Study on Software Quality Factors and Metrics to Enhance Software Quality Assurance

Rana Muhammad Ammad, Muzamail Rafique, Saleem Zubair Ahmed

Abstract— These days software Quality Assurance is highly used in the fields of science and medicine. Software quality assurance deals with the specific requirements of customer or user's necessities and expectations. It can be a mixture of so many factors. The basic purpose of writing this paper is to extract the most effective factors and metrics which are considered helpful for enhancing the software quality assurance. The recognition of factors and metrics is based on the literature surveys through analysis and study of different research works. The outcomes of this research paper can be very useful and beneficial for software developers, students, researchers, and scholars which can be used to measure the qualitative attributes of the software.

Index Terms— Enhance SQA, Factors, Metrics, Software quality assurance, SQA

1 Introduction

FOR achieving qualitative outputs Software Quality Assurance (SQA) has describes many methodologies. SQA can be much helpful for monetizing the processes of software engineering. Software metrics can be helpful in managing the proximity of the product's output. In today's competitive time every one wants the most authentic and reliable software with highest standard results to fulfil their necessities. This writing is basically designed to extract the qualitative software and metrics software from the one who is using it, which is helpful for software companies to provide high-quality in all types of software. Usually, software's quality is measured by its greatness to satisfy the demands of its clients. This paper is basically written for client's prospective qualitative model.

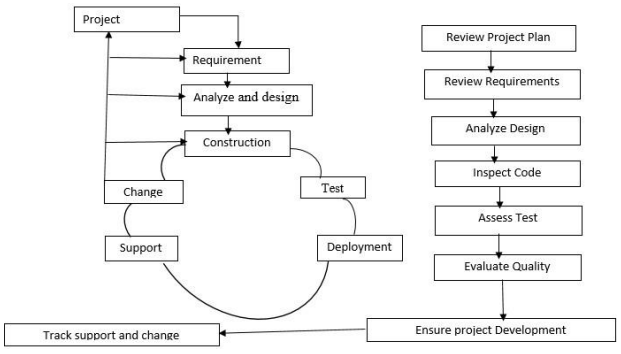

Fig. 1 A software quality life cycle's concept framework of quality assurance support

Source: Lee and Chang (2005)

2 Literature Review

2.1 Factors of Software Quality

There are many software quality factors which are proposed by different researchers among them the most effective factors are proposed by Schlemmer and McManus in 1992 which includes:

1. Functionality
2. Reliability
3. Usability
4. Portability
5. Maintainability
6. Efficiency

1. Functionality

It is a degree to which a software can be used regarding availability of functions and their mentioned characteristics. These functions and characteristics are helpful in fulfilling the requirements of the users or clients.

2. Reliability

It demonstrates the performance and capacity of a system to perform the functionality of a software correctly without any barer.

3. Usability

It is the capacity through which only specified customers can achieve the outcomes with efficacy, productiveness, fruitfulness, regulation and satisfaction.

4. Portability

It is a degree to which a software is able to run successfully and effectively on various computers, hardware's and operating systems.

5. Maintainability

Maintainability is concerned about efficiency of the system without any complexity. It basically means tha a software can be repaired accordingly if needed.

6. Efficiency

Efficiency is the capability of required functions to finish any task within given time limit.

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Fig: 2 Software Quality Factors

2.2 Software Quality Metrics

A metric can be described as a value stated with units related to any product. Awarding to (Sudha man, 2011; Fenton and Beeman, 2014). Product metrics include:
Client's satisfaction (Whether the customer is satisfied or not)
Client's problems (What are the problems of a customer and how they can overcome)
Mean time to failure (The time of failure and sorting out solutions)
Defect Density (The actual size of the software)

3 METHODOLOGY

3.1 Software Quality Models

For generating software quality, Software Quality Models (SQM) are used. For showing the quality of system several quality factors are used. These models are used differently in every field according to needs. For attaining wishful needs software quality is measured differently. There are for main models of software quality included:

