

Current design patterns' practices and their quality impact on software product- A crowd wisdom approach

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Abstract.

The software technology has centered our lives for a long time. In order to keep it running with a good quality, the developers are making all possible efforts. In software development the most crucial part is its designing. For designing purpose the design patterns are used. Design patterns are repetitive solution to the design complications. This paper uses crowd-wisdom tactic to recognize the finest practices of using design patterns in the software industry today and highlights the influences of these patterns on quality attributes of an End-product. It also highlights the patterns that are most commonly used in web and mobile applications respectively and the quality attributes that are effected with these patterns.

Keywords—Crowd-wisdom, Crowdsourcing, Design patterns, Software Quality

I. INTRODUCTION

21st century is known to be the golden era for computer technology as it has covered almost every single part of the necessities today. To continue this comfort for its users, software developers have left no stone unturned to improve this technology. To achieve the fruitful results, it is necessary to make sure that the software achieves its intentional purpose and quality within feasible time and budget. SQA (Software quality assurance) is a technique which ensures the achievement of desired quality used with SDLC (software development lifecycle) steps. Among SDLC steps the design step is perceived as more complicated because there is no algorithmic rule to transform theoretical requirements into diagrammatic design. The only approach can be used is to use some techniques, previous experience and design Patterns. Design Patterns are repeatedly occurring solution to design problems. Or it can be said that design patterns convert problem domain into solution domain.

The purpose of this research was to investigate documented design problems and how their implementation has an influence on software product. The technique used to do it is known as Crowd-Wisdom Design method.

Crowd-wisdom is a type of crowdsourcing practice. Crowdsourcing is a method to involve various participants into a common chore to get a collective end result and crowd-wisdom is the crowdsourcing by using questionnaire survey approach. This research has been mainly focused on the following main objectives:

To identify which design patterns (i-e behavioral, creational and structural) are best suitable for what type of applications (i-e web app, android, iOS, desktop, hybrid etc.) to achieve the desired quality application, To analyze that which design pattern category (i-e structural, Behavioral or creational) effects which quality attributes like maintainability, reliability or more, To what extent (in percent) the design patterns categories effect quality attributes of the end-product. To recognize that which design pattern category is more frequently being used in industries today than others.

The previous work has many limitations some of them are discussed below:

The comparison of Design Patterns exists but “which are the most feasible ones” is still unclear. The research on “What design patterns for which kind of Applications are used” has not been done yet. In this work, we examine the facts that can affect the quality of software and we find out commonly used design patterns in software indus-

try. Also, we propose some particular patterns that can be used while designing particular type of applications. We have converted our research questions into survey questions.

II. RELATED WORK

An automated system based on unsupervised learning technique was proposed to select and recommend the most suitable design pattern to in-experienced users [1].

An overview of all the research work related to design patterns has been defined which has been done so far. Pattern usage and quality impact are two of those topics [2].

Design patterns do not at all times aids positively to software quality, it may occasionally lower the quality as well. Furthermore, they discussed tracing problem (a lot of use of patterns is probable toward unfamiliar structure of pattern) and its resolution (keep tracking and repository). Additionally, they have revealed yet to come work recommendations for future researchers based on (a) behavior of Developers (b) patterns of systems, and (c) present philosophies of patterns [3].

M Noman Riaz performed comparative study about influence of design pattern on software quality. He has stated that there are mainly four attributes (fault proneness, change proneness and evolution, maintainability and performance) that are more focused in the literature while any consensus is not present on their effect. He has concluded in his paper that there is a negative impression of design pattern on three attributes (evolution, proneness and maintainability). Also, the results of performance attribute and change proneness were varied from one another so the researcher declares it as challenging to make judgment for these attributes [4].

Aslı Sarı, Ayşe Tosun and Gülfem Işıklar Alptekin performed a literature review on crowdsourcing in software Engineering. They highlighted the crowdsourced design as special type of crowdsourcing and reviewed certain crowdsourced design platforms like Topcoder and 99designs. They also stated that yahoo Answers is one of the popular platforms of crowd wisdom [5].

Bin Lin explained the role of crowdsourced methodology in software development. He considers that crowdsourcing the decisions of design supports in enhanced design choices. Bin Lin also proposes a system that recommends plus stores thoughts from crowd [6].

