Architectural Patterns for Finding your Innovative Sweet Spot

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Abstract

The paper discusses the innovative patterns such as subtraction, multiplication, division, task unification and attribute dependency change for evaluating the software architecture to identify the risk factor, check all the quality attributes have been addressed in the software. Architecture evaluation for a large system can be done by using an approach called Architecture Tradeoff Analysis Method (ATAM). In large system the achievement of quality attributes such as maintainability, reusability, extensibility, scalability and Stake Holders Expects (SHE) are not full filled in ATAM approach. By combining the innovative patterns and the ATAM for the evaluation of the software architecture would result in better solutions. The innovative patterns are therefore useful not only for categorizing new software ideas but also for generating them.

Keywords

Software Architecture, Innovative Patterns, Quality Attributes, Risk Factor, ATAM, SHE.

1. Introduction

Most ideas for new patterns are either uninspired or impractical. A systematic process based on five simple patterns, can generate ideas that are both ingenious and viable. The major issue in software development today is quality. The idea predicting the quality of software from a higher level design description is not a new one. Quality of software is bound by basis of its architecture. It is recognized that it is not possible to measure the quality attributes of the final system based on software architecture design. This would imply that detailed design and implementation represents a strict projection of architecture.

Analyzing the software looking for

- Their progress towards refinement over time
- Their main contribution
- Advantages obtained by them

Software architecture of a system is defined as "the structure of structures of the system, which comprise software components, the externally visible properties of those components, and the relationship among them".

ATAM is a method for evaluating architecture-level designs and identifies trade-off points between attributes, facilities communication between stakeholders (such as user, developer, customer, maintainer) from the perspective of each attribute, clarifies and refines requirements, and provides a framework for ongoing, concurrent process of system and analysis.

We could find that ATAM is a risk identification mechanism of quality achievement. Normally ATAM does not discuss with all possible quality attributes. Efficiency of ATAM depends on the expertise and potential of Stakeholders (SH) and quality attributes. The modules or templates are therefore useful not just for categorizing new pattern ideas but also for generating them. The proposed method called Enhanced Architecture Tradeoff Analysis Method (EATAM) by combining the modernized patterns such as reduction, aggregation, slicing, merging task, property interdependence change and the ATAM for the evaluation of the software architecture would result in better solutions.

2. Innovative patterns

At the core of our process are the five innovation patterns. These "templates of innovation" have emerged from our historical analysis of product development trends. Our research indicates that more successful product innovation fit into at least one of these five patterns. Indeed, we have found that the patterns can help predict the emergence of new products before the appearance of signals indicating market demand.

2.1 Subtraction Pattern

While introducing new patterns, the marketers tend to eliminate the complexities in the old version thereby adding some interactive and innovative Add-on features that would enhance its performance and at the same time satisfying the customer needs better . The subtraction pattern outweighs the former by removing some of the unwanted components and replacing it by a better component in the "closed world" of the pattern and its immediate environment.

Everyone would have browsed the Job Portal. Users found it difficult because each and every detail of the resume had to be typed. Due to this there was wastage of time and unwanted errors occurred. Now these demerits were analyzed and a better replacement was made by new website which is used currently. Here applicants can upload their resumes directly in a jiffy instead of wasting their time in typing the resume. The subtraction patterns got a tremendous response and satisfied the needs of the customers. While this is a perfectly logical approach, it can result in those incremental improvements that have an impact on customers.

2.2 Multiplication Pattern

The second pattern represents a very different approach to innovation. This is the prime logic behind multiplication pattern: here the existing components or features are untouched, but another copy of these features are made. The objective is to go beyond a mere quantitative change and achieve a qualitative change.

Google search engine serves to be a classic example for this. Initially it had just a simple search engine, where the users used to while away their time in searching for information. Now the search engine contains a new feature called "Advanced Search" where one can filter his/her query and reduce the time by specifying appropriate fields such as date, file type, range etc. The user can find what he is looking for by this method.

2.3 Division Pattern

One can use the division pattern to split an existing product into many component modules. There is a change in the perspective which may lead to the reconfiguration of those modules in an unanticipated way – or even keep the modules separate in a manner that offers unexpected yield. The specialty of division is that each module preserves the characteristics of the whole.

Yahoo known for its wide range of usage all over the globe had all the utilities integrated into a single domain. Those utilities were yahoo messenger, search engine, mail, sports, and movies. Now they have been separated into individual modules. The main advantage of this method is that even if the "yahoo.com" is down, the user can still browse the various areas using their individual modules.

2.4 Task Unification Pattern

According to this method one can understand pattern innovation by assigning a new task to an existing product or its constituent environment, thereby fusing two tasks in a single component. The basic rationale for this bundling of tasks: if a single component is sufficient for performing the task of the pattern and its environment, why not just see whether it can be made to do double duty.

A classic example for task unification would be Borland C which used to compile only 'C 'Programs. The newer version Turbo C contains the files required for both C and C++, so that both C and C++ codes can be compiled in the same environment. An even more specific example would be Microsoft VC++, which can execute all codes that run on a common platform. By creating patterns which provide double benefits, a huge customer base is created and an incredible level of innovation is achieved.

2.5 Attribute dependency change Pattern

This pattern mainly involves dependent relationship between attributes of a product and attributes of its immediate environment. Pattern can be made more adaptable to the given environment. One can also create dependencies that exist between two unrelated attributes of a single pattern. The attribute dependency pattern often generates what later seem like inevitable patterns.

