Understanding, modeling, supporting, and reviewing architecture decisions

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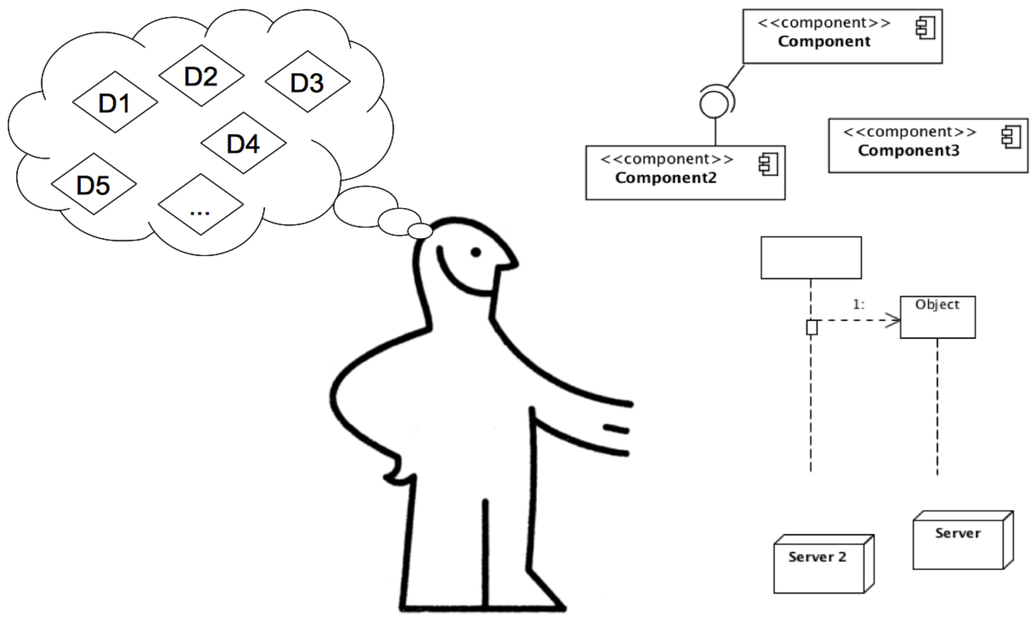
Introduction

Software architecture is the result of a set of interrelated architecture decisions (AD).



Problems

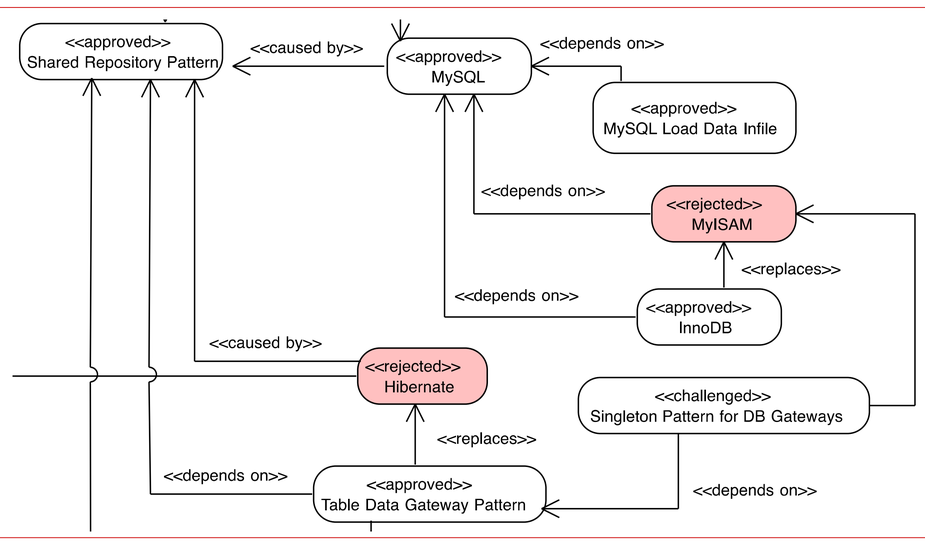
The stakeholders' concerns about architecture decisions are manifold, e.g.:

- What decisions have been made?
- What is the rationale for a specific decision?
- Which requirements have conflicting influences on a decision?
- What other decisions are dependent on a specific decision?
- What decisions are impacted by a change?
- What decisions influenced a specific architecture element (e.g. a component)?
- What decisions became obsolete and need to be reconsidered?

