Clarifying Requirements for Architectural Design

Claudine Allen

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Software Architecture Gathering

Outline

- About me
- Architecturally Significant Requirements(ASRs)
- Quality Attributes
- Quality Attribute Scenarios
- Methods for identifying and Prioritizing
  - Working with Stakeholders
  - Architectural experience and expertise

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Architecturally Significant Requirements

- We don’t want to begin designing systems without thought to what requirements are architecturally significant
- We need to identify and clarify things like
  - Constraints and architectural concerns:
    - External system requirements
    - Devices such as sensors also actuators
    - Project Management requirements – scheduling, costs
  - The purpose of the architectural design being undertaken
  - Which functionality are architecturally significant?
  - Quality Requirements

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  - Which functionality are architecturally significant?
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Quality Attributes

- QA attribute requirements are among the most important architecturally significant requirements. But …

1. Sometimes these cannot be garnered at the level that architects require from the requirements specifications
2. We therefore need to find ways of clarifying them so that they are more useful to the architecture design process

We often must rely on stakeholders for clarification but …

- Stakeholders don't often know exactly what they require (or may be challenged to express this clearly)
- Stakeholders' needs conflict with each other
- Stakeholders' statements of quality requirements can be ambiguous and may need clarification in terms of context, response expected and the measure of that response
- We also need to find a way of removing ambiguity presented by some quality attribute names being used without complete context e.g. availability and security may both be used to describe the same quality concern when the stakeholder concern is a denial-of-service situation

Establishing Quality Requirements for Architecture Design

1

Get quality requirements in the form of quality attribute scenarios

2

Prioritize these quality attribute scenarios

3

Use these to drive the architecture design process

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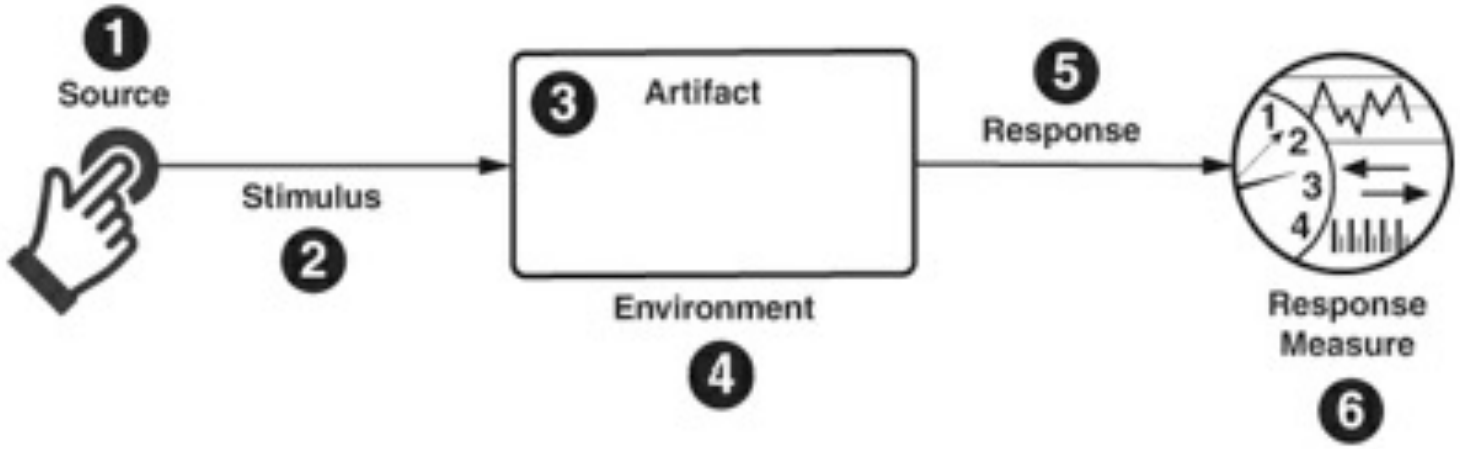
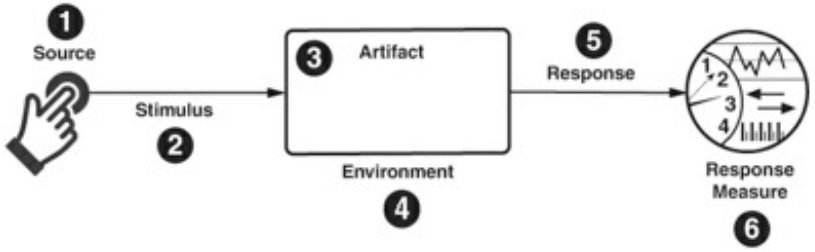
Quality attribute Scenario

- 6-part statement of a quality requirement
- Clarifies requirements by requiring us to get answers to very specific facets of a quality requirement



Len Bass, Paul Clements, and Rick Kazman. 2012. Software Architecture in Practice (3rd. ed.). Addison-Wesley Professional.

