

Decision-Centric Architecture Reviews

Method Description

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Motivation

Software architecture is the result of a set of fundamental design decisions made by a system's architects and other stakeholders. These decisions are in different levels of maturity and some introduce uncertainty. Decisions that turn out to be sub-optimal, or even risky are likely to be subject to change in later project stages. However, changes to the software architecture become more expensive the later they are made. Therefore, software architecture should be evaluated in early stages of the system development in order to avoid extraneous effort and cost.

Unfortunately, current (scenario-based) architecture evaluation methods are not broadly established in industrial practice. The critique from industrial practitioners focuses mostly on the excessive effort the methods take, as well as their level of difficulty. In some cases, information about these methods is so overwhelming that it prevents practitioners from following them. Instead, many companies perform architecture evaluation ad hoc, inadequately, or not at all.

The main motivation of the Decision Based Architecture Review method (DCAR), presented in this document, is to alleviate some of the known problems of scenario-based evaluation methods. In particular, these methods suffer from two major problems. First, they are rather heavyweight. This is partly due to the fact that scenario-based evaluation has a rather broad scope: it uses considerable time for discussing and refining business goals and (quality) requirements in addition to the analysis of the actual architecture. Second, since the analysis is structured according to the scenarios, which are basically test cases for the architecture, only a very limited number of scenarios can be analyzed in practice; thus the coverage of scenario-based evaluation remains an open question. This means that the trustworthiness of scenario-based evaluation cannot be guaranteed.

The idea of DCAR is to organize the evaluation according to the architectural decisions, rather than using scenarios. The main expected advantages are that the evaluation process can be made in shorter time and less company work hours, and that the coverage of the evaluation can be directly expressed in terms

¹ In alphabetical order

of the decisions and corresponding system parts in the architecture that have been analyzed. It is assumed that an average DCAR evaluation session can be carried out in half a day, requiring the presence of only 2-3 members of the development team, including the chief architect. Thus, the total amount of company working hours is expected to be less than two person-days plus another two person-days for the review team.

DCAR can be regarded as a systematic technical review rather than a comprehensive validation of the system against its business goals. Since the architecture is viewed and analyzed in terms of its major decisions, judging the justifications of each decision, the results of DCAR concentrate more on possibly ignored or forgotten consequences of the decisions than on poorly understood quality requirements. Thus, DCAR can be recommended in situations where there is less uncertainty about the nature of quality requirements, but more interest on assuring that the architectural solutions optimally balance all forces acting on the decision.

DCAR is a lightweight, easy to understand architecture evaluation method, which can be used to identify and evaluate the most important design decisions at the current stage of a project. The method encourages architects and non-technical stakeholders to openly discuss the decisions and their motivations.

A DCAR session results in a list of issues, risks, non-risks and indicators for technical debt, as well as a thorough documentation of the evaluated decisions including the main technical and non-technical decision forces.

DCAR participants

DCAR participants can be divided into two groups: stakeholders from the company and the evaluation team.

Company stakeholders

In order to make the DCAR as efficient as possible, we recommend the following stakeholders to be present:

- The architects of the system
- Project manager(s)
- Domain experts (optional)

The architects of the system are obligatory participants of the evaluation. If multiple architects were in charge of designing the system, at least one or two of them must attend who know the system and its objectives very well.

As described below, one essential step of DCAR is a presentation of the architecture by one of the architects. This presentation, and a subsequent interview are used to complete the list of architectural decisions assessed during the review.

Additionally to the architects, DCAR requires the presence of at least one project manager. The manager presents the business model of the project and elaborates on the main business drivers. This is necessary, because DCAR aims at holistically capturing potential forces that influenced the architecture decisions made. Optimally, the manager is present during the whole DCAR session. He can

act as a catalyst for stimulating the information exchange between the technical stakeholders and the review team.

Furthermore, domain experts, as optional DCAR participants, can provide additional insights in the domain's problem and solution spaces.

Evaluation team

The evaluation team is familiar with the review procedure and has experience in designing software architectures. They do not necessarily need experience in the domain of the evaluated system, although this is clearly a benefit. Ideally, the members of the review team are independent from the project's company, because this allows for a more objective view on the system. However, if this is not feasible, for instance because of confidentiality issues, the reviewers can be company internals who have not had any responsibilities in the project under review.

The following list shows the different roles of the DCAR evaluation team; they will be explained in detail below:

- Review leader
- (Architecture) decision scribe
- Minute writer
- Questioner

Roles in the DCAR method can be assumed by the same person. That way, DCAR can be implemented with less effort. The minimum number of persons required for the evaluation team is two. In this case, one person takes the roles review leader and questioner, and a second person can be the decision scribe and minute writer. However, three or four people are the optimum number of reviewers. In that case, different persons take the review leader, decision scribe, and minute writer roles. The questioner role can be combined with any other role.

The review leader is responsible for preparing the review. He gathers the evaluation team and acts as contact person for the company. The review leader furthermore negotiates the evaluation schedule and the scope of the review. During the DCAR, he opens the session and acts as a review chair. As such, he makes sure that the evaluation remains on schedule and focuses on the DCAR steps.

The decision scribe captures potential architecture decisions on the fly, during the presentations held by the architects and the managers and domain experts. He constructs a graphical decision relationship view, which is incrementally refined during the whole review session. The decision view primarily serves two purposes: on the one hand it allows the review team to keep an overview over the important decisions and their interrelationships, during the review session. On the other hand, it is used to establish a feedback loop, i.e. it is presented to the company stakeholders during the review session to make sure that the review team understood the decisions well.

