



Architectural Evaluation for Fun and Profit!

SPA2005 – TU4

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Outlook



Software architecture

Why architectural assessment?

Approaches for architectural assessment

Architectural assessment methods

SAAM

ATAM

Case Study & Exercises

Summary and Conclusions

Zuhlke Engineering



Zuhlke is a leading Swiss technology consultancy. We specialise in the leading edge technologies required in today's enterprise systems, and in the processes and methodologies required to engineer them.

Our core technology competencies are in component and object based systems, security, distributed architecture; our process competencies are in iterative development and project management.

We have clients ranging from ALSTOM and British Airways to Xerox and Zurich Financial Services, and operations across Switzerland, Germany and the UK.

We completed over 3000 projects for over 500 clients in our 35 year history.

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Defining Software Architecture



A common definition ...

*The software architecture of a program or computing system is the **structure** or structures of the system, which comprise software **elements** the externally visible **qualities** of those elements, and the **relationships** among them*

Len Bass, Paul Clements and Rick Kazman (SEI)
Software Architecture in Practice, 2nd Edition

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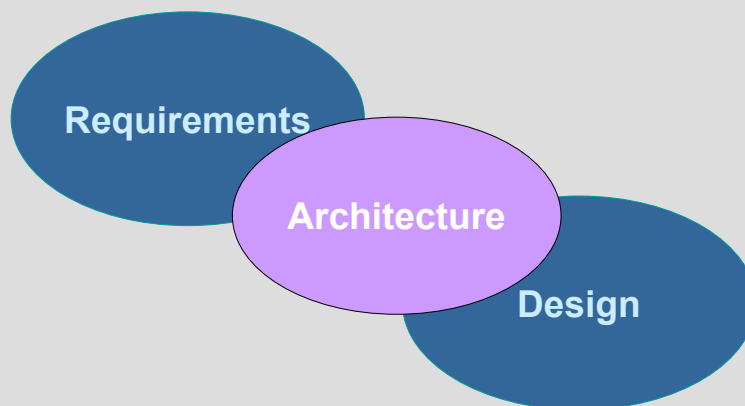
Defining Software Architecture

Architecture involves balancing stakeholder needs

- Mediating between stakeholders & their competing desires
- The “art of the possible”
- A basis for the future
- Defines the fundamental qualities of the system

Role of Software Architecture

A crucial bridge between requirements and design



Software Architecture and Requirements

Requirements frame the architectural problem

- Stakeholder needs and desires

Yet, architecture must influence requirements

- “The art of the possible”
- Helps stakeholder understanding of risk/cost
- Helps stakeholder understanding of possibilities

Software Architecture and Quality Properties

The non-functional system characteristics (“-illities”)

- Performance, Efficiency, Security, Availability, Time to Market, ...

Quality properties are crucial to stakeholders

- Slow functions don't get used
- Unavailable systems cause business interruption
- Security problems cause headlines

Yet quality properties are often an after-thought

Addressing quality properties is a key architectural task

The Software Architecture Problem

Why software architecture is difficult

- Multi-dimensional problem
- Diverse stakeholder community to serve
- Making trade-offs inherent in the process
- Often no one “right” answer

Yet, it's hard to “test” an architecture to see if you've met these challenges

Why Architectural Assessment?



Architecture can't be directly tested

- “Bubbles don't crash”
- Large scale prototyping is expensive and time consuming
- Need to assess a number of options simultaneously
- Architecture assessment provides testing for architectures

Architecture needs stakeholder involvement

- Architecture evaluation methods can involve stakeholders
- Stakeholders feel involved
- Helps to validate the architecture against real needs
- Communicates the architecture

Types of Architectural Assessment

- Exploratory
 - Consider alternatives
- Validating
 - Confirm the suitability of an architecture
- Forensic
 - Establish why an architecture wasn't suitable

Each has their place in the lifecycle – we'll focus on validating

Goals of Architectural Assessment

Goals of architectural assessment

- Establish credibility of an architecture
 - Validate abstractions
 - Check correctness
- Communicate the architecture
 - Sell
 - Explain
- Other
 - Validate assumptions
 - Management decision points
 - Basis for formal agreement
 - Ensure technical integrity of implementation

Approaches to Architectural Assessment (i)

Reviews and Walkthroughs

- Present the architecture via document and/or presentation
- Collect comments from attendees at the meeting
- Inspection based approaches can provide more rigour (see Tom Gilb)
- Can create a false sense of security!

