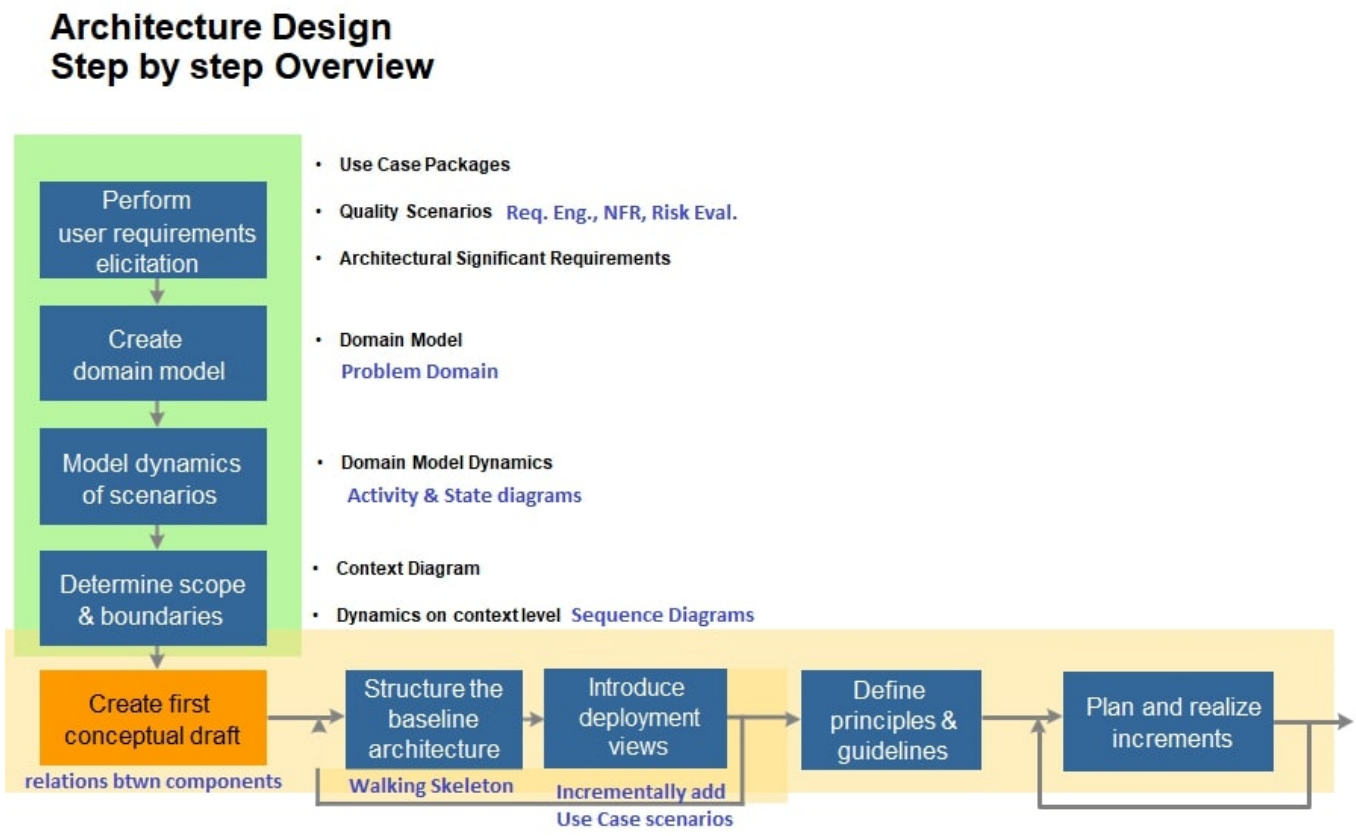
# SYSTEMATIC ARCHITECTURE

What is architecture?

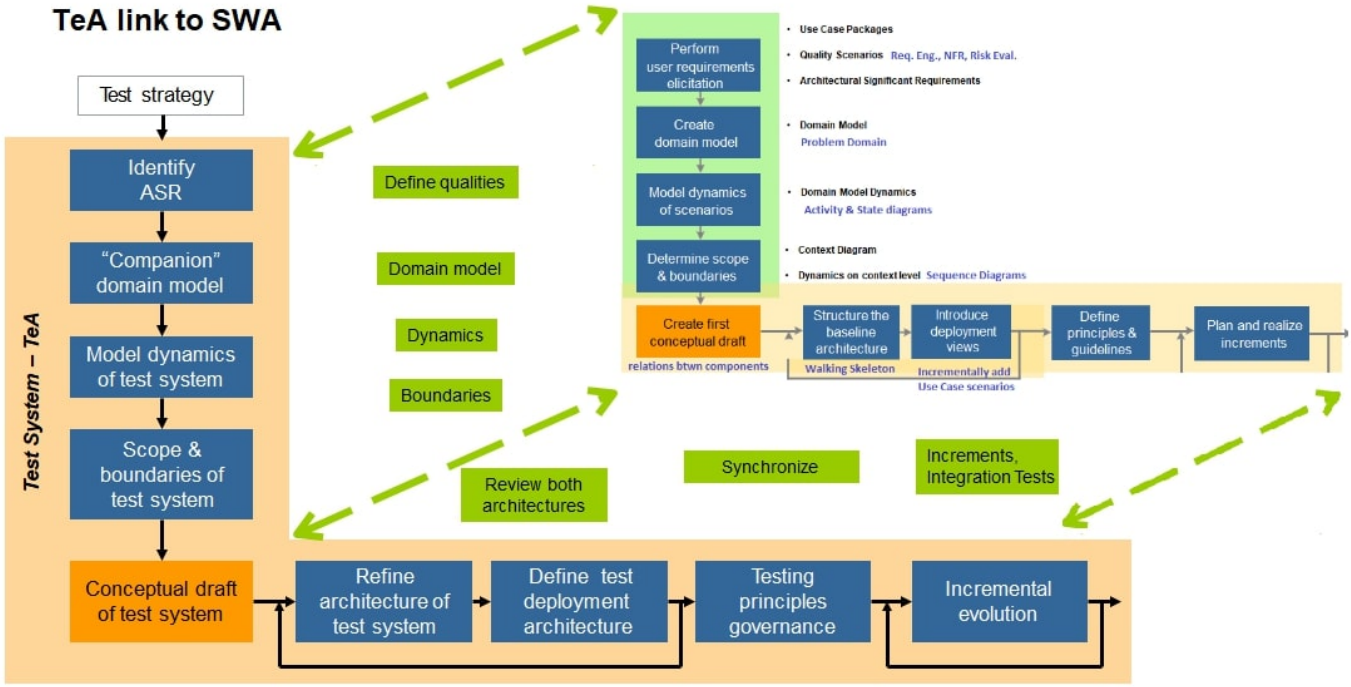
- Abstraction of reality
- Focus on fundamental & critical concepts
- Rationels / Why

Architecture Design = Creative freedom - Forces: *(func./non-func. reqs + org./biz./processes)*