The minute writer keeps track of all discussions held. It is his special responsibility to note down all forces that potentially impacted the architecture decisions made. The minute writer has an active role during the review. He asks questions for clarification and tries to elicit additional forces that did not come up during the initial presentations. Typically, in the analysis phase, the minute writer additionally acts as a questioner.

The minute writer also supports the company stakeholders during the decision documentation phase (see Step6 below) to document decisions, especially if the stakeholders are not familiar with the concept of decisions and forces. After the review, the minute writer and decision scribe compose a comprehensive documentation of the architecture decisions elicited and discussed during the review session. This documentation is part of the final report.

It is in the questioners' responsibility to question and challenge the decisions made by the architect. However, unlike other architecture evaluation methods, in which the architecture is under scrutiny, DCAR aims at *supporting* architects in identifying risks and issues, but also to raise confidence in noncritical decisions.

Essential Steps

	Step1: Preparation for the evaluation
	Step2: Introduction of the DBAR method to the participants
	Step3: Management presentation on the domain and business drivers
	Step4: Architecture presentation
Loop	Step5: Decision overview and prioritization
	Step6: Decision documentation
	Step7: Decision evaluation
	Step8: Retrospective and report

Figure 1 Essential steps of DCAR

Figure 1 shows the main steps of a DCAR evaluation. In the following, each of the steps is described:

Step1) The review leader invites the company stakeholders for the DCAR session. Each participant is informed about his role and responsibilities during the review. The company provides reading material, which can be used by the reviewers as a preparation. This material includes requirements and design documents, as well as technical reports and management summaries. The evaluation team uses this material to mine preliminary forces and decisions.

Step2) The review session starts with an introductory presentation of the DCAR method to all participants. This includes the schedule of the DCAR steps, the expectations and goals of the participants, and again the roles and responsibilities of all participants. Finally, all participants quickly introduce themselves to the other participants of the DCAR.

Step3) A manager gives a short presentation about the application domain, the main financial drivers, and the business model. During the presentation, the minute writer and the other members of the review team note down potential forces that influence the architecture decisions made in the system.

Step4) The architects introduce the system including the system objectives and the main architecture decisions from their perspective. Architects may not know exactly what decisions are and which ones to report to the team. To alleviate this issue, during the architects' presentation, the minute writer takes notes about potential decisions and asks the architects to validate that they are indeed decisions, especially important ones. If architects are provided with examples of typical architecture decisions, they usually understand the concept better and come up with important decisions themselves. The reviewers use the requirements (especially the QAs), which were provided by the company in advance to make sure that no important decisions were left out. Along with decisions, the architect is asked to provide a short rationale for every decision.

During steps three and four, the decision scribe creates a graphical decision relationship view. He asks questions to clarify decisions and their relationships.

Step5) The reviewers present the architecture decisions they elicited on the basis of the reading material and the presentations. The decision relationship view serves as a means to facilitate the presentation and discussion of the decisions. The review team and the company stakeholders clarify questions related to the decisions and reach mutual agreement on the correctness of the decision description.

Then the company stakeholders negotiate which decisions are the most important ones. These might for instance be mission-critical decisions, decisions bearing risks, or expensive decisions.

The following procedure can be used to choose decisions: Each company stakeholder gets 100 points. He can distribute the points over the decisions based on their personal criteria for the importance of decisions. Then the points of all participants are collected. The DCAR participants discuss the rationale behind each person's choices and check the relation of the choices to the forces, which were elicited beforehand. About 25% of the decisions with the highest rating are taken to the next steps of DCAR (depending on the available time, a higher or a lower percentage may be used). Alternatively to the personal criteria of each reviewer, the review team can focus on specific aspects when selecting decisions. The reviewers could for instance be instructed to assign the points based on their personal estimations on the influence that the decisions have on achieving the most important quality attribute requirements. If some of the QAs are not or not sufficiently regarded by any decisions, then this is an indicator for a missing decision.

Step6) The decisions selected in the previous step are subsequently evaluated. First, the architects are asked to document each of the selected decisions using a decision description template. Each stakeholder selects a few decisions he is

knowledgeable about. The decisions should be documented by describing the applied architectural solution, the problem or issue it solves, arguments in favor of the solution, arguments against the solution, and a list of considered alternatives. The minute writer supports the architects during this process. Then the documented decisions are collected.

Step7) Each documented decision is discussed for ten minutes. In our experience, the quality of discussion diminishes after a short time. If a decision requires more than ten minutes, it can be flagged as a point for further discussion later.

The stakeholders briefly present the decisions they documented. After that, the reviewers try to come up with more arguments in favor of or against the applied solution. They use the elicited decision forces and the decision relationship view to challenge each of the decisions in the context of the forces and related decisions. The documentation of the decisions and the decision relationship view are continuously updated during the whole process. All participants discuss whether the arguments in favor of the decision outweigh the arguments against it. Finally, the stakeholders decide whether the decision is good or has to be re-discussed internally. During the whole discussion, the reviewers note down potential issues, risks, or indicators for technical debt.

After step 7 is finished, the DCAR participants revisit the decision overview and prioritization from step 5 and discuss, if all important decisions were covered, or if steps 5-6 have to be repeated. A second review session should be scheduled if too many decisions remain.

Step8) Finally, all DCAR participants reflect on the efficiency and accuracy of the DCAR session. The minute writer collects all notes and artifacts created during the review session; they serve as input for the review report.

The evaluation team writes a review report within two weeks from the review session. The report is sent to one of the architects for verification and eventually refined by the DCAR team. The DCAR reporting template can be found in the appendix.

Appendix

DCAR reporting template

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