Scenario-Based Methods

- Investigate the architecture by considering how it deals with scenarios
- A scenario describes a situation the system will face in production
- Each scenario reflects a concern or requirement of a stakeholder
- Scenarios can be analysed using qualitative or quantitative techniques
- Considering combinations of scenarios allows tradeoff analysis

Approaches to Architectural Assessment (ii)

Prototypes and Proof of Concepts

- Create some representative code, learn from it, throw it away
- Can be a valuable learning experience, in a safe environment
- Allows qualitative and quantitative conclusions to be drawn
- Danger is building the wrong prototype & can be expensive

Skeleton Systems

- A first build of the real system, implementing a small set of functions
- Creates a base upon which to build (“executable architecture”)
- May be too expensive/too late to allow consideration of architectural options

This session is about scenario-based methods

Architectural Assessment Methods

SAAM

- Simple, scenario-based approach, focusing on functionality

ATAM

- Sophisticated, scenario-based approach, focusing on quality properties

ZAAF

- Zühlke's commercial offering, a scenario-based approach, building on top of ATAM

We'll use ATAM as our example method

SAAM Method



Software Architecture Analysis Method

- First generation “scenario-based” architectural assessment method
- Developed at the SEI @ CMU
- Focus on functionality and ease of change
- Simple, easy to apply
- “*Evaluating Software Architecture – Methods and Case Studies*”, Clements, Kazman and Klein, Addison-Wesley, 2002 (also SEI-2000-TR-004)

SAAM Method

Software Engineering Institute

- Institute within Carnegie-Mellon University (CMU), Pittsburgh, PA, USA
- Leading software architecture research
- Funded by US DoD (research for US military and subcontractors)
- Prolific publishers (6 major books in 3 years; dozens of TRs)
- <http://www.sei.cmu.edu/ata>

Key Aspects of SAAM

Focus on Functionality

- Does the system do what the stakeholders actually want

Focus on Modifiability

- Can the system be modified for likely changes (“indirect scenarios”)

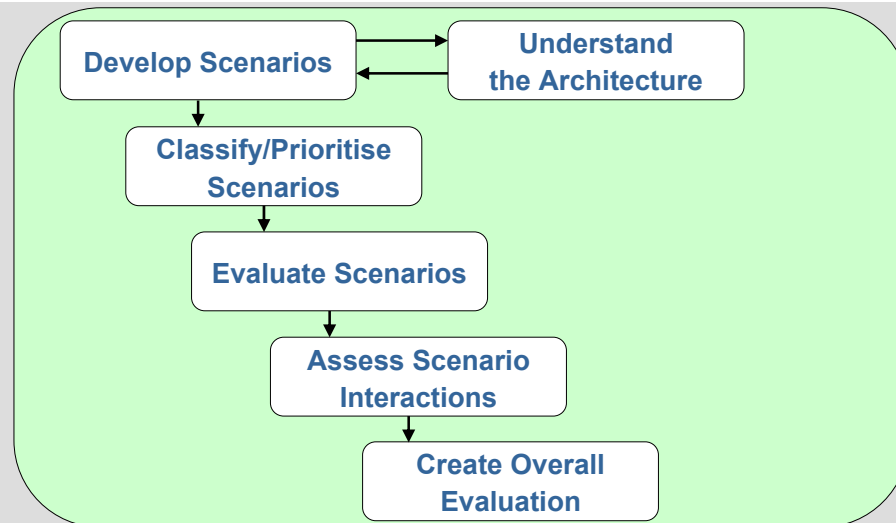
Scenario Based

- Analysis centres on evaluating system’s ability to cope with scenarios
- Interactions between scenarios considered for conflict