# Architecture Design - step by step



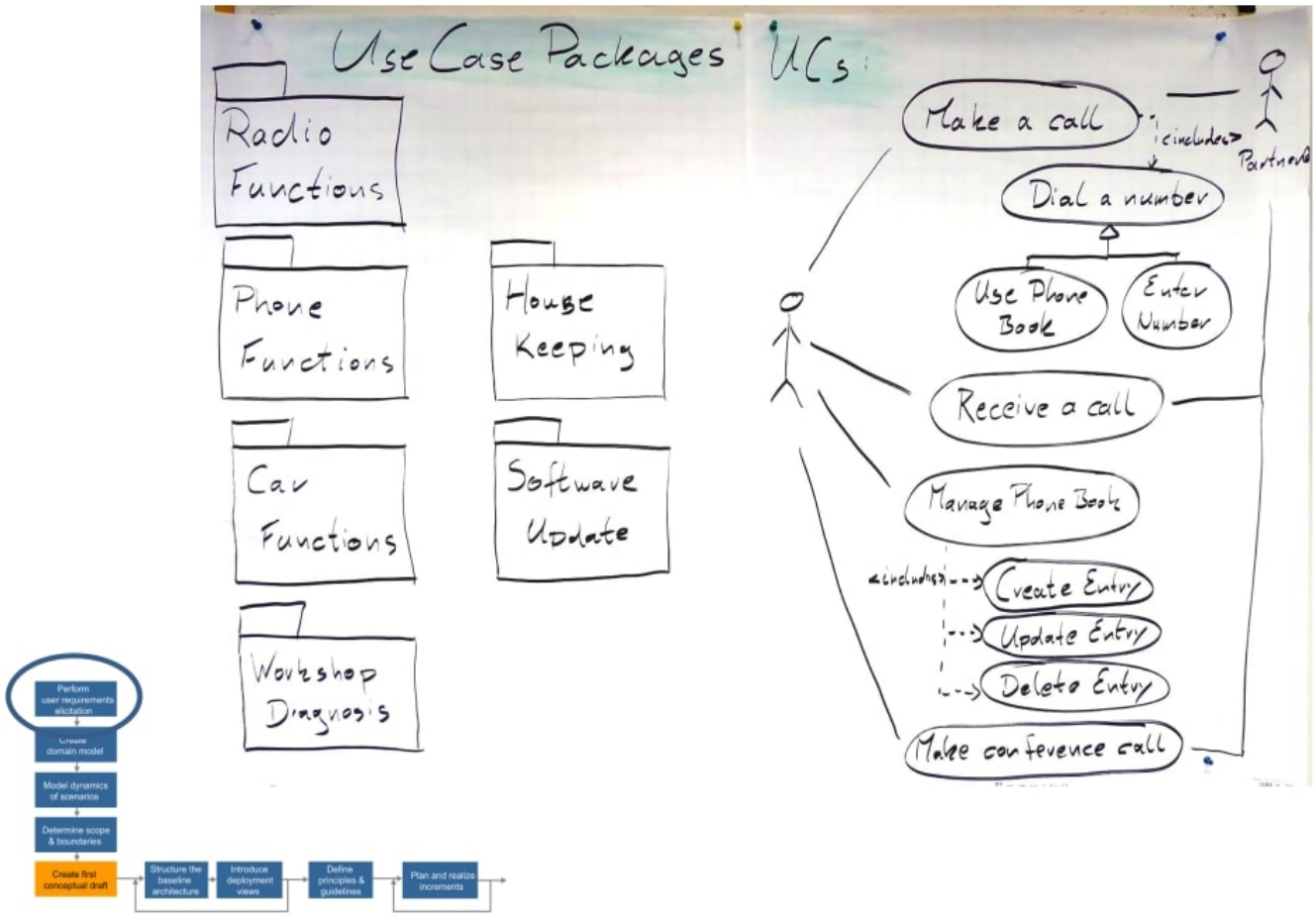

## Link between TeA and SWA




# 1) SWA: Requirements Elicitation - TeA: Identify ASR's

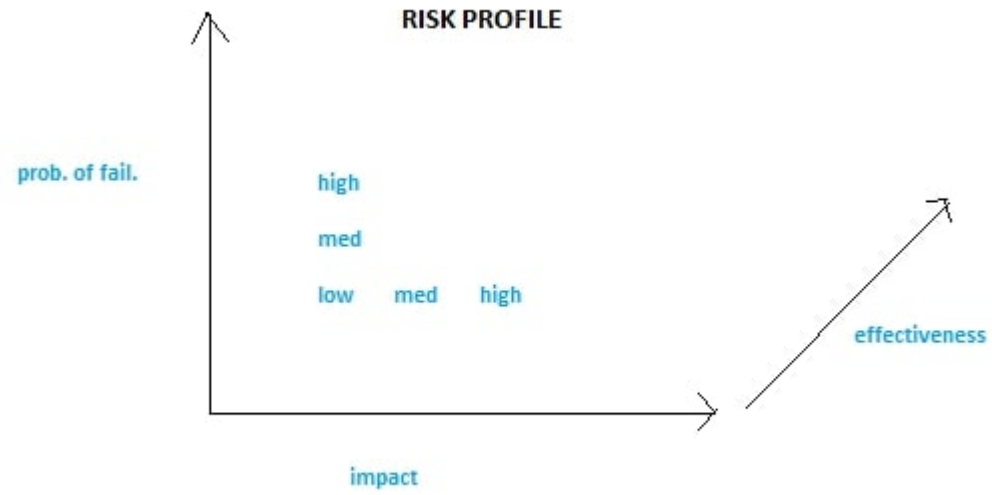
## Use Case Packages

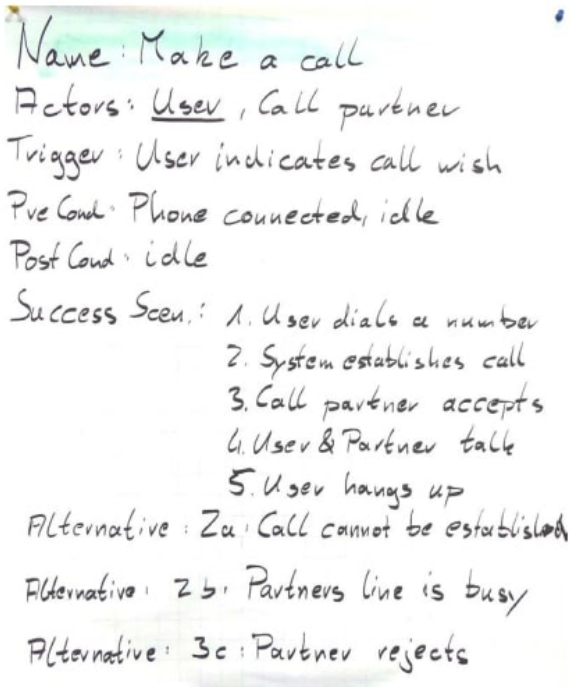
Each use case is a requirement.