Existing approaches to architecture decision documentation have a number of problems:

1. Each approach satisfies only a small subset of the stakeholders' concerns about ADs, but none of them satisfies all concerns
2. They do not integrate well with the rest of the architecture documentation, which is usually organized using multiple interrelated and traceable views [1].
3. They focus on documentation after the fact; they do not support the architect in making good decisions during the design process. Ideally, decision documentation should provide support for architectural analysis, synthesis, and evaluation [2].

Example relationship view

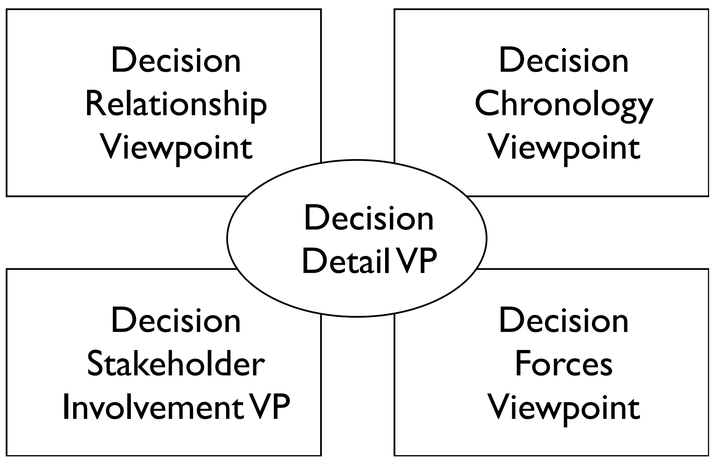


References

1. ISO/IEC/IEEE42010, Systems and software engineering—Architecture description, ISO, December 2011.
2. C. Hofmeister, P. Kruchten, R. Nord, H. Obbink, A. Ran, and P. America. Generalizing a Model of Software Architecture Design from Five Industrial Approaches. In Proceedings of the 5th Working IEEE/IFIP Conference on Software Architecture, IEEE Computer Society, 2005.
3. U. van Heesch: 2012, Architecture Decisions: The next step – Understanding, modeling, supporting, and reviewing architecture decisions, PhD thesis, University of Groningen.

A framework for architecture decisions

To tackle problems one and two, we developed a framework for architecture decisions [3], following the conventions of the international architecture description standard ISO/IEC/IEEE 42010 [1].



The framework comprises five interrelated viewpoints:

- The **decision relationship viewpoint** makes relationships between architecture decisions explicit. The box on the left shows an excerpt from a relationship view.
- The **stakeholder involvement viewpoint** explains the responsibilities of specific stakeholders in the decision-making process.
- The **decision chronology viewpoint** shows the evolution of architecture decisions over time.
- The **decision forces viewpoint** makes explicit the relationships between architectural decisions and the forces that influenced the architect when making decisions.
- Finally, the **decision detail viewpoint,** as an aggregate viewpoint, combines the information shown in the other viewpoints for single decisions. Additionally, it allows to elaborately document the rationale behind decisions.

The adherence to ISO/IEC/IEEE 42010 allows to combine decision viewpoints with all other architectural viewpoints that use the standard. Supported by adequate tooling, this allows to trace decisions to all other types of architectural description elements.

Decision modeling supports rational decisions

To analyze if the decision framework can also address problem three (decision making support), we conducted several empirical studies with practitioners and software engineering students. The results show that modeling decisions according to the decision framework significantly supports a rational decision making process [3]:

- Decision views provide strong support in the area of solution evaluation and selection (architectural synthesis)
- At least partial support is provided for the management of architecture significant requirements (architectural analysis)
- No evidence for the support for handling complexity and evaluating the viability of design options was found.

DCAR – Decision-Centric Architecture Review

In order to use decision viewpoints for supporting architecture evaluation (part of problem three), we developed DCAR, an architecture evaluation method that uses architecture decisions as first class evaluation targets [3]:

- DCAR uncovers and evaluates the rationale behind the most important architecture decisions
- It uses *decision forces* to consider the entire context, in which the decisions were made. A force is any non-trivial influence on an architecture when making decisions. Forces include requirements, constraints, risks, political or organizational considerations, personal preference or experience of the architect and the development team, or business goals like quick time-to-market and low price.
- DCAR is lightweight and can be performed during or after the design is finalized.

Promising experiences in large software projects have shown the applicability of DCAR in the industry.