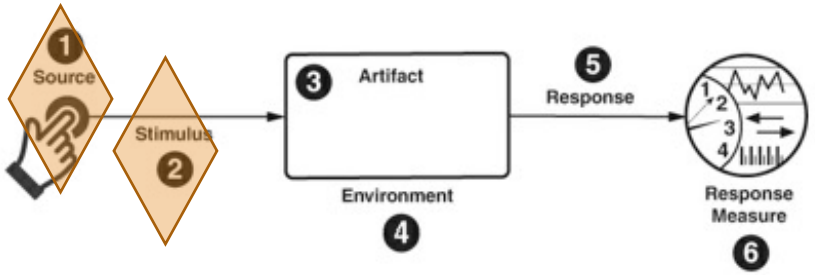
Quality attribute Scenario



Helps us answer specific questions about a quality requirement for the software

- What triggers the need for the quality response? (stimulus and source of stimulus)
- What is the context and/or condition under which the response is required (environment)
- Where in the software is the quality response required? Or where is the triggered issue occurring? (artefact)
- What is the response required? (response)
- How do we measure the required response? (response measure)

Quality attribute Scenario



Helps us answer specific questions about a quality requirement for the software

- What triggers the need for the quality response? (stimulus and source of stimulus)
  - Stimulus - Component failure, increase in resource demand, the need to learn to use a system or to minimize errors made, attack, completion of a unit
  - Source of stimulus – user, external authenticated trusted system, external untrusted system
- What is the context and/or condition under which the response is required (environment)
- Where in the software is the quality response required? Or where is the triggered issue occurring? (artefact)
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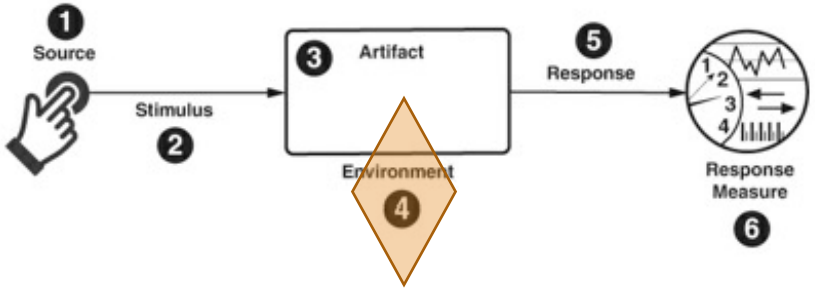
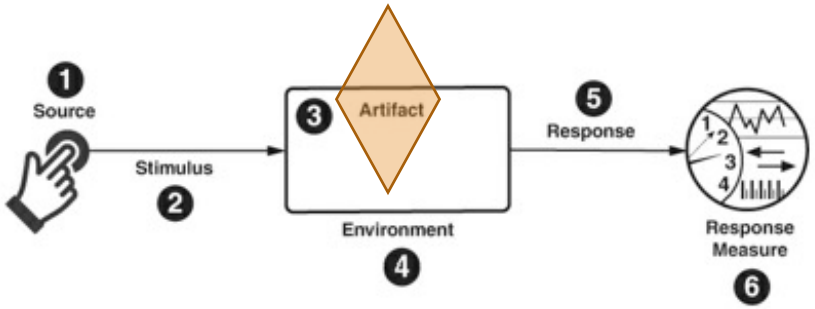


Helps us answer specific questions about a quality requirement for the software

- What triggers the need for the quality response? (stimulus and source of stimulus)
- What is the context and/or condition under which the response is required (environment)
  - During peak load, during setup, during development, normal operations, at start up, at shut down
- Where in the software is the quality response required? Or where is the triggered issue occurring? (artefact)
- What is the response required? (response)
- How do we measure the required response? (response measure)

Quality attribute Scenario



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- What is the context and/or condition under which the response is required (environment)
- Where in the software is the quality response required? Or where is the triggered issue occurring? (artefact)
  - Image repository, shopping cart component, video streaming component, communication channel
- What is the response required? (response)
- How do we measure the required response? (response measure)