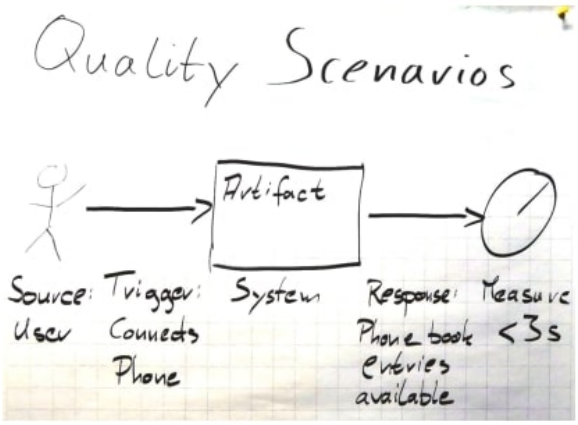


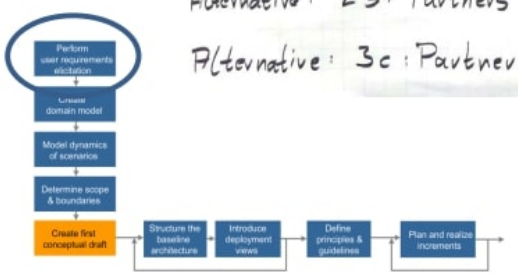

## Quality Scenarios

- Requirements Engineering: Given When Then
- NFRs
- Risk based evaluation: Risk Based Testing

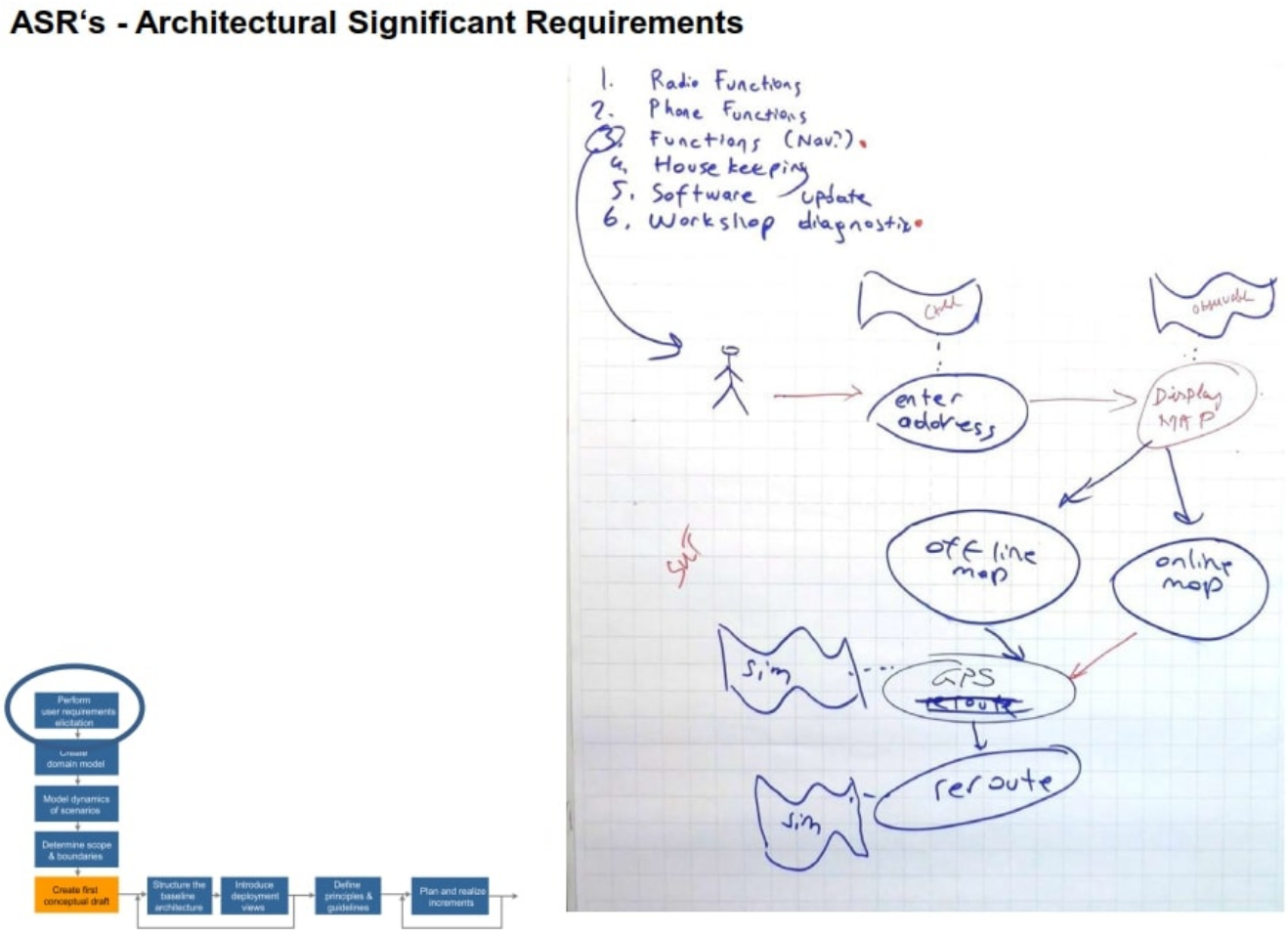




Architectural Significant Requirements (ASR's)



