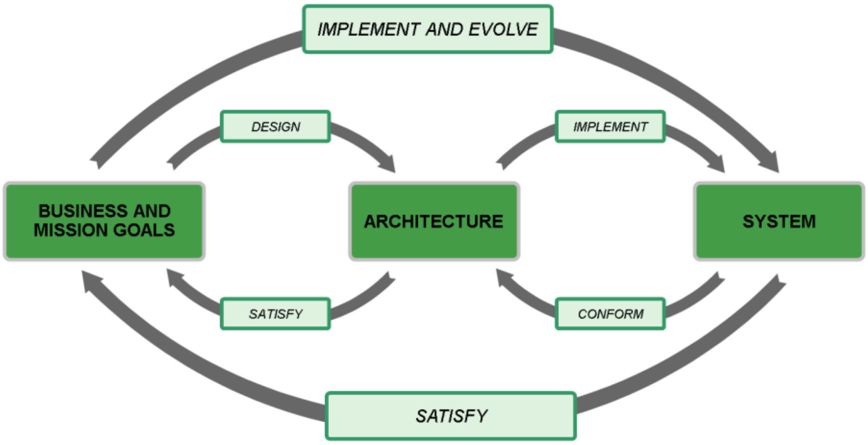
Software Engineering Institute | Carnegie Mellon

Architecture-Centric Engineering (ACE) Initiative

For many organizations, the achievement of business and mission goals is frustrated by software system problems such as

- poor quality—seen in, for example, systems crashing or behaving unpredictably, or users judging that a system is unusable; and
- slow time to market—seen in missed integration deadlines due to difficulty in identifying root causes of problems

In the Architecture-Centric Engineering (ACE) Initiative, we aim to improve product development and quality by using architecture to gain early confidence in achieving system-related business and mission goals.



We use architecture as the focal point for performing ongoing analyses to gain increasing levels of confidence that systems will support their missions.

Our Work

We develop and use techniques for analyzing quality attribute behavior based on a system's architecture. Our current research focuses on quality attribute foundations in cyber-physical systems, architecture-centric practices for large-scale systems, and architecture principles for ultra-large-scale (ULS) systems.

The ACE approach results in

- early identification and mitigation of design risks—yielding fewer downstream, costly problems and cost savings in integration and test
- predictable system quality—creating competitive advantage
- flexibility—enabling cost-effective system evolution

How We Can Help

The ACE team can help organizations and individuals through

- designing and analyzing software, system, and system-of-systems (SoS) architectures relative to business and mission goals
- developing precise models and quantitative analyses of systems for mission-critical quality attributes such as safety, performance, and reliability
- evaluating architecture evolution technical plans
- reconstructing a system's architecture from its implementation
- assessing and improving organizational architecture competence
- coaching to help introduce architecture-centric development to a software organization

Our Methods

- Architecture Tradeoff Analysis Method® (ATAM®)—for evaluating software architectures relative to quality attribute goals
- System and Software ATAM and SoS Architecture Evaluation—for evaluating system and SoS architectures, respectively, to ensure early identification of quality attribute inconsistencies and architectural risks
- Architecture Analysis and Design Language (AADL)—for specifying analyzable architecture models and enabling early discovery of integration problems
- Architecture Improvement Workshop (AIW)—for improving software architectures relative to quality attribute goals
- Architecture Evolution Workshop (AEW) —for evaluating architecture evolution plans relative to evolution-specific quality attribute goals
- Attribute-Driven Design (ADD) Method—for designing the software architecture of a software-intensive system
- Quality Attribute Workshop (QAW)—for identifying a system's architecture-critical quality attributes
- Mission Thread Workshop (MTW) —for eliciting an SoS's mission threads and augmenting them with architecture-critical quality attributes
- Architecture Documentation, Views and Beyond (V&B) Approach—for

guidance on documenting a software architecture

- Active Reviews for Intermediate Designs (ARID)—for ensuring quality detailed designs in software
- Cost Benefit Analysis Method (CBAM)—for determining the costs and benefits of architectural decisions

Our Courses

- Courses in software architecture essentials, documenting software architecture, software architecture design and analysis, ATAM Evaluator and Leader roles, and modeling system architectures
- Software Architecture Professional and ATAM Evaluator certificates
- SEI certification program for ATAM Leaders

Research Collaboration Opportunities

ACE researchers are interested in teaming with in areas such as

- developing techniques for agile architecting to balance rapid capability delivery with preparation for future capability delivery
- investigating the use of economic analyses for architecture evolution
- developing new metrics and approaches for using architecture knowledge to assure the reliability of software-reliant systems
- investigating techniques for using architecture knowledge to reduce system testing
- developing resource allocation strategies and analyses for predicting real-time performance
- developing analytic techniques for making system-wide tradeoffs between conflicting quality attributes
- identifying SoS architecture patterns and associated quality attribute analyses
- developing protocols and analyses for ensuring predictable quality of service in wireless devices
- investigating the use of scalable static analysis in the migration of systems to multi-core platforms
- investigating the use of market-based mechanisms for resource allocation

Relationship to Other SEI Work

The ACE Initiative resides within the Research, Technology, and System Solutions (RTSS) Program, which is part of the Carnegie Mellon® Software Engineering Institute (SEI). The RTSS team focuses on the structure and behavior of software-reliant systems—and the intimate relationship between structure and manifested quality attributes—to enable assured and flexible system capabilities at all scales.

Related Website

www.sei.cmu.edu/architecture/

For More Information

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About the SEI: The SEI is a federally funded research and development center that provides the technical leadership to advance the practice of software engineering, so that software-reliant systems can be acquired and sustained with predictable and improved cost, schedule, and quality.

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