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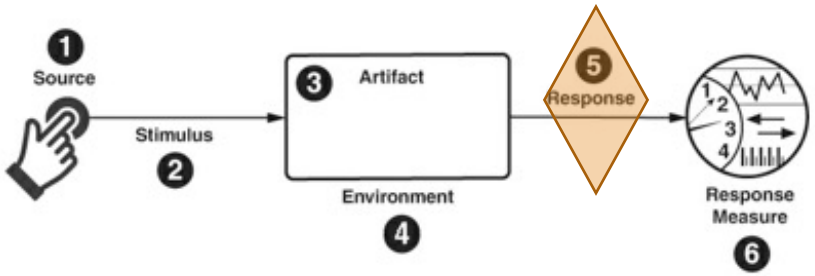

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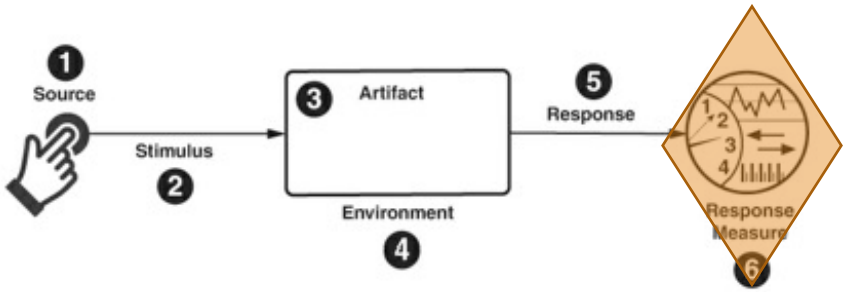
- What is the response required? (response)
  - Update is rolled back, the failure is logged and an error message sent to the operator, user is able to complete the withdrawal without needing any assistance,
- How do we measure the required response? (response measure)

Quality attribute Scenario



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- What is the response required? (response)
- How do we measure the required response? (response measure)
  - Maximum number of transactions per unit of time, average time per transaction, response time, recovery time, maximum man hours, maximum down time, cost in dollar amounts, time taken to execute something

Examples

The product shall switch between displaying and hiding non-printing characters instantaneously. *Example taken from processimpact.com/article/qualreqs.pdf and written by Karl Wiegers*

- *Can the developer tell what triggers the need for the quality response and the source of that trigger?*
- *Instantaneous is quite subjective – depends on who is looking*
- *Are there specific conditions under which this switch should occur*
- *Where would this change be occurring?*

Examples

- The product shall switch between displaying and hiding non-printing characters instantaneously. *Example taken from processimpact.com/article/qualreqs.pdf and written by Karl Wiegers*
  - *An improvement might be:*

  When the user selects the formatting characters option while formatting characters are displayed, formatting characters on the document display will be hidden within 1 second of the user's selection.

Examples

- The product shall switch between displaying and hiding non-printing characters instantaneously. *Example taken from processimpact.com/article/qualreqs.pdf and written by Karl Wiegers*
  - *An improvement might be:*
  - *When the user selects the formatting characters option in the editor while formatting characters are being displayed, formatting characters on the document display will be hidden within 1 second of the user's selection.*

Another example

- A wearable device attempts to send data to the mobile app but loses power during the transfer. The mobile app should log the failed transfer and roll back any changes that have been made to the state of the data within 7 seconds.

Another example

A user begins to play a video sequence to guide his exercise routine within the mobile application. The video plays after a maximum initial lag of 5 seconds for a 30-minute video. The entire sequence should play with a maximum lag ratio of 3% including the initial lag. The video must play with a minimum bit rate of 6Mbps on any device.

Quality Attribute Workshop

- A method of collaboratively collecting stakeholder view on what quality attributes are important
- The QAW is a facilitated, stakeholder-focused method to generate, prioritize, and refined quality attribute scenarios before the software architecture is completed.
- The output is a prioritized list of quality attribute scenarios

Steps of the QAW

- *Introductions*
- *Explanation of the Quality Attribute Workshop*
- *Business/mission presentation.*
- *Architectural plan presentation.*
- *Identification of architectural drivers.*
- *Scenario brainstorming.*
- *Scenario consolidation.*
- *Scenario prioritization.*
- *Scenario refinement.*

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Business/mission presentation.

- Business Stakeholder presents the business concerns behind the system
- Business context
- Broad functional requirements
- Constraints
- QA Requirements
- Takes about 1 hour

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Architectural plan presentation.