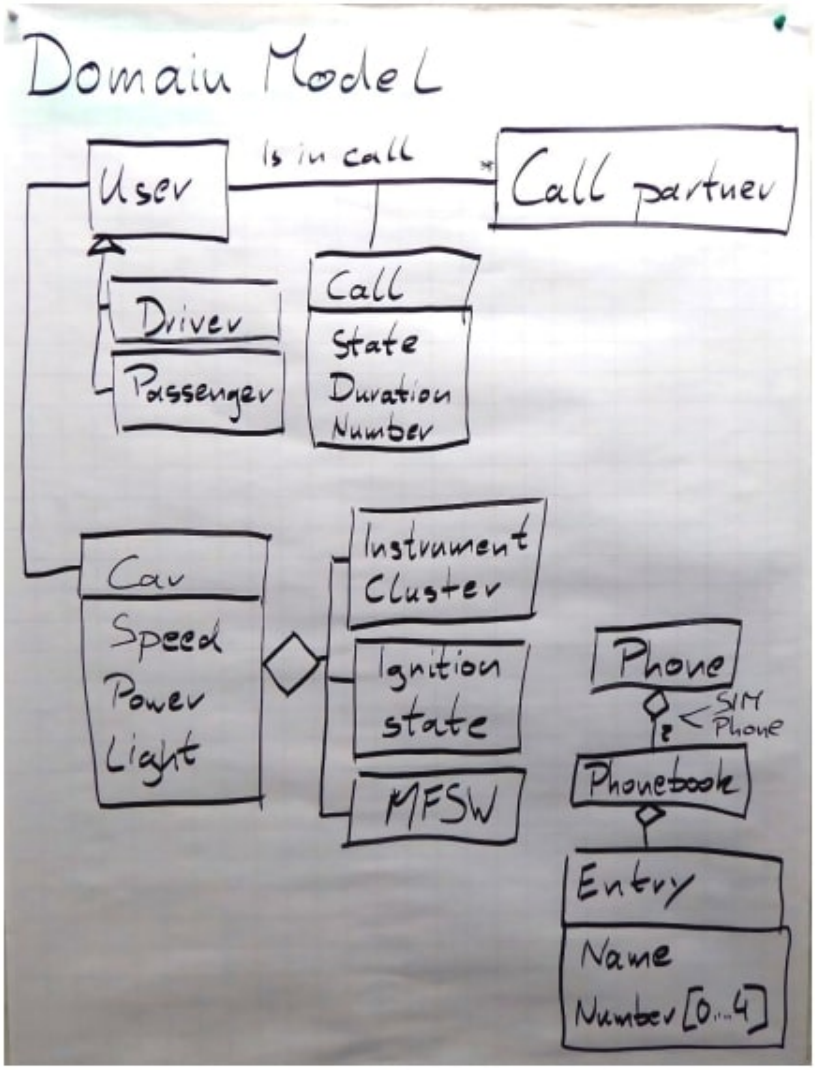

## 2) SWA: Domain Model - TeA: "Companion" Domain Model

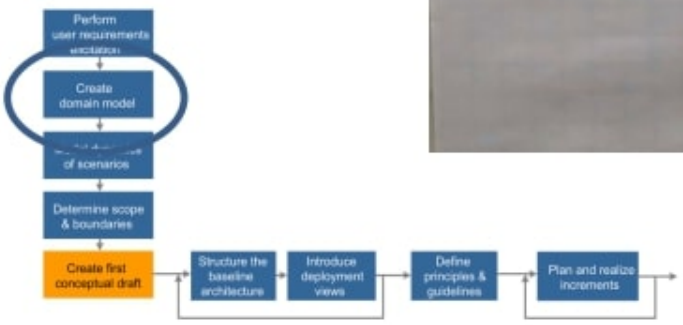
This is not a class diagram, but the **Problem Domain**. **It is a conceptual model that incorporates behavior and data**.

Question: what is the relation between a Domain Model and a requirement?

> There can be long discussions on requirements – features – use cases – epics – domain models – context diagrams – package diagrams – component diagrams – etc. These are different perspectives/views/notations used to specify something with different intent, purpose, scope, level of detail.

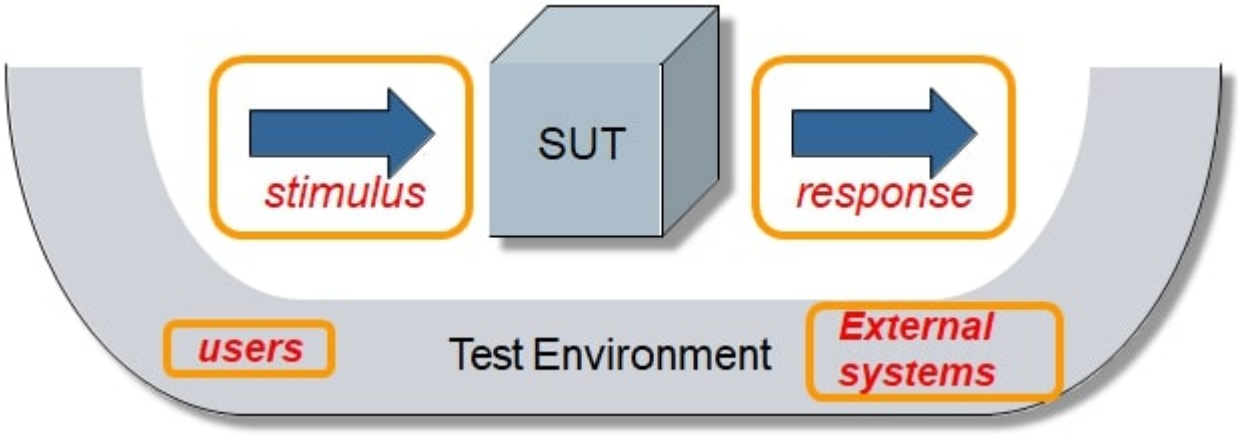
> - *Requirement* : capability or condition needed by a stakeholder
> - *Domain Model* : conceptual model that incorporates behavior and data
> - *Context diagram* : focuses on what is in/out of scope, boundary between system and environment



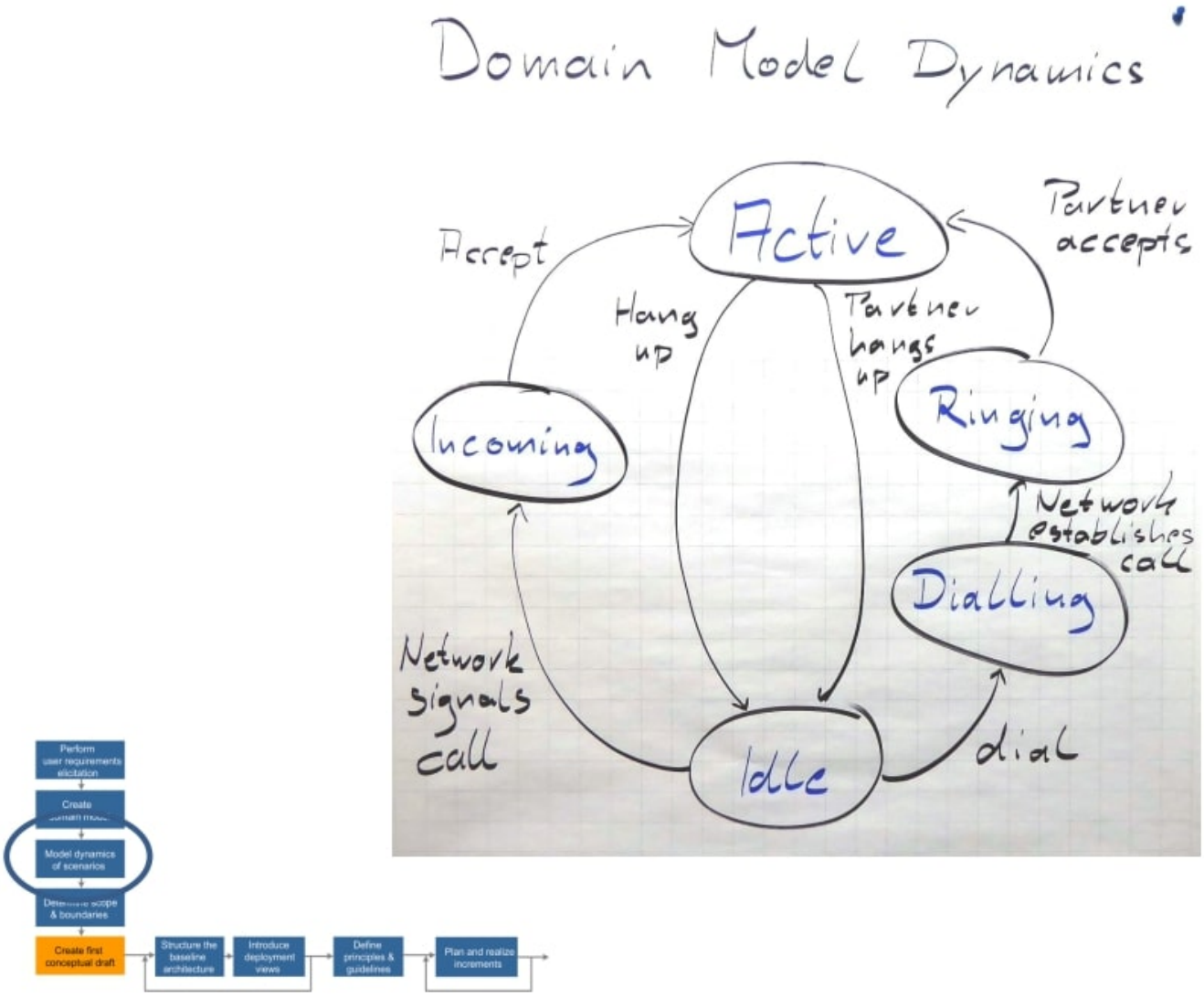

Your Test System is the "companion" Domain Model, you have to cover all the other elements:

- Human user interaction (simulated or real)
- Communication with other actors (external systems, ...)
- Identify capabilities of these elements and design test cases accordingly



# 3) SWA: Domain Model Dynamics - TeA: Test System's Model Dynamics

Activity & State Diagrams




# 4) SWA: Determine Scope Boundaries - TeA: Test System's Scope & Boundaries

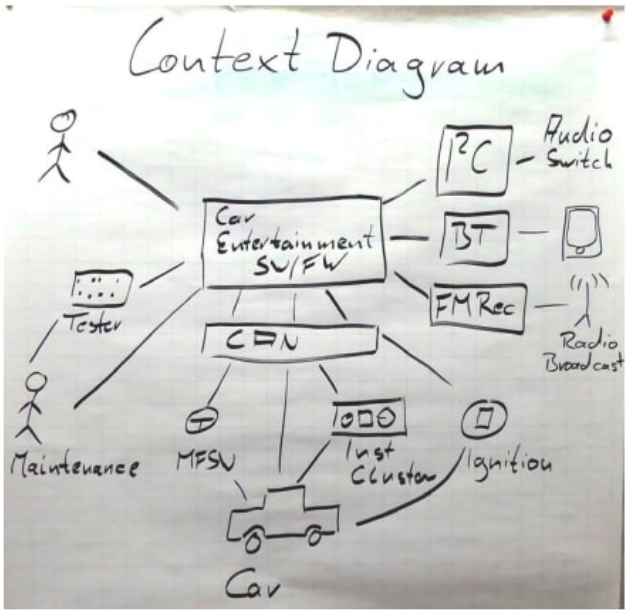
## Context Diagram

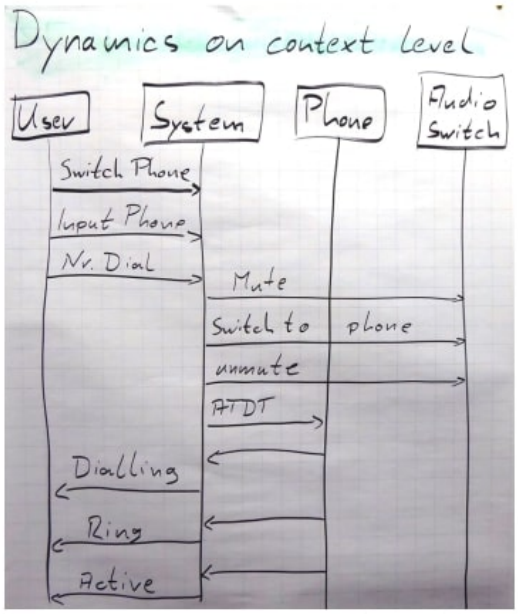
For the product/ system, clearly define the boundaries: **What is IN and what is OUT of scope, boundary between system and environment.**

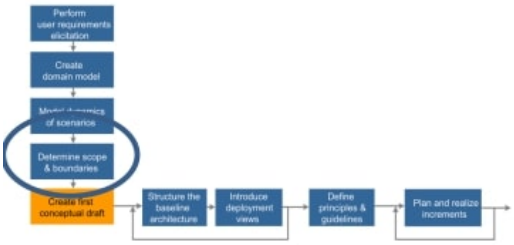
> Context diagram may look like a use case package diagram but has different intent:
>
> - context diagram: describes what is in/out of scope, the so-called “context”, the interaction between system and the environment around.
> - use case package diagram: shows packages and relationships between them, but can be more an “internal only” view.

## Dynamics on Context level

Sequence Diagrams

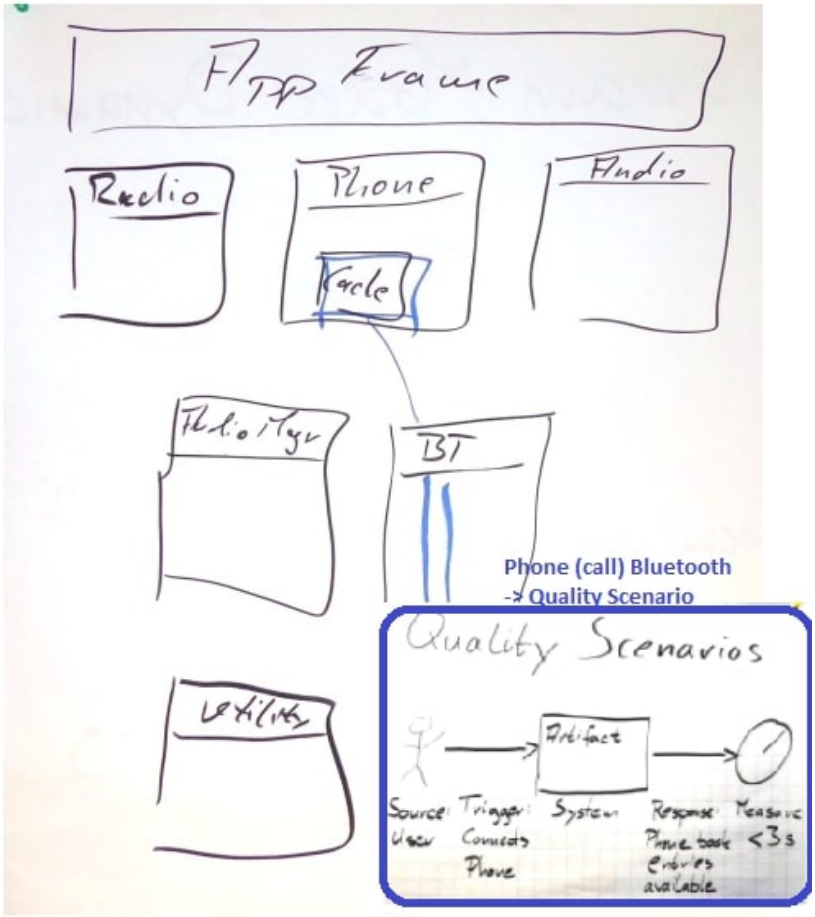


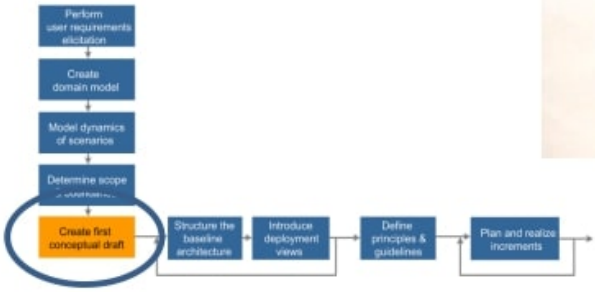




## 5) SWA: Conceptual Draft - TeA: Test System's Conceptual Draft

Relations between components.



