



Standard, Simplicity, Integration

We are leading the global market by innovating the entire process of product management including process, system and operation system to provide customers and the market with the products they demand in a highly efficient and timely manner.

소프트웨어 아키텍처 평가 : ATAM

(ATAM : **A**rchitecture **T**rade-off **A**nalysis **M**ethod)



Start your future with
SAMSUNG

SAMSUNG links people together to create richer and more efficient communication environment.

Software Engineering Lab

김영기 책임

resinous@gmail.com



ATAM

(Architecture Trade-off Analysis Method)

What is ATAM ?

❖ ATAM is

- Architecture Trade-off Analysis Method
- To assess the consequences of architectural decisions in light of quality attribute requirements
- Primarily a risk identification mechanism
- Not a predictor of quality achievement



❖ Vocabulary

Vocabulary	Description
<i>Scenario</i>	<ul style="list-style-type: none">▪ A scenario is a short statement describing an interaction of one of the stakeholders with the system
<i>Stakeholder</i>	<ul style="list-style-type: none">▪ An individual, team or organization (or classes thereof) with interested in, or concerns relative to, a system
<i>Architectural view</i>	<ul style="list-style-type: none">▪ A representation of a whole system from the perspective of a related set of concerns
<i>Functional requirements</i>	<ul style="list-style-type: none">▪ specify what software has to do
<i>Non-functional requirements</i>	<ul style="list-style-type: none">▪ specify how well it should be done

Purpose of ATAM

❖ ATAM is for ...

- Evaluation design decision
 - Evaluate if the design decision satisfactorily address the quality requirements
 - Elicit rationale of design decisions (traceability)
- Discover risks
 - Alternatives that might create (future) problems in some quality attribute
- Discover sensitivity points
 - Alternatives for which a slight change makes a significant difference in a quality attribute
- Discover tradeoffs
 - Decisions affecting more than one quality attribute



❖ Side-effect of ATAM

- ✓ Improve the architecture documentation
- ✓ Foster stakeholder communication & consensus

Output of ATAM

❖ ATAM Outputs ...

- Precise description of the architecture
- Articulation of the business goals
- Quality requirements in terms of scenario's
- Risks
- Trade-off points
- Sensitivity points



❖ **Result depends on the quality of the architecture specification**

- ✓ Garbage in, Garbage out

❖ **Not an attempt to predict quality attributes**

- ✓ Quality properties that are not easily expressed quantitatively, such as usability, interoperability ...

❖ **ATAM Weakness**

- ✓ Subjective judgment that depends on the experience of the participants
- ✓ No guidelines for definition of useful change cases
- ✓ Risk : check list thinking

ATAM Benefits

❖ The results are improved architectures

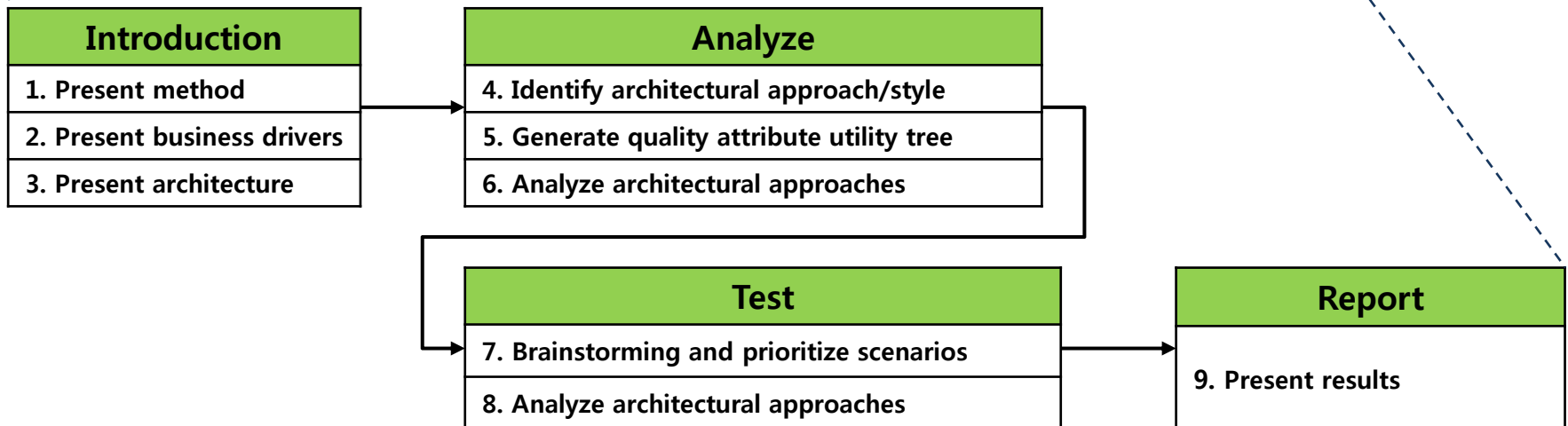
- ATAM 'buys' time to think about an architecture while development processes are often under time-pressure
- Identification of risks early in the life-cycle
- Focuses on features that are essential for the stakeholders and not on technical details
- Improved architecture documentation
 - Forces stakeholder to
 - Think about qualitative requirements
 - Prioritize qualitative requirements
 - Documented basis for architectural decisions