- Now the architect gives some sense of what the architectural plans are at this point. This may just be a context diagram or a simple component diagram highlighting main components
- It could also be a deployment diagram or some diagram that gives a sense of the physical layout of the solution

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Identification of architectural drivers.

- Now the architect shares the list of key architectural drivers that they have have assembled from (listing to business stakeholders) and their own thoughts from the architecture thus far
- They ask the stakeholders for clarifications, additions, deletions, and corrections. The idea is to reach a consensus on a distilled list of architectural drivers that include overall requirements, business drivers, constraints, and quality attributes.

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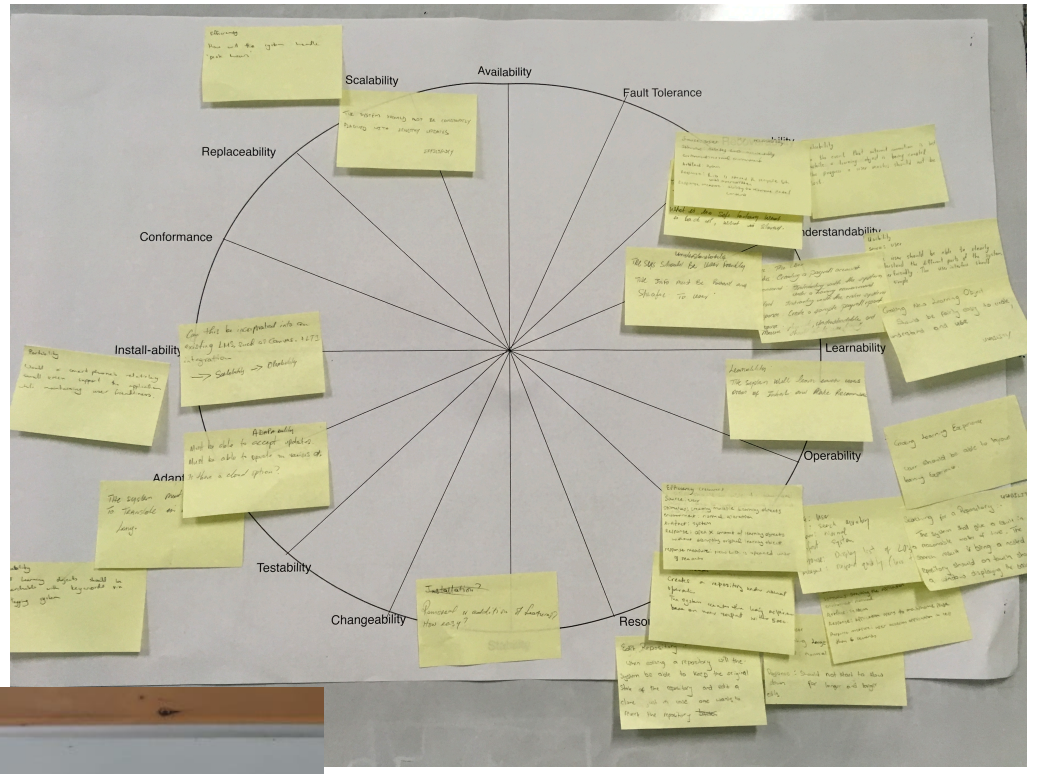
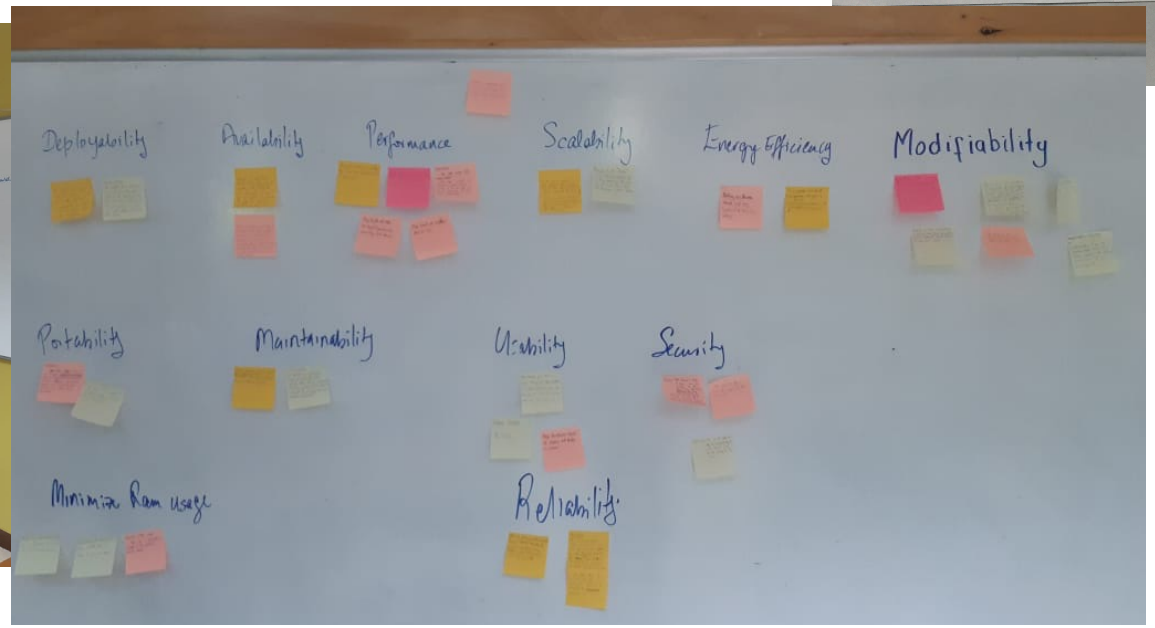
Scenario brainstorming.