Relates pattern with quality of code. They interpreted that the existence of design patterns pulls down the figure of code smell occurrences. Moreover, they indicated that State-Strategy, Factory-method and Adaptor-command are less probable to be relative to smelly code [7].

III. METHODOLOGY

The research was basically comprised of following steps:

(a) Designing questionnaire, (b) Conduct survey, (c) Analysis of results, (d) Identify Facts.

The Research assumptions which contributed towards design of a questionnaire were made at the start that were:

R-1: Some design patterns are more commonly used in design decisions to produce high quality product while others are very rare.

R-2: Some design patterns become infeasible or degrade the quality if the software product is enhanced or expanded.

R-3: Among all quality attributes, the maintainability attribute is affected the most from design pattern decisions.

R-4: It is usually difficult for inexperienced designers to choose the best pattern which leads to degrade software quality.

R-5: Choice of best design pattern for product reduces higher than 40% of chances of getting a poor quality.

The survey questionnaire was designed by interviewing with Professional, getting guidance from related work, following tutorials and based of previous field understanding. All the questions of survey were sensibly designed to fulfil the goal of our research. Specially, the questions were focused to recognize the factors of design patterns which affect the quality of software product. The survey was conducted from crowd of software engineers from expanded areas of Pakistan and abroad, then all results were evaluated and conclusions were made in accordance. We clarified the respondents about the aim of our research. The Monkey survey was used to serve and receive responses from Crowdsourced companies. The survey links were posted through E-mail, Facebook, WhatsApp and Twitter. Fig. 1 shows the system diagram

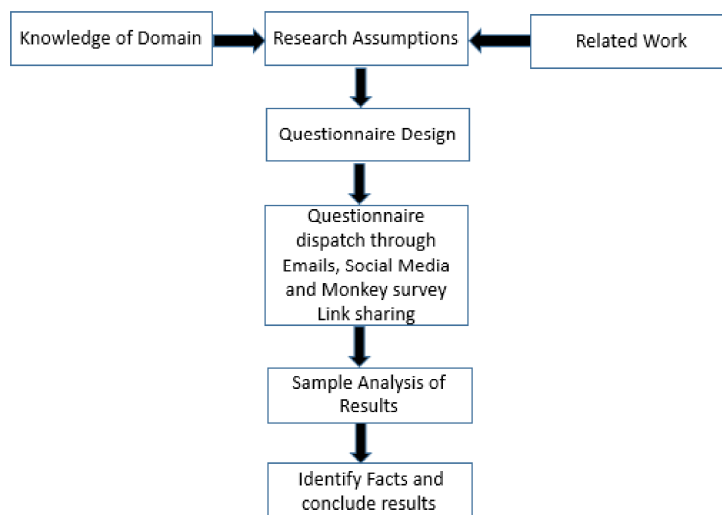


Fig. 1 System diagram

A total of 92 (samples) survey responses were collected and analyzed over a period of 03 Months. The results are further described in next section

IV. RESULTS AND DISCUSSION

Online surveys were conducted from leading software companies in Pakistan and from abroad.

90 (samples) responses were selected for analysis. Among 90 respondents, 40 were from Pakistan, 50 were from abroad. Regarding gender 70 were males and 20 were females.

The research assumptions were analyzed based on survey results.

R-1: Rarely and commonly used patterns in industries today?

To prove this assumption, we asked respondents about which patterns they use commonly in their industry. The results are shown in Fig. 2

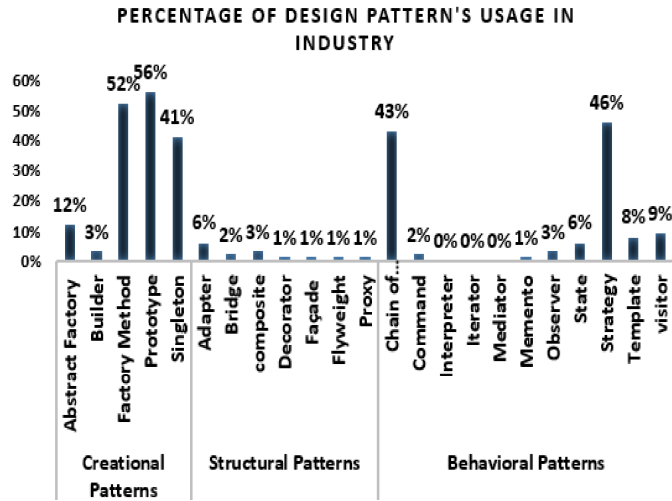


Fig. 2 Patterns

Fig. 2 describes the Patterns, Here, we assume that patterns with more than 40% are commonly used while less than 40% are rarely used in software industry.