Architect Biased

- Scenarios identified/prioritised by stakeholders
- Evaluation process performed by architects / evaluators

SAAM Process



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SAAM Strengths and Weaknesses

Strengths

- Simple to understand, explain & apply
- Relatively little preparation/training needed
- Scenarios are a proven technique
- Scenario interaction analysis often reveals problems

Weaknesses

- Neglects most quality properties
- Focus on function and modifiability can mask other problems
- Lack of wide stakeholder involvement

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ATAM Method



Architecture Trade-off Analysis Method

- Second generation “scenario-based” architectural assessment method
- Developed at the SEI @ CMU
- Focus on tradeoffs made between different requirements
- Two phase (architects, then stakeholders)
- “*Evaluating Software Architecture – Methods and Case Studies*”, Clements, Kazman and Klein, Addison-Wesley, 2002 (also SEI-2000-TR-004)

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Key Aspects of ATAM

Two phase process

- Architects in 1st phase, stakeholders in 2nd

Scenario Based

- Analysis centres on evaluating system’s ability to cope with scenarios
- Interactions between scenarios considered for conflict
- Use case, growth and exploratory types of scenario

Stakeholder Centric

- Key stakeholder(s) in first phase
- Wide stakeholder involvement in second phase

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Key Aspects of ATAM

Focus on Decisions and Tradeoffs

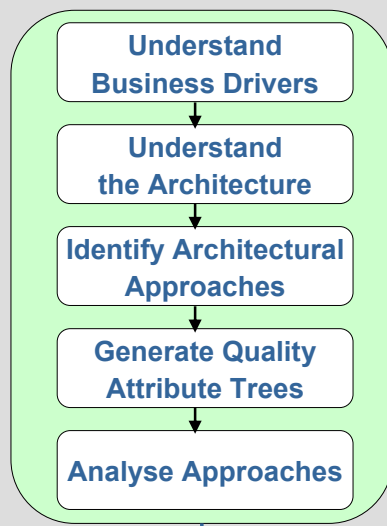
- Risks
 - Decisions not yet made, or not understood
- Sensitivity Points
 - Decisions/attributes having a direct effect on a quality property
- Tradeoff Points
 - Decisions/attributes affecting two or more properties in conflicting ways

Quality Property Centric

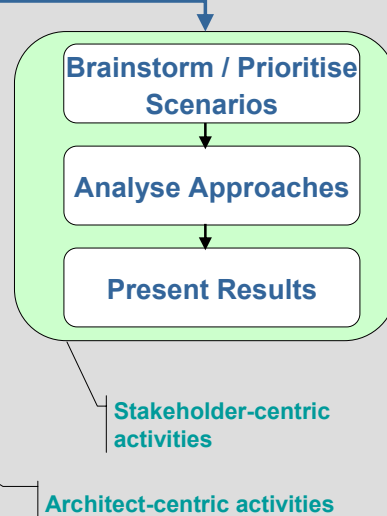
- What “stimulus” does the system need to cope with?
- What is the required response?
- What architectural decisions impact the ability to provide that response?
- SEI people call these “business drivers”

ATAM Process

Phase 1



Phase 2



ATAM Phases

Phase 1

- Work with architects and one or two key stakeholders (“customer”)
- Understand the “business drivers” (quality property requirements)
- Technical understanding of the architecture
- Development of quality attribute trees
- Identification of key scenarios
- Analysis of architecture

Phase 2

- Work with wider community of stakeholders to validate results
- Allows scenarios to be identified/prioritised by those outside core team