ATAM Structure (1/5)

ATAM Phases

-	Project Preparation	Evaluation				Follow-up
		Introduction	Analyze & Investigate	Test	Report	
Phase 0	↔					
Phase 1		↔				
Phase 2		↔				
Phase 3						↔





ATAM Structure (2/5)

❖ Phase 0 : Partnership, Preparation (Informally)

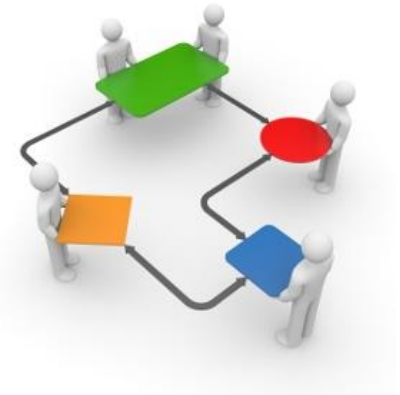
- Attendee : Evaluation team leader / Project decision makers
- Activities
 - Building a partnership
 - 평가 팀 리더는 아키텍처 평가 방법을 간단히 소개한다.
 - 평가대상 조직은 아키텍처에 대한 자료를 제공하고 평가 팀 리더는 프로젝트 진행을 결정한다.
 - 평가대상 조직과 평가수행 조직은 계약을 체결한다.
 - 정보열람 권리와 정보보호 의무를 확인한다.
 - 아키텍처 평가 비용과 이득을 평가대상 조직이 충분히 이해하도록 해야 한다.
 - Preparation of architecture evaluation
 - 평가 팀 구성 : 팀을 구성하고 팀원의 역할을 결정한다.
 - Kick-off 미팅 : 팀원들이 자신의 역할을 이해하고 아키텍처 평가에 대한 지식을 공유한다.
 - Phase 1 준비



ATAM Structure (3/5)

❖ Phase 1 : Evaluation 1

- Attendee : Evaluation team leader / Project decision makers
- Period : 1 day
- Activities
 - ATAM Execution : Execution from 1 step to 6 step
 - Phase 2 Preparation
 - Phase 2 진행 여부 결정
 - Phase 2 참여자 결정
 - 부족한 정보를 파악한다.
 - Features
 - 아키텍처 중심 : 아키텍처에 대한 정보를 발굴하고 분석한다.
 - 아키텍처를 파악하는데 초점을 맞춘다. (자세한 분석은 Phase 2에서 수행한다.)
 - 파악한 아키텍처를 기반으로 아키텍처 평가팀 구성을 최종 결정한다.
 - Phase 1과 Phase 2 사이에 2~3주 공백 기간을 두고 이 기간 동안 계속 아키텍처에 대한 정보를 발견하고 수집한다.