Windows Media Player is mainly used for playing audio and video files. This media player identifies the file format and plays the file accordingly. That is if the extension is .mp3 then it identifies that it is a audio file and plays the file in the audio format. If the extension is .avi then it identifies that it is a video file and plays it in the video format. In this way it adapts to the given environment and satisfies the needs of the customer.

The Functional Diagram of Innovative patterns show in Figure 2.1

3. Algorithm for enhanced ATM (EATM)

Input : A set of innovative patterns a = { *subtraction, multiplication, division, task unification and attribute dependency change* }
Ouput : Feasibility of achieving quality metrics such as subtraction, multiplication, division, task unification and attribute dependency change

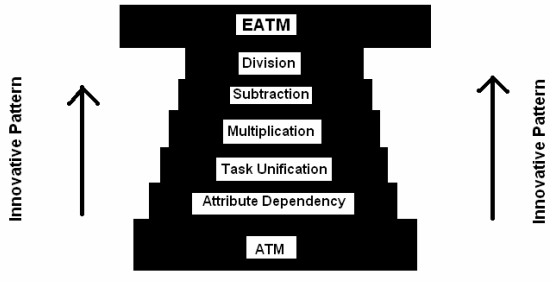


Figure 2.1 Block diagram of Innovative Patterns

Step 1: Apply a set of innovative patterns
Step 2: Identifying the business goal and major stakeholders and relevant technical and managerial constraints
Step 3: Compute software functional architecture by means of :

(i) Identifying the technical constraints such as operating system, hardware and architectural patterns

(ii) Identifying the nature of the behavioral, quality requirements and specify time for design and document

Step 4: Reward the set of architectural innovative patterns and which each one affects the particular quality attribute.
Step 5: Identify the quality attributes suitable for architecture.

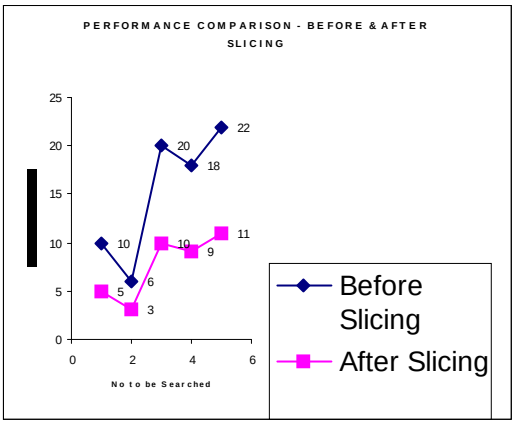
Repeat from step 1 to 5 until generate a set of quality attributes.

Step 6: Collect and prioritized the scenarios in the architecture and analyze the architectural approach.
Step 7: Generate final result and satisfy the customer.

4. Example

Build a search engine for a travel company, which allows searching the resorts, fitting in the required criteria and available for booking.

With a firm belief that Integrated Direct Connect is the key to a successful future, Trav'mart started planning for a search engine planning for a search engine supporting IDC. They planned for a complete search engine solution that will cater the present business needs as well as pave the way for integration of so called futuristic trends such as personalized services, configurable inventory, seamless integration between the search and booking etc.



Requirements

1. User enters search criteria (multiple resorts IDs, date range, multiple resort amenities, multiple region hierarchy (region / sub-region / market) on the screen and submits the same.
2. User defines the result sort order
3. System support multiple levels of validations
   a. User's access control to execute the search
   b. Validations of the search criteria
4. System executes the search criteria
5. System returns the results in the required sort order
6. User can drill down on the returned results and get more details

Non-Functional Requirements

1. Performance of the system is a critical aspect - with 5 million records in the database, the search should take a maximum of 5 seconds
2. Recommended technology is J2EE using Weblogic. Any COTS component can be suggested with proper justification

Expectations

The stress while defining the architecture should be on business components and database rather than presentations. The architecture should identify the following:

1. Various layers in the architecture
2. Various business components in each layer
3. Responsibility of the component
4. Data transfer across layers
5. Considerations for the performance for each of the above, as well as database.

By applying our method, the typical issues that are under investigations are as follows:

1. Are all stakeholders considered?
2. Have all requirements been identified?
3. Is the architectural solution being provided appears rationale?
4. Are the documents well managed?
5. Is the architectural solution being provided appears rationale?
6. Whether all the quality attributes have addressed?

Table 4.1: Sample scorecard for evaluating software architecture features

Requirement	Weight	Score	Total
Book a tour	5	5	20
Search for a tourist spot and routes from South to the spot	5	4	25
Change screen layout to suit the PDA screens	3	3	9
Portability	4	3	12
Maintainability	3	3	9
Reusability	4	2	8
Extensibility	3	3	9
Scalability	4	2	8
Total: 100			

5. Conclusion

The ATAM is the robust method for evaluating software architectures. It works by having these stakeholders articulate a precise list of quality attribute requirements in the form of patterns and scenarios and by illuminating the architecture with respect to our design patterns. ATAM has proven itself as a useful tool hence we use the ATAM architecture to integrate the above mentioned innovative patterns for better evaluation. We have heard some pattern developers initially complain that imposing these patterns seems to take the fun out of their work. But the process, by forcing developers to follow a certain path, can actually make the creative challenges more interesting. We would like to emphasize by combining EATAM and innovative patterns that the process we have described isn't meant to replace all of the companies' pattern development methods. The method we have suggested focuses on the components- that are essential, that can be reshuffled, removed or replicated in new ways thereby enhancing the discipline of the pattern that is vital to guide the company to a sweet spot.

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