ATAM & Stakeholders

Stakeholders are key to the ATAM process

- Architecture aims to *meet* stakeholder needs
- ATAM aims to *validate* architecture against stakeholder needs
- One or two key stakeholders in Phase 1
- Large constituency of stakeholders in Phase 2
- Stakeholders “acceptance test” the architecture
- ATAM helps stakeholders to understand the architecture’s tradeoffs

ATAM Quality Attribute Trees

Simple technique at the heart of ATAM

- Allow clear identification of scenarios for business drivers
- Force concrete consideration of each business driver
- Indicate where more scenarios are required
- Ensure business drivers are not ignored
- Force stakeholders to prioritise business drivers (via scenarios)
- Force architects to consider difficulty of meeting business drivers

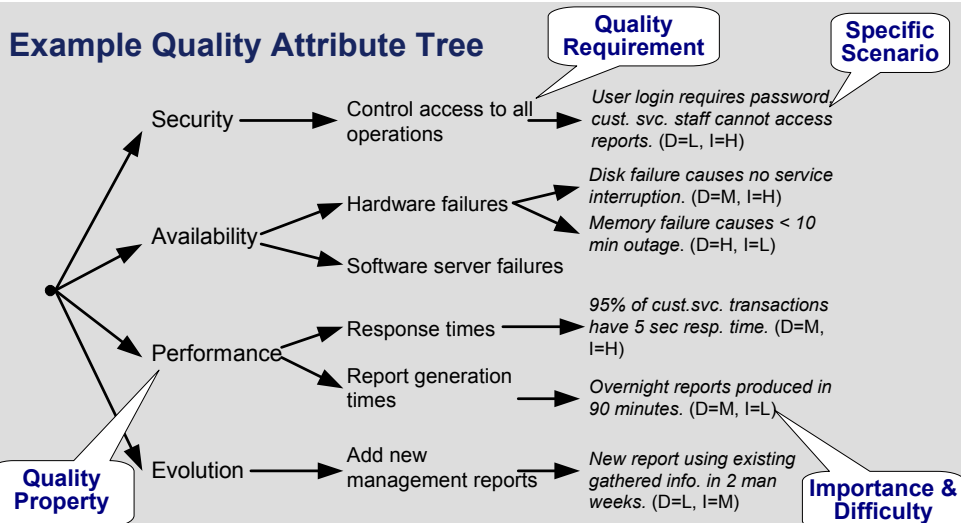
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ATAM Quality Attribute Trees