- Each stakeholder expresses a scenario representing his or her concerns with respect to the system
- Facilitators ensure that each scenario addresses a QA concern, by specifying an explicit stimulus and response.





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Scenario consolidation.

- After the scenario brainstorming, similar scenarios are consolidated where reasonable. Facilitators ask stakeholders to identify those scenarios that are very similar in content.
- Scenarios that are similar are merged, as long as the people who proposed them agree and feel that their scenarios will not be diluted in the process.

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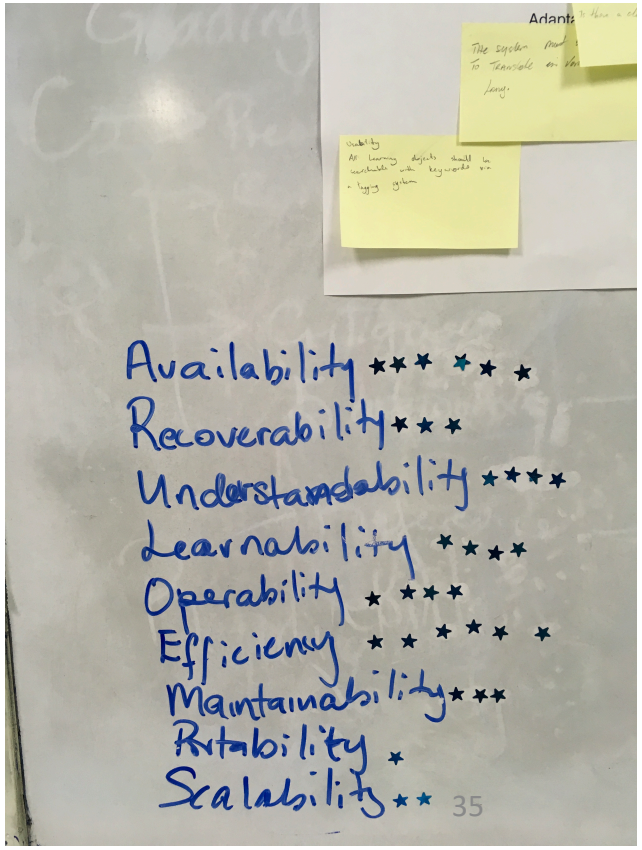
Scenario prioritization

- Allocate each stakeholder a number of votes equal to 30 percent of the total number of scenarios generated after consolidation
- Stakeholders can allocate any number of their votes to any scenario or combination of scenarios.
- Scenarios are then prioritized according to the number of votes received after everyone has voted.



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Scenario refinement.

- The top scenarios are refined and elaborated.
- Facilitators may help to refine the 6-part model of the scenarios
- Doing this helps to refine and clarify the issues surrounding satisfaction of the scenarios

Summary

- It is valuable to have Architecturally Significant Requirements established prior to design activity
- Quality attribute requirements are perhaps the most important of these
- They need to be expressed as quality attribute scenarios to ensure clarity in terms of context, response expected and the measure of that response
- Quality Attribute Scenarios are also valuable for avoiding ambiguity presented by some quality attribute e.g. availability and security may both be used to describe the same quality concern when the stakeholder concern is a denial-of-service attack
- Quality attribute workshop is a stakeholder collaboration type of activity led by an architecture team that assists in gathering quality requirements (in the form of quality attribute scenarios) from stakeholder perspective and prioritizing them.