Foundations of Software Architecture : Module 1b

Architectural Analysis

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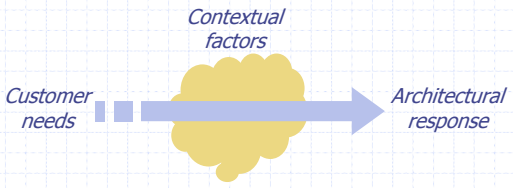
Wherefore† art thou architecture?



Customer needs give rise to architectural responses, shaped by contextual factors

† **wherefore**
n : the cause or intention underlying an action or situation
http://www.dictionary.com

"Contextual factors"?

risks

Constraints

enablers

"OS-Z is not backwards compatible"
"OS-Z improves security"
"OS-Z has no other source"

A factor can have elements of all of these.

Types of contextual factors

- *We look for factors in lots of places:*
  - *Market/competitive*
  - *Organizational*
  - *Technological*
  - *Policy*

"The development team in Indiana…"

"Lawsuits based on failure of…"

"An updated version of…"

"Standard 3576 requires that we…"

"Our strong Java development capability…"

"Our competitive market window…"

Shapers

- Change…!
- Organisational structure
- Time performance

Usage narratives

- An informal but useful way to describe system functionality as scenarios
- Create "characters" and tell a "story"
- Sometimes seen as a prelude to writing use cases

He took his vorpal sword in hand:
Long time the manxome foe he sought
So rested he by the Tumtum tree,
And stood awhile in thought.

An example usage narrative

"Julie is interested in correlating sightings of Perameles Nasuta in the Northern beaches area of Sydney with bushfire patterns. She brings up tracking data for the last five years and proceeds to sort the data, and then export it into a form that it can be used by a statistical analysis package."

"Julie" is a science officer with the National Parks and Wildlife Service.

Functional requirements

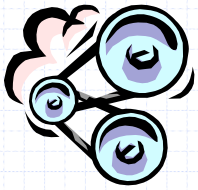
- Arise from stakeholder needs
- Express what functions the system provides
- Varying approaches
  - Structured language (requirements analysis)
  - Use cases
  - Formal models
  - User stories (agile methods, XP)

Non-functional requirements

- Expressed as quality attributes
- Architecture deals with identifying, analysing and realising quality attributes

Runtime qualities

- Runtime quality attributes emerge from the execution of a deployed system
- Quality scenarios relate to specific instances of runtime execution



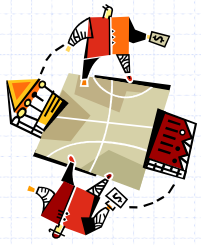
A useful acronym...

performance	*Processing speed, resource utilization, response to load*
usability	*Human factors and impact*
reliability	*Failure rates, modes, severity, and recovery*
security	*Data integrity, confidentiality, resistance to attack*

These quality attributes are a useful set of "umbrella" qualities.

Non-runtime qualities

- Non-runtime qualities relate to the lifetime of a system
- Quality scenarios are expressed in terms of incidents that occur during system development, deployment, or operation



Acronym time again...

- *Maintainability*
- *evolvability*
- *testability*
- *reusability*
- *integrity*
- *Configurability*
- *Scalability*

Any more quality attributes?

availability auditability modifiability feasibility compatibility backwards-compatibility standards-compliance continuity-of-view friendliness customizability learnability memorability enjoyability responsiveness schedulability verifiability analyzability reparability adaptability integrability interoperability predictability extensibility dependability safety portability survivability expendability expandability extensibility distributability flexibility

Performance

- Performance manifests in many ways:
  - Latency
  - Throughput
  - Memory efficiency
- Different performance metrics may apply to different parts of the system

Usability

- Usability has many aspects:
  - Learnability
  - Enjoyability
  - Time to complete task
  - Error rates
- For good results, must be performed with a usability expert

Reliability

$$\text{Availability} = \frac{MTTF}{MTTF+MTTR}$$

- A complex field:
  - Hardware/software failures
  - Mean time to failure (MTTF)
  - Mean time to repair (MTTR)
- Reliability needs often depend on criticality:
  - Inconvenience
  - Loss of income
  - Loss of life

Criticality

- Effect of system failure
  - Non-critical
    - Disrupt work
  - Low
    - Business loss, but not serious
  - Medium
    - Long-term damage to business
  - High
    - Injury, loss of life, etc.

Security

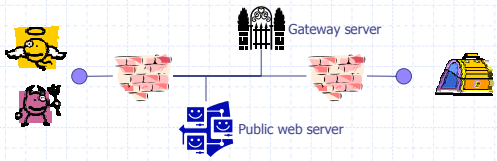
- Almost any system can be under threat:
  - External attack (network)
  - Policy weakness
  - Data integrity
- High security is very expensive
- Secure expert help

Firewalls

Packet filtering rules specify:

- Source address (or range)
- Destination address (or range)
- Destination port
- TCP/UDP
- Application protocol

Demilitarized zone (DMZ)



DMZ:

- Protects a whole enterprise, while
- Allowing specific services to be exposed, with
- Multiple security barriers

Addressing quality attributes

- Quality narratives (or scenarios) → Coming right up!
- Behavior → Soon!
- Patterns → Later!
- Styles → In module 5
- Tactics → See supplementary reading…

Quality narratives

- A narrative or scenario that highlights a quality attribute need
  - Context
  - Action
  - Response

He took his vorpal sword in hand:
24 hours the manxome foe he sought
So rested he by the Tumtum tree,
And stood 5 minutes (mean) in thought.

Measurable if possible!

Performance

"Under load at the peak event rate, any given event is analyzed and logged in no more than 200 ms."