Example Quality Attribute Tree

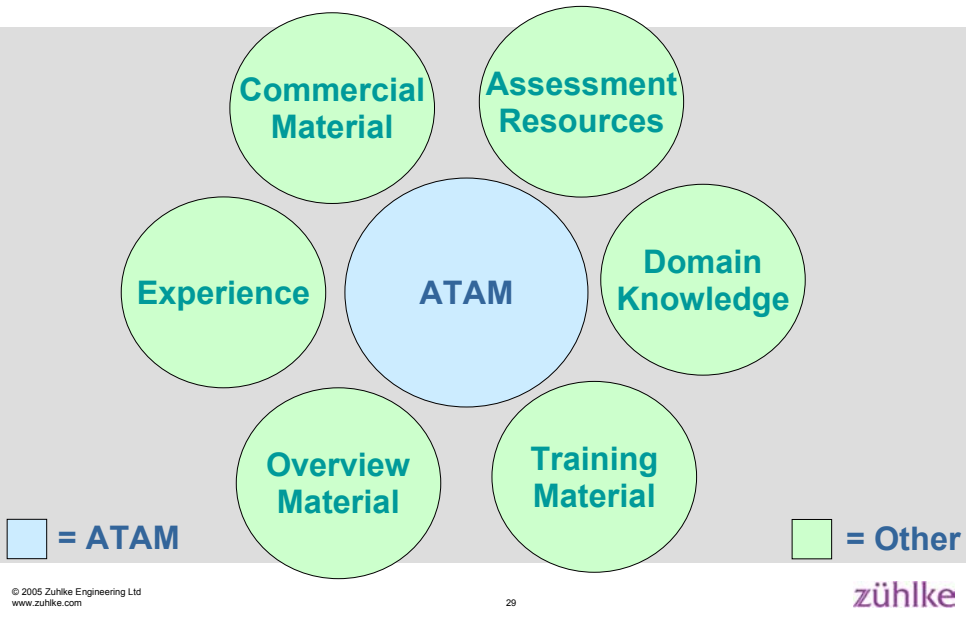


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What ATAM Doesn't Include



ATAM Strengths and Weaknesses

Strengths

- Strong focus on & direct involvement of stakeholders
- Allows decisions, tradeoffs and risks to be understood
- Forces concrete consideration of business drivers
- Allows early consideration of priorities and risks
- Two phase approach is very useful

Weaknesses

- Higher complexity than SAAM
- Stakeholder involvement in Phase 2 may not be realistic
- Method definition missing important elements for practical application
- Largely ignores functionality (as presented by its creators at least)

Case Study



An Example of ATAM for Assessment

- Financial markets company wants to rationalise data integration
- Currently many point-to-point links
- Decide to introduce a common data service
- Key concepts
 - Source Systems
 - Target Systems
 - Mapping

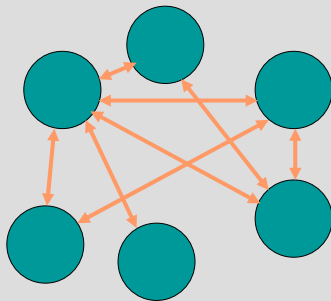
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31

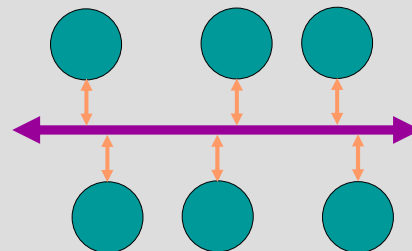
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Case Study

From this



to this ...



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Case Study – Exercise 1



Identify Stakeholders

- Consider the system that we have just discussed
- Imagine you are to perform an ATAM assessment
- Who are the key stakeholders for Phase 1?
- Who is in the community of stakeholders for Phase 2?

Work in small groups, we'll collate answers at end

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Case Study – Exercise 2



Create Quality Attribute Tree

- Consider the system that we have just discussed
- Imagine you are to perform an ATAM assessment
- Identify two or three important “business drivers”
 - Modifiability?
 - Security?
 - Performance?
 - Internationalisation?
- Create a small QAT to drill down to prioritised scenarios

Same groups as before ... may need to use imagination!

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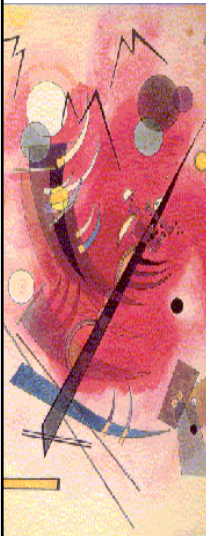
Summary and Conclusions

SAAM and ATAM

- SAAM first generation method; ATAM second generation
- Both use scenario-based analysis of the system
- SAAM focuses on function; ATAM on qualities generally
- SAAM is simpler to apply; ATAM requires more planning/understanding
- ATAM considers design decisions more explicitly
- ATAM captures tradeoffs more explicitly
- ATAM involves more stakeholders more directly
 - although you could involve stakeholders in SAAM

Starting with SAAM, moving to ATAM later is a definite option

Summary and Conclusions



- Architectural evaluation is “testing” for architecture
- Applied early, evaluation can allow risk identification and management
- Useful for exploring, validating, diagnosing
- Scenario based techniques are easy to apply and have proven useful
- SAAM for functionality
- ATAM for quality properties
- ZAAF provides ATAM with its missing pieces

*If you don't evaluate your architecture ...
when will you find the errors?*

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DIE DENKFABRIK.

Final Comments and Questions...



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