R-2: Patterns feasible for enhancement or not?

For this 30 respondents said that all patterns are feasible to be expanded or enhanced,

20 said that enhancement depends on the nature of the software product while 15 named some particular patterns which are feasible for them to be enhanced and which do not degrade the software quality as shown in Table. 1 and Fig. 3 shows the Percent of responses for pattern

TABLE. 1 Pattern's enhancement feasibility

Options	Number of Respondents	% of Responses
All	30	48.35
Depends on nature of product	20	28.02
Structural Patterns	15	6.59
Behavior Patterns	15	8.24
Creational Patterns	10	8.79

PERCENT OF RESPONSES

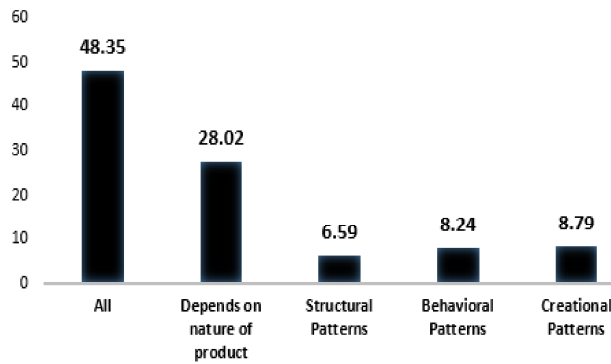


Fig. 3 Percentage of Responses

Fig. 3 shows Percentage of Responses. It is clear that 48.35% respondents think that “ALL” option could be possible for enhancement.

R-3: Maintainability is affected most with design pattern as compared to other quality attributes?

For this assumption, all respondents agreed that design pattern effects end product’s quality. When asked about quality attributes the results were shown in Fig. 4

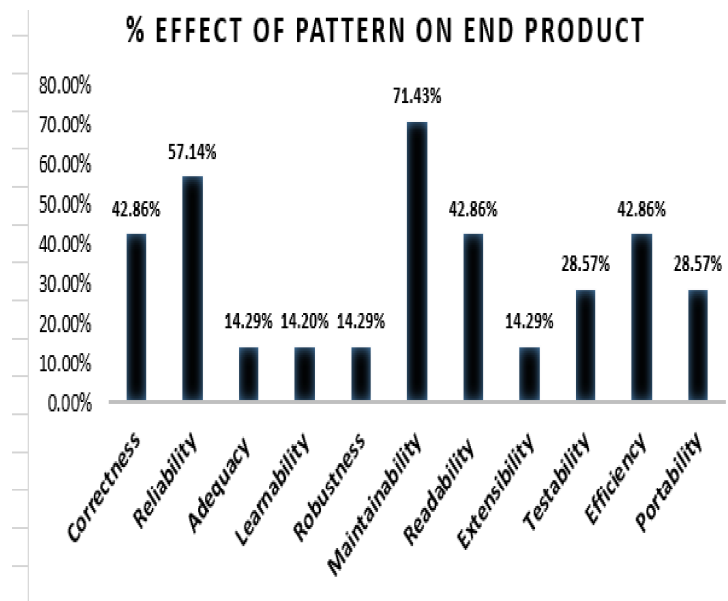


Fig. 4 Percentage Effect of patterns on End-product

Fig. 4 describes the effect in percentage of patterns on End-products.

And this proves that percentage of Patterns on Maintainability has a highest percentage as compared to other attributes.

R-4: Choice of design patterns for inexperienced versus experienced designers?

For this assumption, we asked respondents for their work experience and age first. And then we asked about how easy or difficult it is for them to choose the pattern. We assumed that people having work experience up to 3 years are in In-Experienced and more than this are Experienced as shown in Table. 2

Table. 2 Ratio of In-experienced versus Experienced

Working Experience	Number of Respondents
Experienced	40
In-Experienced	50

Table. 3 Difficulty in choosing Patterns

Difficulty in choosing patterns	Number of Respondents
Yes	50
No	30
Depends	10

Table.2 shows the ration of working experience of Respondents, it is clear that 40 (Respondents) having more than 3 years of working Experience while 50(Respondents) having up to 3 years of working Experience.