ATAM Structure (4/5)

❖ Phase 2 : 평가 국면 2

- Attendee : Evaluation team / Project decision makers / Other stakeholders
- Period : After Phase 1, 2~3 weeks later, 2 days
- Activities
 - Perform ATAM Evaluation : From step 1 to step 9
- Features
 - Architecture centric : 이해관계자의 관심사를 찾아내고 Phase 1에서 Phase 1을 통해 충분히 이해한 아키텍처를 분석하고 평가한다.

	Phase 1	Phase 2
참가자	■ 이해관계자 2~4명 참가	■ 이해관계자 10~15명 참가
특징	■ 아키텍처 중심 ■ 문제 해결 중심 ■ 분석 중심	■ 이해관계자 중심 ■ 문제 중심 ■ 검증 중심
목적	■ 아키텍처 이해를 돕는다	■ 이해관계자들 사이의 상호작용을 돕는다.
시나리오 용도	■ Utility Tree를 만들기 위한 시나리오	■ Utility Tree 검증하기 위한 시나리오
진행방식	■ 다양한 비공식 방법	■ 정규 회의;

ATAM Structure (5/5)

❖ Phase 3 : Follow up

- Attendee : Evaluation team / Client (team)
- Period : 1 week
- Activities
 - Generate the final report
 - What is analyzed and assess?
 - Results of analyzed and evaluated ?
 - What's is your point ?
 - Collect data for evaluation method improvement and measure to evaluation satisfaction
 - Collecting data of evaluation team and development team
 - Collecting improvement points, cost data and profit data
 - Upgrade deliverable repository
 - Save current evaluation result for later evaluation



Architecture Evaluation Step (1/6)

1. Present method

- Architecture evaluation team leader introduce evaluation method to stakeholders
 - ATAM Steps & techniques
 - Explain methods
 - Explain evaluation deliverables
 - Output : Architectural approaches, Utility tree, Scenarios, Risk and Non-risks ...



2. Present business drivers

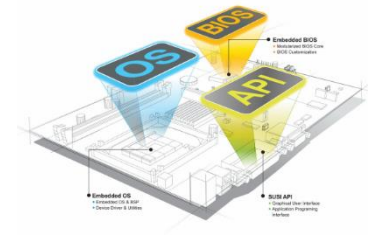
- Evaluation team and stakeholders are understand that why system is developed and business drivers
- Customer representative describe the system's business drivers
 - Business context for the system
 - Most important functional requirements
 - Most important quality attribute requirements
 - Architectural drivers
 - Quality Attributes most central to the system's success



Architecture Evaluation Step (2/6)

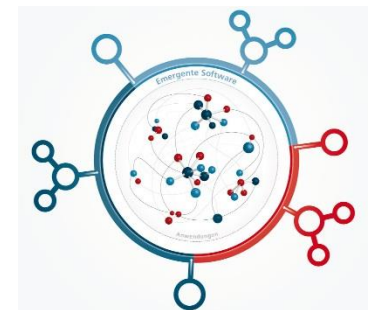
3. Present architecture

- Senior Architect introduce architecture to evaluation team
 - Technical constraints & external systems must to interaction
 - Architectural approaches for satisfaction of the quality attributes
- Use the important architecture view among the architecture views
- Architecture team may make initial architecture version with their architectural approach
- Evaluation team begins probing for and capturing risks