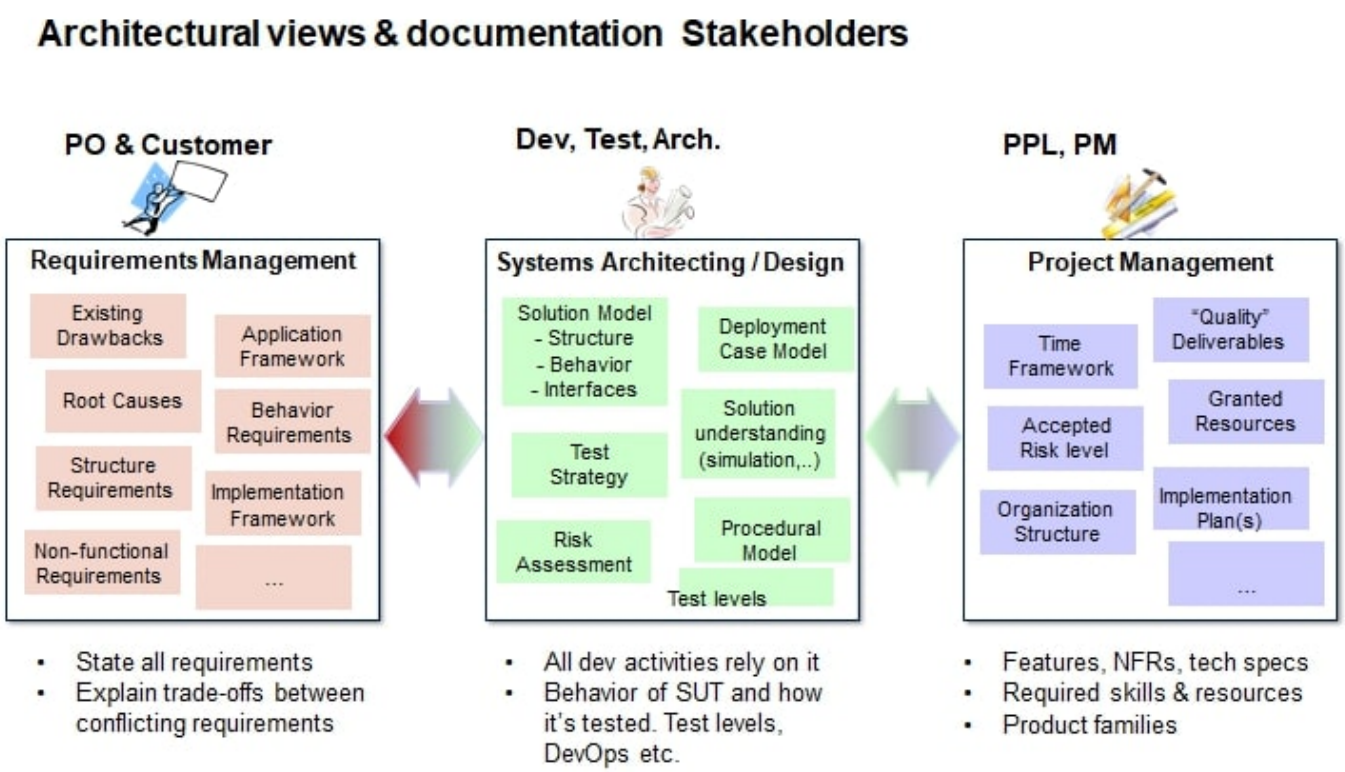

## 6+) SWA: Structure the baseline Architecture & Introduce Deployment Views - TeA: Refine test architecture & Define test deployment architecture

- Walking Skeleton : most important & highest risk
- Incrementally add use case scenarios

# Architectural Views & Documentation

What should be documented?

- Context & boundaries
- UML views of the architecture itself
- Design rationale
- How the architecture addresses FRs & NFRs & cross-cutting concerns



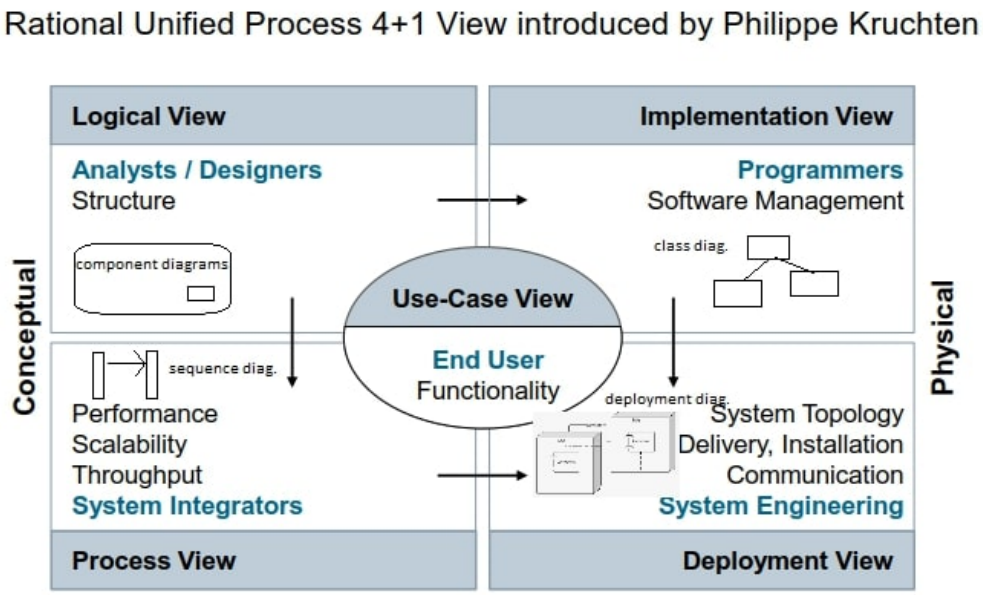

Architectural Views: Kruchten, Zachmann...

4+1 View explained:

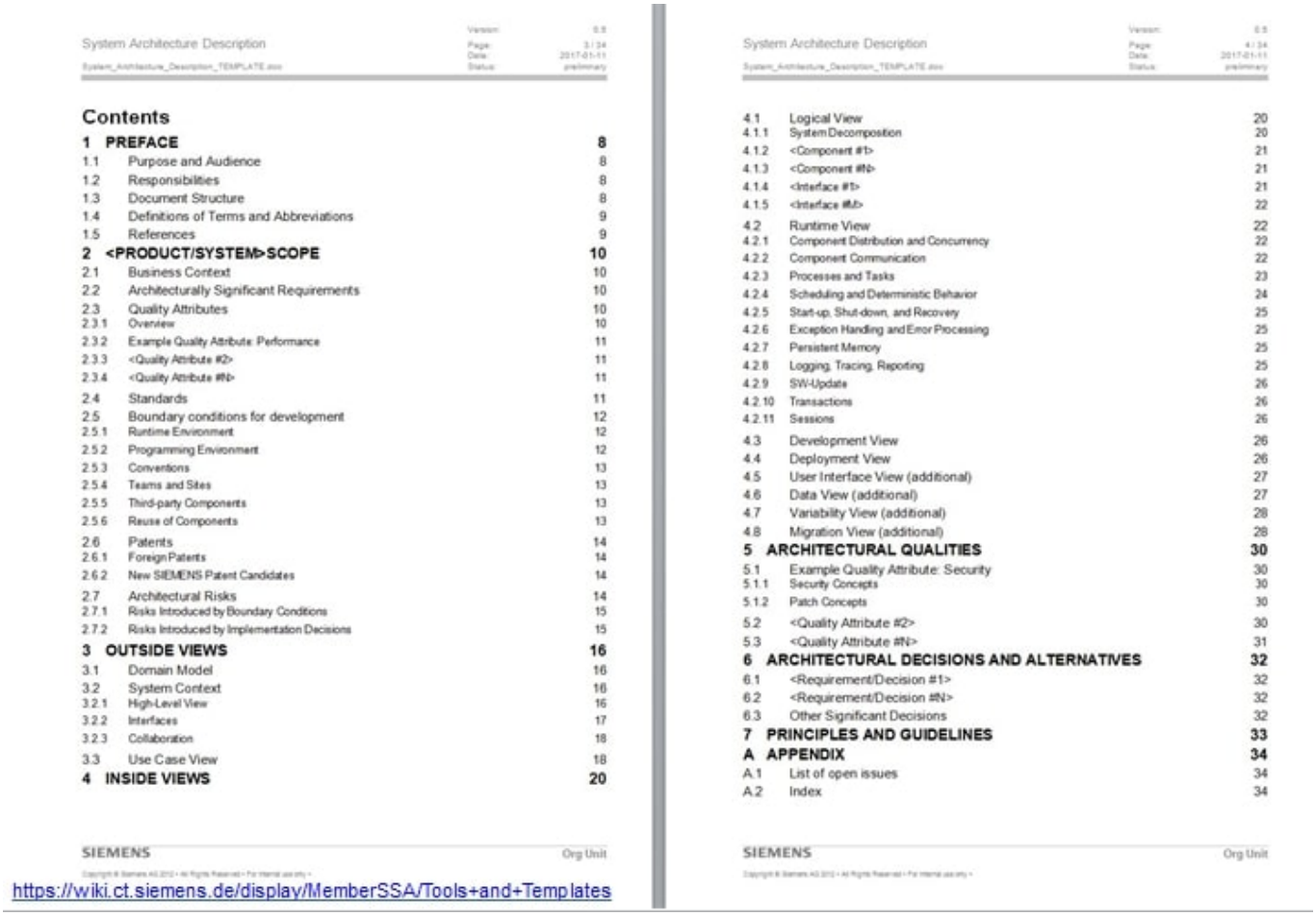
- User view: all posibble scenarios the user expects from SUT
- Functional aspects:
  - Logical View: how the functionality use cases are modeled. *Component diagrams*
  - Implementation/Development View: how the functionality is implemented (source code, libs, executables etc.) *Class diagrams*
- Non-functional aspects:
  - Process View: how the artifacts will be executed in terms of concurrency, scalability, synchronization. *Sequence, Activity, State diagrams*
  - Deployment View: maps software artifacts to hardware entities and shows the distribution of functionality. *Deployment diagrams* . one view in the 4+1 views by Kruchten, sometimes also

called physical view, see [https://en.wikipedia.org/wiki/Deployment_diagram]

## 4+1 View (Kruchten)




Siemens SW Architecture Doc Template



System Architecture Description

Contents



SIEMENS Org Unit

https://wiki.ct.siemens.de/display/MemberSSA/Tools+and+Templates

# Test Architecture Documentation

Driven by Architecture documentation; you must understand & review it as the TeA.

## ISO/IEC/IEEE 29119-3: Test documentation Overview

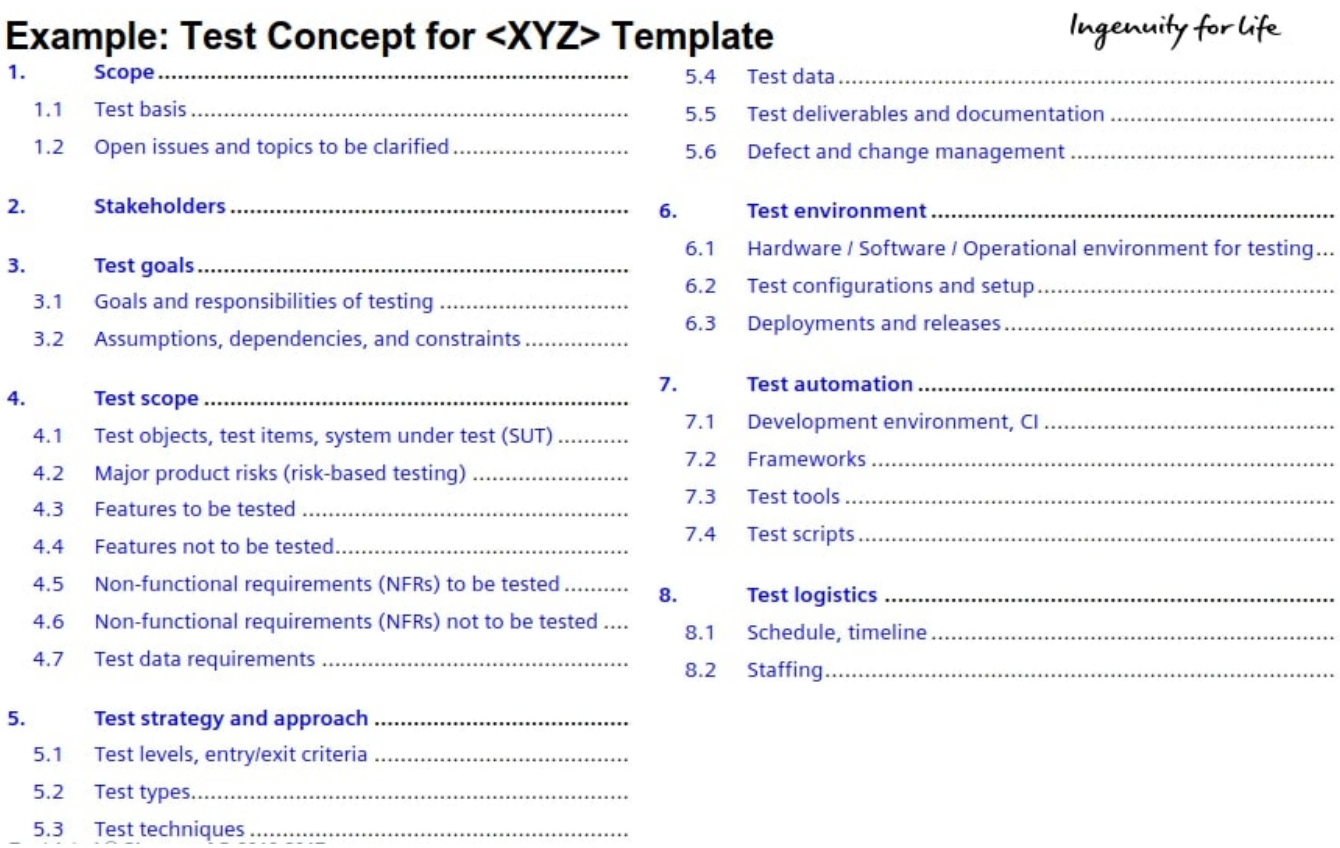
- Part 1: Concepts and Definitions
- Part 2: Test Process
- Part 3: **Test Documentation**
- Part 4: Test Techniques

**Test Documentation**

- **Organizational test process**
    - Test strategy *(test levels, test goals, who does what)*
- **Test management processes**
    - Test plan
    - Test status
    - Test completion report

  *(Test Exit Criteria: test coverage, test progress, defects)*
- **Dynamic test processes**
    - Test Designs
    - Test case/specs
    - Test data
    - Test environment
    - Test execution log
    - Defects

