

Introduction to Software Architecture (1)

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Architect's roles – not just technology

- Creating the “right” technical vision – aligned with organization's business strategy
- Getting the organization to “buy into” this vision: executive sponsors, project managers, developers – requires a lot of political skill
- Leadership and communication – read *Role of the Software Architect* for more on this
- We will focus on technical aspects

Purpose of Software Architecture

[Jazayeri et al. 2000]

- a vehicle for communication
 - architectural views: functional, concurrency, code, development, physical view
 - architectural description: UML, ADLs
- a manifestation of earliest design decisions
 - quality attributes: performance, availability, reliability, etc.
 - architectural styles
- a reusable, transferable abstraction

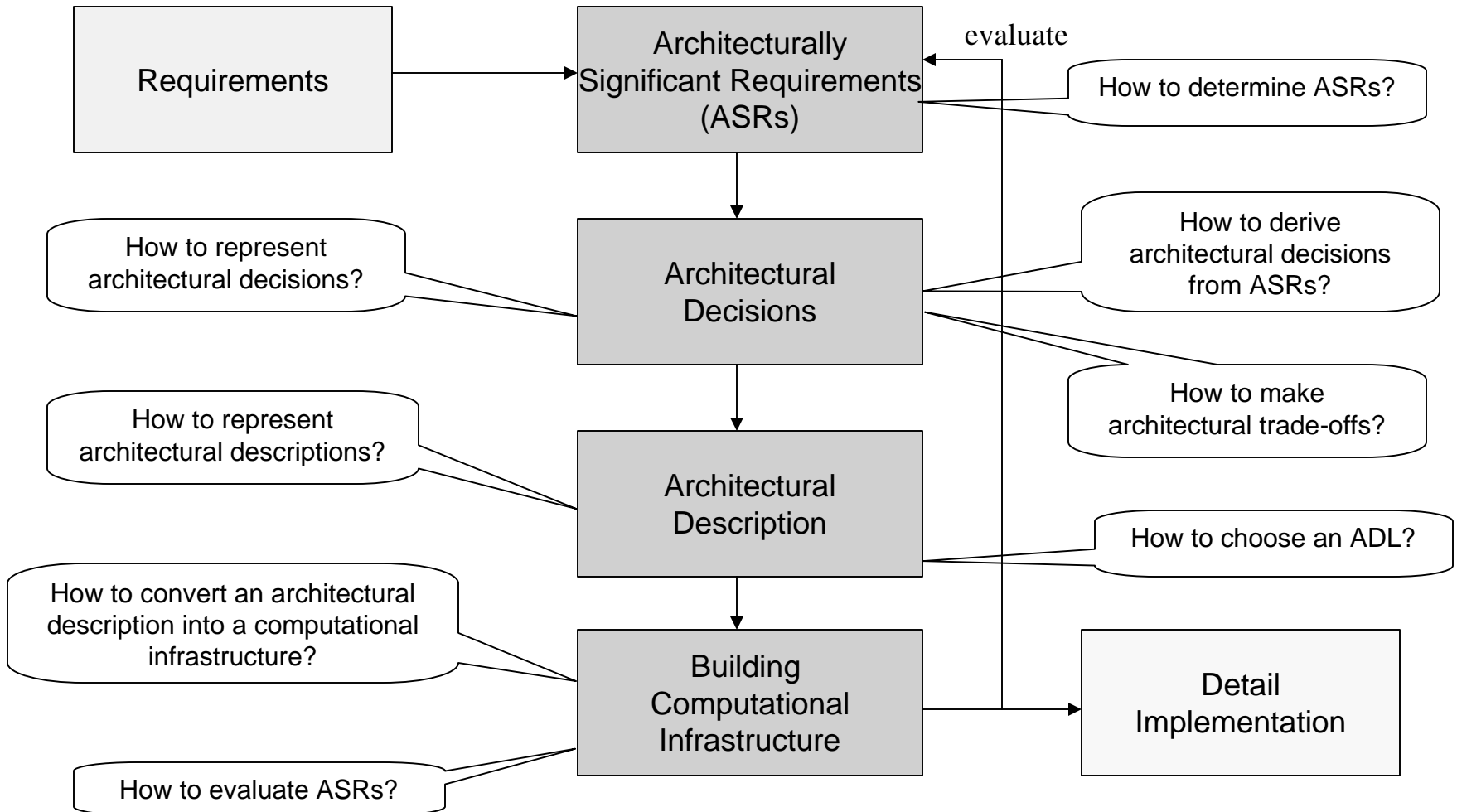
Software Architecture

- Is a craft, not an engineering discipline, at this point in time (Shaw & Garlan)
- Is a creative, not a routine, activity
- No formal notion of “optimal” architecture, given a product domain
- No repeatable methodology to write down optimal architecture
- Formal training less valuable than experience, including some degree of learning from your own errors (Penny)

However...

- This does not mean you cannot reuse any of the vast experience of architects who came before you
- Can reuse traditional formats and modeling notations for capturing and communicating architectures
- Can reuse architectural styles – popular structures of components and connectors, each having a defined impact on functionality and quality attributes

Architectural Design Stages



Architecture blueprint should be:

- Self-motivating: include some rationale with your architectural decisions. Don't leave the reader wondering why you made these choices
- Relevantly biased: not all viewpoints are equally important for all systems – focus on the right aspects (e.g. for an AI system, knowledge base structure & reasoning mechanisms – logical view – deserves more detail than deployment view)
- Simple yet decisive (the hard part)
- Based on known architectural styles

Architectural Styles

- Like patterns in class design
- Common styles (Shaw & Garlan 1996):
 - Pipes and filters (e.g. Unix shell, data processing)
 - Implicit invocation (e.g. GUI's: when an event is announced, any interested components may process it)
 - Layered functionality (e.g. network protocols, graphics rendering)
 - Repository / blackboard (e.g. online transaction processing, pattern recognition)
 - Interpreter (e.g. Java Virtual Machine)

More on Architectural Styles

- Attribute-based architectural styles (Klein & Kazman 1999):
 - Synchronization
 - Data indirection
 - Abstract data repository
 - Publish/Subscribe
 - Layering
 - Simplex
- Attempt to quantify the impact of styles on a system
 - e.g. authors show that Repository reduces the number of code changes in situations where data producers and consumers evolve while data schema stays frozen

Architectural Description Languages (ADLs)

- ACME
 - interchange
- Adage and Meta-H
 - avionics system
- Aesop and UniCon
 - real-time analysis
- Darwin
 - π -calculus
 - analysis of distributed message-passing
- Rapide
 - design simulation and analysis
- Wright
 - formal specification and analysis
- UML Approach
 - direct link to implementation
 - practitioners like it
 - poor vocabulary for AD
 - informal, less automated analysis

Next Tutorial

- We present
 - format of practical architectural design document
 - examples

References

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3. M. Shaw and D. Garlan, *Software Architecture*, 1996.
4. M. Jazayeri, A. Ran, and F. Linden, *Software Architecture for Product Families: Principles and Practice*, 2000.
5. M. Klein, R. Kazman, *Attribute-Based Architectural Styles*, 1999 (CMU/SEI-99-TR-22).