1. *McCall's Quality Model*

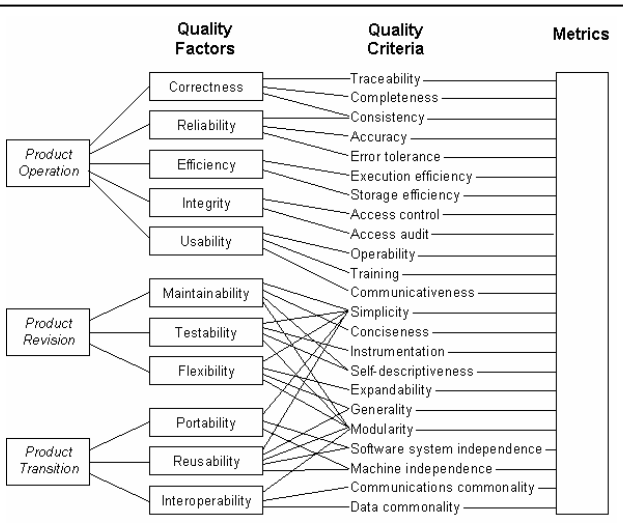

Fig: 3 McCall's Quality Model

This model is having variety of features which was designed in US military. The Model actually represents the common software quality factors to show client's point of view and development of progress. Every feature can be associated with different factors which can be a mean of metrics. The 11 quality factors represent the exterior software while the 23 quality factors show the inner of the software. The metrics may be useful for quantifying and measurement of the criteria to show quality is availed.

The useful thing of McCall's quality model is having a realizable relationship between the quality specialization and metrics. Its model is useful but its having disadvantage of quality measurements. But it has a rigid answer of "yes" or "NO" which is against accuracy.

2. Boehm's Quality Model

It's an automated and quality estimated model of qualitative system. It having an advance level of accuracy than that of McCall's quality model which narrates (3) qualitative factors such as: Utility, maintainability and portability. In this qualitative Model high level and low level factors are available which performs their respective responsibilities. The low-level factors are called primary Factors, whereas the Highveld factors are called intermediary factors. As you can observe in the given diagram the intermediary factors may be measured by many low-level factors to show the exactness of any assessment.

As Boehm's model is advance than that of McCall's model then the difference is obvious and can be measured clearly.

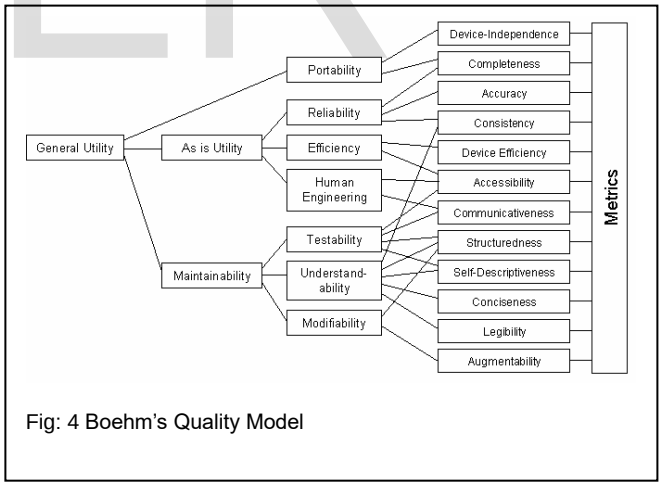

Fig: 4 Boehm's Quality Model

3. Drome's Quality Model

Drome's Quality Model is the framework of outcome or result quality. It basically shows the consequences and results which can be apply in any situation on different software's. The below given diagram shows the measurable and qualitative characteristics.