4. Identify architectural approach/style

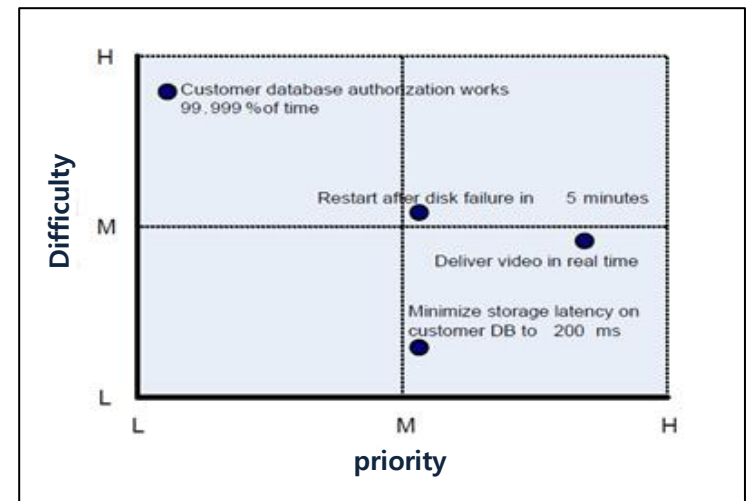
- Find the architectural approaches by questioning or initial architecture version which are made in previous step
- But, Architectural decisions are not analyze, yet
- Find the architecture style by architectural approaches
- Attribute-Based Architectural Style (ABAS)
 - It describes how to satisfy the specific quality attribute



Architecture Evaluation Step (3/6)

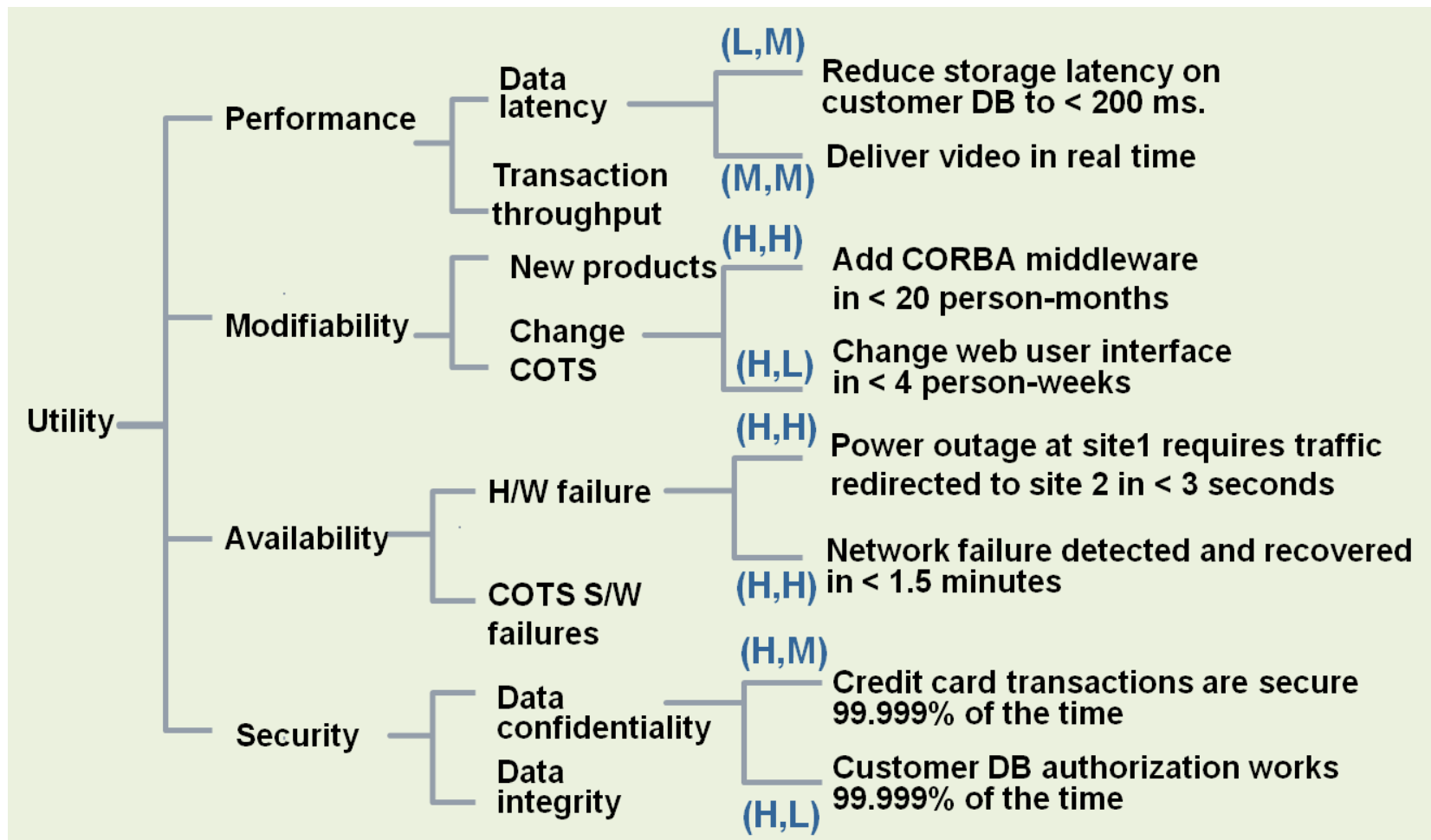
5. Generate quality attribute utility tree