Table. 3 shows that a respondent faces difficulty while choosing Pattern. It is concluded that Respondents (50) are agreed that it is difficult to choose a Pattern, while 30 (respondents) think that it is not much difficult, and 10(Respondents) think that it depends on situation.

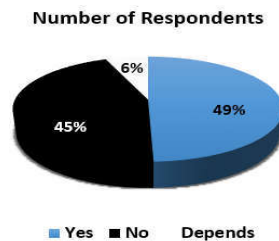


Fig. 5 Number of Respondents for choosing patterns

Fig. 5 shows that number of choosing pattern with respect to Yes, No, depends assumptions that were made earlier.

This proves that difficulty of choice of pattern is regardless of experience and more depending on the domain knowledge of designer.

R-5: Right pattern reduces the >40% chance to produce lower quality product?

The weighted average for the agreement of this statement was 4.57 out of 5 stars as shown in Fig. 6

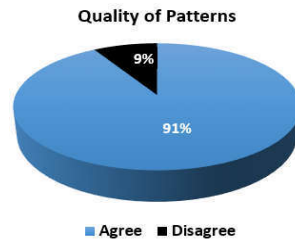


Fig. 6 Quality of Pattern

Fig. 6 describes that choosing Right pattern might it can reduce more than 40% of producing poor quality, according to survey 91% respondents are agreed with this assumption, while only 9% respondents are disagreed with this assumption.

Other than this we added questions about what kind of patterns are more commonly used for what kind of Applications and which quality attributes are effected the most by those patterns. Most of the respondents answered that it all depends upon nature of Application. While few answered with particular domain name of applications as shown in Table. 4

Table. 4 Pattern types for application domain and their affected Quality Attributes

V. CONCLUSION

The crowd-wisdom tactic specified in this paper was directed to discover optimum practices of patterns in software Domain and their effect on quality. The assumptions were validated or invalidated based on responses that collected from

Application Domain	Patten Type	Most Effected Quality Attributes
Web app	Chain of Responsibility	Reliability, Maintainability
	Singleton	Correctness, Maintainability, Readability, Extensibility, Testability
	Strategy	Reliability, Readability, Maintainability
Mobile app	Prototype	Portability, Efficiency, Reliability, Robustness, Readability, Maintainability

crowd of software engineers. This research determines that 5 out of 23 patterns are more frequently being used in industries at the moment. Almost all the patterns are good for enhancement while according to some respondents the viability depends

upon the requirements of End-Product. It is established from survey that maintainability is most effected quality attribute among all the attributes. Additionally, the effortlessness of selection of pattern does not merely depend on experience as it comprises other aspects like familiarity of domain and critical thinking skill too. Moreover, we identified that our web and mobile app engineers practice a number of particular patterns which impact specific attributes of the product. This finding of exact patterns guides the mobile and web app designers to concentrate on these patterns more than others while focusing on software product's desired quality to be gained.

Table. 5 Conclusion table for Rarely/commonly used patterns and Enhancement suitability

Pattern Category	Pattern Type	Commonly Used/ Rarely Used	Good For Enhancement?	
Creational Patterns	Abstract Factory	Rarely Used	Yes	
	Builder	Rarely Used	Yes	
	Factory Method	Commonly Used	Yes	
	Prototype	Commonly Used	Yes	
	Singleton	Commonly Used	Yes	
Structural Patterns	Adapter	Rarely Used	Yes	
	Bridge	Rarely Used	Yes	
	composite	Rarely Used	Yes	
	Decorator	Rarely Used	Yes	
	Facade	Rarely Used	Yes	
	Flyweight	Rarely Used	Yes	
	Proxy	Rarely Used	Yes	
	Behavioral Patterns	Chain of Responsibility	Commonly Used	Yes
		Command	Rarely Used	Yes
		Interpreter	Rarely Used	Yes
Iterator		Rarely Used	Yes	
Mediator		Rarely Used	Yes	
Memento		Rarely Used	Yes	
Observer		Rarely Used	Yes	
State		Rarely Used	Yes	
Strategy		Commonly Used	Yes	

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