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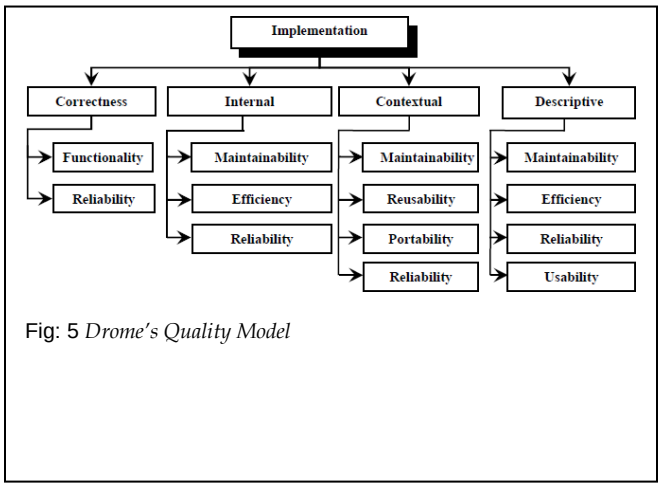

Fig: 5 *Drome's Quality Model*

The most important thing about this model is that it is applicable on any type of product and model. The limitation of this model is that this model is representative of theoretical model and it do not provide any type of authenticity as it does not give any broad way to metrics.

4. International Standardization Organization 9126 Quality Model

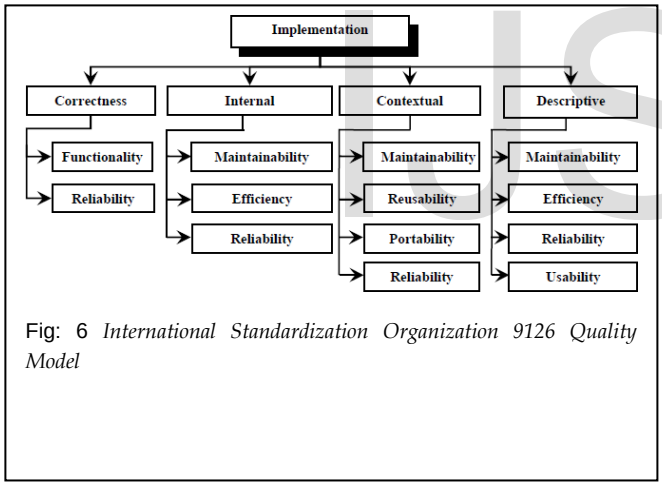

Fig: 6 *International Standardization Organization 9126 Quality Model*

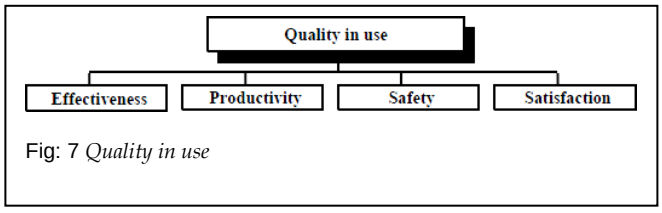

Fig: 7 *Quality in use*

International Standardization Organization was formed in 2010 which is an advance form of the rest of three mentioned models. It's the best pf all model which is used for measuring the quality and standard of any product or software. This model is basically designed to fulfill the needs of clients and its most secure and safest model ever made.

TABLE 1

Name	Status	Status	Status	Status
Serviceability			□	□
Elasticity	□			
Assessment	□			
Accuracy	□			
Effectiveness	□	□	□	□
Consistency		□	□	□
Reliability				
Usability				□
Compactness		□		□
Reusability	□			
Compatibility	□		□	□
Production	□	□	□	□
Understandability	□	□	□	□
Flexibility	□	□		
Functionality	□		□	□

The second model of ISO fulfills outer and inner quality of any software and these properties may be analyzed without any kind of ambiguity. Both the inner and outer functions are accomplished into six quality attributes which are measurable and quantifiable. Moreover, ISO provides complete qualitative characteristics and sub-characteristics for the perception of correctness and lessen unreliability

The 3rd Model represents an internationally accepted and standardized quality model. From the below given diagram its clear that in this model internal characteristics determines external factors.