- Find the most important quality attribute and set priority by evaluation team and decision maker and share the priority of quality attribute
- Generate a document for quality attribute requirement and priority
- Utility Tree
 - Utility is the qualities are supported by system
 - Utility → Quality Attribute → Detailed Quality Attribute → Scenarios
 - It is helpful to make decision to set a priority of quality attribute requirement
 - Assign a priority score the each scenario
 - Matrix for priority decision
- Scenario
 - Describe how to interact between system and stakeholder
 - Consist of
 - Stimuli, Response, and Environment



[Appendix] Utility Tree

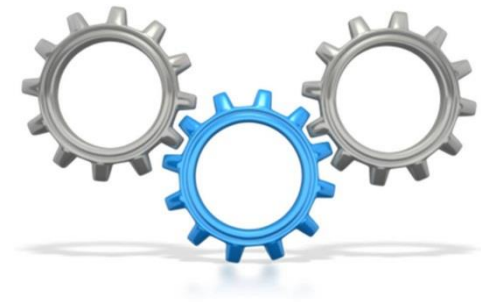
❖ Example of Utility Tree



Architecture Evaluation Step (4/6)

6. Analyze architectural approaches

- The evaluation team probes architectural approaches specific quality attributes to identify risks
 - Identify the approaches that pertain to the highest priority quality attribute requirements
 - Generate quality attribute specific questions for highest priority quality attribute requirement
 - Ask quality attribute specific questions
 - Identify and record risks and non-risk, sensitivity points and tradeoffs
- Risk and Non-risks
 - Risks are potentially important architectural decisions that need to be made explicit
 - Non-risks are good decisions frequently relying on implicit assumptions
 - Risk and non-risk constituents
 - Architectural decision
 - Quality attribute requirements
 - Rationale
 - Sensitivity points are candidate risks



[Appendix] Sensitivity & trade-off Point

A *Sensitivity point* is a parameter of the architectural to which some quality attribute is highly related



Suppose throughput depends on one channel !!!

Increase channel Speed → Increase performance

A *trade-off point* is a parameter of the architecture that affects multiple quality attributes in opposite direction

A system requires high performance, high reliability, high security

Increase channel Speed → Increase performance & decrease reliability

Increase encryption → Increase security & decrease performance

Architecture Evaluation Step (5/6)

7. Brainstorming and prioritize scenarios

- Stakeholders generate scenarios using a facilitated brainstorming process
 - Examples are used to facilitate the step
 - The new scenarios are added to the leaves of the utility tree

8. Analyze architectural approaches

- Identify the architectural approaches impacted by the scenarios generated in the previous step
- This step continues the analysis started in step 6 using the new scenarios
- Continue identifying risks and non-risks
- Continue annotating architectural information

❖ Essentially a process steps above ...

- ✓ Include a larger group of stakeholders
- ✓ Extend consensus (on priorities)
- ✓ Extend confidence in completeness of scenario's



Architecture Evaluation Step (6/6)

9. Present results

- Recapitulate steps of the ATAM
- Present ATAM outputs
 - Architectural approaches
 - Utility tree
 - Scenarios
 - Risks and "non-risks"
 - Sensitivity points and trade-offs