Test Plan Template



**Example: Test Concept for <XYZ> Template**

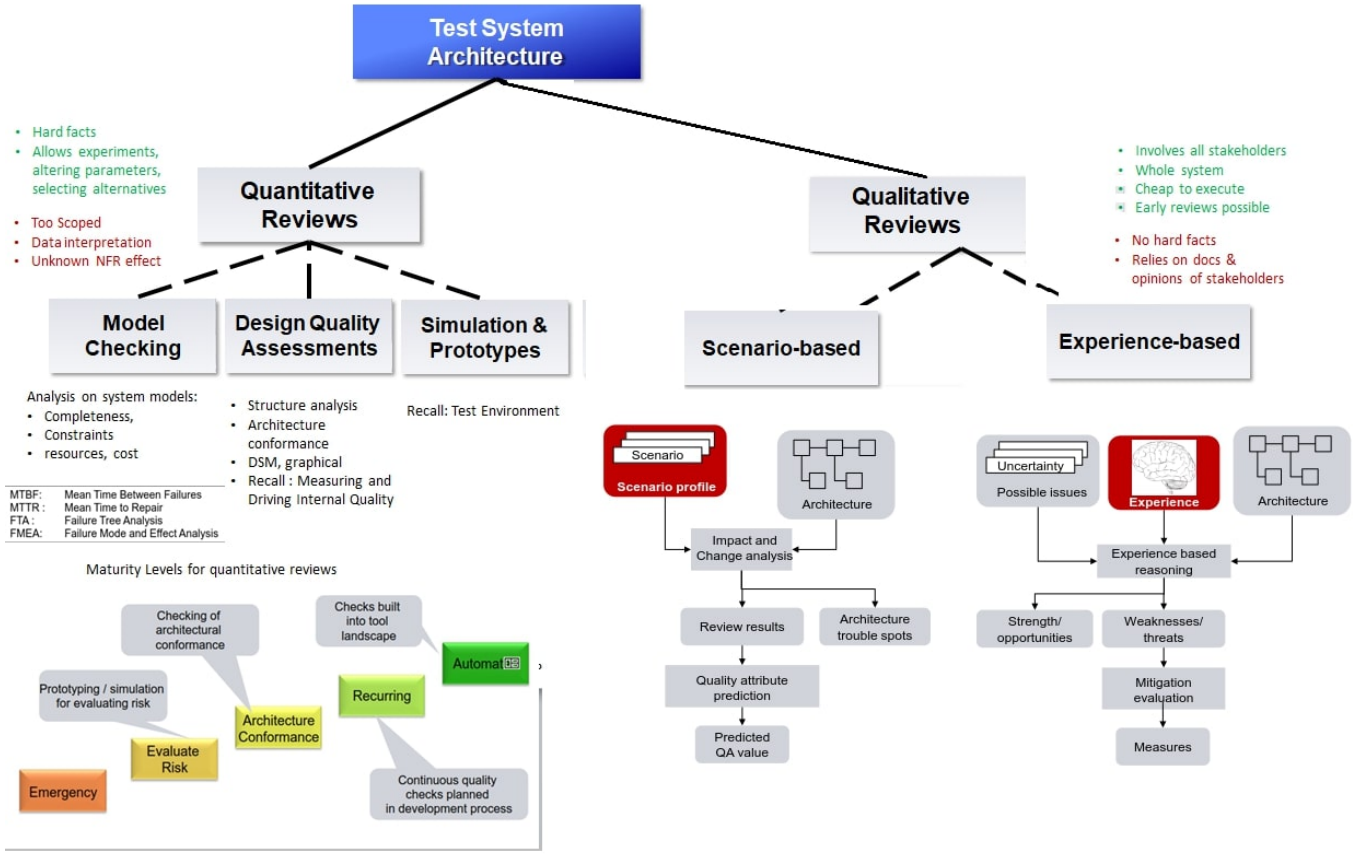
*Ingenuity for life*



# Architecture Quality & Reviews

Criteria for good architecture (recall NFRs and Quality Characteristics) :

- Reliable
- Maintainable
- Scalable
- Performance
- Security




**Qualitative Review Phase**

- Prep: clarify review goals / *reviewers*
- Collect: interviews with stakeholders, docs, source *reviewers & stakeholders*
- Elaborate / *reviewers*
    - SWOT analysis: Strengths, Weaknesses, Opportunities, Threats
    - Dealing with Weaknesses
    - ATAM (SWOT alternative:) : Architectural Tradeoff Analysis
- Consolidation : final report / *reviewers*
- Presentation to stakeholders / *reviewers*
- Workshop (optional) *reviewers & stakeholders*

## Qualitative Review Toolbox

Ingenuity for life

| | Active design review | Industry practice | Architecture Tradeoff Analysis Method | System Architecture Analysis for the Field |
|---|---|---|---|---|
| **Type** | Experience-based, scenario-based | Experience-based | Scenario-based | Scenario-based |
| **Intention** | Improve design, find errors | SWOT analysis, identify measures | Clarify and prioritize requirements, evaluate suitability of architecture for change scenarios | Improve design, find errors, identify measures for mitigating typical lifecycle issues |

## Error classification

Ingenuity for life

| Error type | Examples |
|---|---|
| **Inconsistencies** | ▪ Places where the design will not function properly<br>▪ Contradicting behavior |
| **Inefficiencies** | ▪ Unnecessary complexity<br>▪ Inefficient use of resources, channels, etc |
| **Ambiguities** | ▪ Unclear requirements<br>▪ Undocumented assumptions<br>▪ Elements of the design specification which can be understood in different ways |
| **Inflexibility** | ▪ Elements making change requests difficult<br>▪ Obstacles for dealing with lifecycle issues (e.g. configuration, service, upgrade, etc.) |

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Ingenuity for life

## Comparison of qualitative reviews

| | Active Design Review | Industry Practice | Architecture Tradeoff Analysis Method | System Architecture Analysis for the Field |
|---|---|---|---|---|
| **Interaction** | Designer, reviewer | Interviews | Workshop | Workshop |
| **Phase** | Detailed component / module design ready | After architecture has been designed | Architecture design complete enough for walkthroughs | Detailed component / module design ready |
| **Strength** | Focused on finding defects in design | Concrete measures | Bring stakeholders together, requirement prioritization | Concrete measures |
| **Key restriction** | Small scale | No common understanding of requirement priorities | No measures | Focus on system in operational conditions |
| **Duration** | 2 days / reviewer | Four weeks regular<br>1 day flash | Two weeks | Two weeks |

## Overview of qualitative architecture reviews

Ingenuity for life

| | SAAM | ATAM | ADR | Industry practice |
|---|---|---|---|---|
| **Type** | Scenario-based | Scenario-based | Experience-based, scenario-based | Experience-based |
| **Intention** | Clarify and prioritize requirements, evaluate suitability of architecture for change scenarios | Clarify and prioritize requirements, find risks, sensitivity points, tradeoffs | Improve design, find errors | SWOT analysis, identify measures |
| **Interaction** | Workshop | Workshop | Designer, reviewer | Interviews |
| **Phase** | Architecture design complete enough for walkthroughs | Architecture design complete enough for walkthroughs | Detailed component / module design ready | After architecture has been designed |
| **Strength** | Bring stakeholders together, requirement prioritization | Like SAAM, but deeper architectural evaluation | Focused on finding defects in design | Concrete measures |
| **Key restriction** | No risks, no measures | No measures | Small scale | No common understanding of requirement priorities |
| **Duration** | 2–3 days | Two weeks | 2 days / reviewer | Four weeks regular<br>1 day flash |