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Software Architecture Evaluation

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Introduction

Software Architecture Evaluation is the process of determining whether the resulting software will probably be able to achieve the bossiness goals it was built for while maintaining the associated quality attributes. The most basic way to do this is to continue with the software implementation then during the testing phase you will discover if this is case or not, this method while guaranteed to provide insights about the system quality attributes that is accurate as much as needed , it costs a lot in case of wrong behavior. Imagine a software system as big as Microsoft Office with more than 3000 Engineer working on it, millions of lines code, thousands of features, and all of this went without architectural evaluation, and finally you find that it was designed to be half as fast as needed. What will you change the core modules the GUI the features implementation. The cost of changing any of this at the production stage can be as costly as the whole project, aside from the time cost and the stinky changing process that will end up to make your code base as bad as first grade student code.

Now that you know what will happen to you, your product, and your development team you will appreciate the research invested in creating evaluation methods for software architecture that can be applied before writing a single line of code. Although those method may not be revealing as the code testing, it will give you enough insights on your system and where are you stepping, it can also - with proper execution- give you a detailed information about every quality attribute and goal you are trying to achieve by building this system. This is not the only benefit from evaluation the list is so long but we can give some important key points:

- Find and report design flaws as early as possible to reduce fixing cost
- Generate a good representation of the Architecture as a result of the evaluation
- Get the opinion of experts in the design of the software and its ability to match the goals.
- Facilitate the non-technical managerial judgment on the technical work of the architecture

Factors of Evaluation

There are different factors to be considered during evaluation and those factors depends on who will be performing the evaluation, whether it will be a dedicated outsiders team , a peer review , or even evaluation by the architect himself. Those factors are:

• Evaluation by the designer

After each key decision taken by the architect s/he can perform a quick analysis to make sure the decision is the best within the constraints of the project. This analysis can take time depending on the following:

- The importance of the decision makes the analysis longer and the more important the decision you should spend more time analyzing it.
- The number of alternatives increase the analysis time to evaluate every possible alternative , so it’s advisable to eliminate the alternative as much as possible to reduce the analysis time
- Seeking perfection is sometimes wasting of time. If you have 2 alternatives and the impact of choosing any of them is not great and any one of them will do the job, then it’s better to quickly choose one of them and save time to carry on other design tasks.

• Evaluation by peers within the design process

Like code peer review, architecture can have peer review. In this method the review is driven by scenarios as following:

- The reviewer(s) will determine the quality attributes important for the final software and for each attributes s/he creates a scenario that will derive the evaluation and will satisfy the attribute
- The Architect then can present the decision(s) related part of the architecture so the evaluator(s) fully understand the architecture.
- For each of the scenarios created at the first step the architect will go through the scenario to show how it is satisfied by the architecture.
- The potential risks and design flaws are then captured.

` The architect and the project manager can then discuss what the required actions to be taken regarding those discovered problems.

• Analysis by outsiders

Analysis by outsiders is one of the most widely used means of evaluation. While “outsider” can be of different levels beginning from outside of the development team up to outside the organization, they are usually chosen because they possess high experience in the field they are going to evaluate for.

The outsider approach is chosen for more than one reason, like for example some organization politics may prevent an employee chosen for evaluation from bringing up sensitive topics to the discussion, also sometimes managers prefer to listen to the advice of an outsider that can see something the organization culture prevent others from seeing.

- Contextual Factors

Those are factors that should be considered whenever an evaluation is being done no matter who is the evaluator or what is his/her title.

- The available artifacts determine the way the evaluation will take place, do you have a complete architecture, an initial design, just a working binary code, or just the class diagrams and scenarios. In every one of those cases you will begin from a different point to reach a good description of the system to begin evaluation
- Whom the final results will be directed to can determine what kind of answers will be provided answers to the project manager may reveal some risks that are not revealed to testers and developers.
- Who will carry on the evaluation can affect the final results and its credibility. The skills and the experience of the evaluator(s) should be known and the organization should ask for the highest affordable skilled evaluators they can get.
- Whom of the stakeholders will participate in the evaluation can greatly affect the results, as every stakeholder is interested in answers of different questions the participants may shift the evaluation into answering certain questions.
- Having the business goals clearly defined affect the evaluation path. The evaluation purpose is to answer whether the architecture meet the business goals or not, if the business goals are not defined then a portion of the evaluation will be to initially define the business goals

• The Architecture Tradeoff Analysis Methods (ATAM)

ATAM is a widely used evaluation method that has been evolving and in use for over a decade, it’s designed so that the evaluator can do the evaluation while the system is not yet ready, the evaluator is not familiar with the system, and a lot of the stakeholders can attend this evaluation meetings on its different phases.

- Participants at different phases:
  - Evaluation Team (3-5 Persons)

    Evaluation team have different responsibilities assigned to every member of the team and several roles can be played by one member

  - Project decision makers

    People who can take responsibility of the project and can demand changes in the design, usually the project manager, the architect, and other managerial positions.

  - Architecture stakeholders

    The Members of the development, marketing, performance, testing, maintenance, deployment and other teams in the project that have certain preference in different quality attributes of the design.

- Output of ATAM Process
  - Accurate presentation of the architecture
  - Articulation of the business goals
  - Prioritized quality attribute requirements expressed as quality attribute scenarios
  - A set of risks and non-risks.
  - A set of risk themes (Patterns)
  - Mapping of architectural decisions to quality requirements
  - A set of identified sensitivity and tradeoff points
- Phases of the ATAM
  - Partnership and Preparation (Phase0)

    Meeting between the evaluators and the decision makers to finalize the paper work and have an overview of the ATAM and the project.

  - Evaluation with Decision Makers (Phase 1)
    - Present the ATAM
    - Present the Business Drivers
    - Present the Architecture
    - Identify Architectural Approaches
    - Generate Quality Attribute Utility Tree
    - Analyze Architectural Approaches
  - Evaluation with Stakeholders (Phase2)

        - Summarize phase 1 results
        - Brainstorm and Prioritize Scenarios
        - Analyze Architectural Approaches
    - Follow up (Phase 3)

      Present Results
      - The architectural approaches documented
      - The set of scenarios and their prioritization from the brainstorming
      - The utility tree
      - The risks discovered
      - The non-risks documented
      - The sensitivity points and tradeoff points found
      - Risk themes and the business drivers threatened by each one

• Lightweight Architecture Evaluation

- The same Steps as ATAM
- Suite small-medium projects
- Doesn’t need review team
- Can be done in half a day

• Summary

If a system is important enough for you to explicitly design its architecture, then that architecture should be evaluated.

The number of evaluations and the extent of each evaluation may vary from project to project. A designer should perform an evaluation during the process of making an important decision. Lightweight evaluations can be performed several times during a project as a peer review exercise.

The ATAM is a comprehensive method for evaluating software architectures. It works by having project decision makers and stakeholders articulate a precise list of quality attribute requirements (in the form of scenarios) and by illuminating the architectural decisions relevant to carrying out each high-priority scenario. The decisions can then be understood in terms of risks or nonrisks to find any trouble spots in the architecture.

Lightweight Architecture Evaluation, based on the ATAM, provides an inexpensive, low-ceremony architecture evaluation that can be carried out in an afternoon.