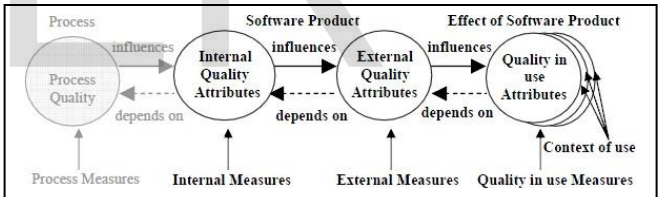

Fig: 8 *Process*

All the given models have proved that quality can be achieved by using them. By using these models quantity and measurable objectives can be achieved. The clients are not concerned with the non- functionality of the achievements but with their expectations for this they can claim the performance of the software. Following is the key comparison between the four above mentioned qualitative models.

4 Software Quality Metrics

The product Metrics is helpful in attaining and achieving the value of any project. It clearly defies risks, limitations and draw backs of any software. The outcomes of metrics are measures internally and externally through reliability. The metrics are having further variation e.g. static and dynamic. The main aim of metric is to measure reliability, compatibility,

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productivity, flexibility and above all functionality of instruments. Cyclomatic and Halstead are the complexity measurements which are used to measure the maintainability of metrics.

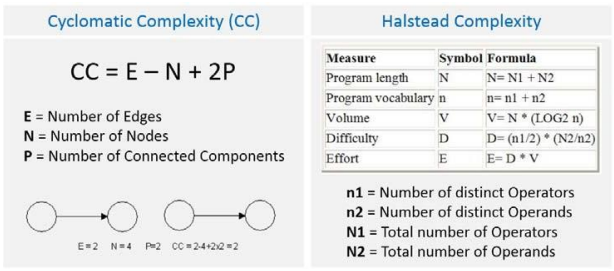

Fig: 9 *Software Quality Metrics*

In metrics efficiency, testability, portability and usability are the key factors through which assessment of software's are taken.

5. Process Metrics

Process metrics gives insight in the field of engineering which is the most reliable tool for productivity. In the process of metrics, the model of GQM (Goal Question Metric) Paradigm is used to achieve the targets goals. It basically deals with the attainable goals, The consumer's questionaries, and the effective measurement of qualitative analysis.

Basically, the main aim of metrics is to find draw backs and detect the defects. It gives the answers of all questions of clients in a reliable way. The procedure and process of metrics fundamentally revolves around finding the exact observations of any query. It measures the results in an effective way through processing of software and efficiency reviewing as shown in the given diagram:

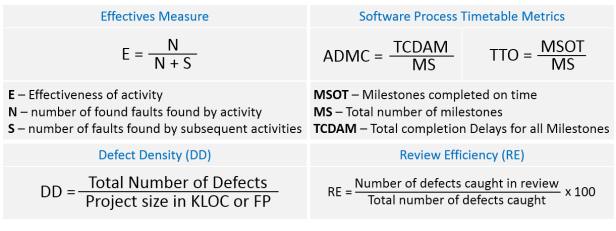

Fig: 11 *Process Metrics*

The basic function of metric is to define, measure, analyze, improve and control the effectiveness of any software product.

6 Structural and sub-factor quality Metrics and quality factors Coverage

TABLE 2

Metrics	Quality Factors	Measures
Structuredness	Usability	McCall's Approach
Readability	Usability	Flesch –Kincaid Readability Index
Cost for Software Development	Reusability	Gaffney & Derek 's cost model
Intricacy	Reliability	Mean Time between Failures
Compactness	Reliability	DP = (cost to port / cost to redevelop)
Mechanical Metrics	Understandability	Correlation Analysis
N, D	Modifiability	Worsening Analysis

7 Conclusion

This paper has successfully reviewed after going through many researches works which fundamentally fulfills all the requirements and processes of software quality assurance of factors and metrics. Software Quality Assurance is a highly needed software service to keep pace in every field of life which can fulfil the expectation of any client. As metrics have the ability to improve any system through its measurable nature yet its highly difficult fir its users to attain satisfactory results all time, for this purpose the quilt assurance of any software is compulsory which can be identified through understandability of system. Overall, in this research paper its concluded that many measurable tools are available for the adequacy and accuracy of software's. In future more work can be done on the characteristics of factors and metrics of software for getting accurate set goals.

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