

Exploring Relationship between Software Product Quality Metrics

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Abstract:- This research paper aims to explore the relationship between internal and external software quality metrics in order to estimate software quality more accurately. Internal metrics measure the software itself whereas external metrics measure the behavior of the computer based system. Users can select and apply these metrics according to their individual application domain.

Keywords- Software quality metric, internal metrics, external metrics, ISO 9126 quality factors, quality in use metrics

1. Introduction

Software quality is the degree to which software possesses a desired combination of quality attributes. The purpose of software metrics is to make assessments throughout the software life cycle as to whether the software quality requirements are being met. The use of software metrics reduces the task to assess and control of software quality by providing a quantitative basis for software quality. However, the use of software metrics does not eliminate the need for human judgment in software assessments. The use of software metrics within an organization or project is expected to have a beneficial effect by making software quality more visible.

ISO-9126 series of standard family is the series of standards that introduces concepts of software quality model. The software quality model is divided into two parts. The first part contains external and internal software metrics. External metrics are categorized into six quality characteristics. These characteristics are further divided into sub characteristics. The second part contains quality in use metrics which is divided into four characteristics.

Internal Quality Metrics

Internal quality metrics are applied when the product is in development phase or is not in execution. With internal metrics the product is examined by looking into its internal parts. These metrics contain static metrics like code complexity and compliance to the selected coding standards. The idea of internal metric’s analysis is to give better picture of the software product and thus help to predict the overall quality of the software.

External quality Metrics

External quality metrics are divided into characteristics the same way as the internal metrics are, but now the software

product is evaluated from outside. The software is analyzed externally when it is running in its working environment. This happens typically when software is analyzed during test phases or its operational actions. Simply external metrics are applicable to running software.

Quality in Use Metrics

These metrics measure the end user’s perspective, how satisfied is the user with the final product. These metrics tell us how well the product meets the needs of the user in the name of effectiveness, productivity, safety and satisfaction.

2. Internal and External Quality Metrics

The following table contains the characteristics and corresponding sub-characteristics for internal and external quality metrics. These are the quality perspectives which may be used in the company’s quality assurance [5-6].

Table 1: Internal and External Quality Metrics

Functionality	Reliability	Usability	Efficiency	Maintainability	Portability
Suitability	Maturity	Understandability	Time Behaviour	Analysability	Adaptability
Accuracy	Fault tolerance	Learnability	Resource Utilization	Changeability	Installability
Interoperability	Recoverability	Operability	Efficiency Compliance	Stability	Co-existence
Security	Reliability Compliance	Attractiveness		Testability	Replaceability
Functionality Compliance		Usability Compliance		Maintainability Compliance	Portability compliance

Functionality

Functionality characteristics means the product’s ability to provide those functions and operations which are required to fulfill the intended task in specified environment. The following table introduces the sub characteristics of the functionality perspective[1].

Table 2: sub characteristics of Functionality

Name	Description
Suitability	Product’s ability to offer required functionality to the task it was designed
Accuracy	Product’s ability to offer correct or specified accuracy in the task’s results.
Interoperability	Product’s ability to be interoperable with one or more external systems.
Security	Product’s ability to secure its internal information so that no unauthorized usage is possible.
Functionality Compliance	Product’s maturity to obey standards and regulations regarding functionality issues in specified environment.

Reliability

Reliability characteristics means the product’s ability to uphold the sufficient amount of performance when the product is used in specified environment. Table introduces sub characteristics.

Table 3: sub characteristics of reliability

Name	Description
Maturity	Product’s ability to avoid errors when an exception is thrown.
Fault tolerance	Product’s ability to maintain specified performance level when an exception is thrown.
Recoverability	Product’s ability to store certain level of performance when an exception is thrown.
Reliability Compliance	Product’s maturity to obey standards and regulations regarding reliability issues in specified environment.

Usability

Usability characteristics means the product’s ability to be easy to use, learnable and understandable when the product is used in specified environment. The sub characteristics for usability are[2].

Table 4: Sub Characteristics of Usability

Name	Description
Understandability	Product’s ability to be understandable so that the user understands how specific task can be done with the product.
Learnability	Product’s ability to allow user to learn how product is supposed to be used.
Operability	Product’s ability to provide sufficient user level’s so that user can do the tasks.
Attractiveness	Product’s ability to be attractive to use from user point of view.
Usability Compliance	Product’s maturity to obey standards and regulations regarding usability issues in specified environment.

Efficiency

Efficiency means the product’s ability to offer sufficient efficiency and using reasonable amount of resources when product is being used in specified environment[4].

Table 5: Sub characteristics of efficiency

Name	Description
Time Behaviour	Product’s ability to provide sufficient response times and speeds.
Resource utilisation	Product’s ability to use right amount of resources.
Efficiency Compliance	Product’s maturity to obey standards and regulations.

Maintainability

Maintainability characteristics means the product’s ability to be changeable, maintainable and updatable. Table introduces the sub-characteristics for maintainability[4].

Table 6: Sub Characteristics of maintainability

Name	Description
Analysability	Product’s ability to be analysable when one is searching reason for erroneous behaviour.
Changeability	Product’s ability to be able change the structure of the program.
Stability	Product’s ability to be stable even if its structure is changed.
Testability	Product’s ability to be testable and thus support the product’s validation.
Maintainability Compliance	Product’s maturity to obey standards and regulations.

Portability

Portability characteristics means the product’s ability to be portable from one environment to another[3].

Table 7:Sub charateristics of Portability

Name	Description
Adaptability	Product’s ability to adapt to different enviornments.
Installability	Product’s ability to be installable to the specific environment.
Co-existance	Product’s ability to work independantly and co-exist with other system in environments where different resources are shared.
Replaceability	Product’s ability to work independantly and co-exist with other system in environments where different resources are shared.
Portability Compliance	Product’s maturity to obey standards and regulations.

3. Quality in use Metrics

Quality in use metrics are divided into 4 different charadterstics which all measure how well the final product fits to its purpose to allow user to achieve his goals[7].

Table 8:Quality in use metrics

Name	Description
Effectiveness	Product’s ability to allow the user to achieve his goal with sufficient accuracy and completeness.
Productivity	Product’s ability to allow the user to achieve his goal with sufficient amount of resouces relatively to the sufficient performance.
Safety	Product’s ability to reach acceptable level of risks.Risks to people ,data or environment .
Satisfaction	Product’s ability to satisfy the user so that she can complete task what she intended to do owith the product.

4. Relationship between Software Product Quality Metrics

ISO-9126 series of standard family is the series of standards that introduces concepts of software quality model. The software quality model is divided into two parts. The first part contains external and internal software metrics.

Internal quality metrics are determined when ssoftware is in its development phase.These are also called static masures.whereas external quality metrics are determined when software is in running mode.Quality in use metrics tell

us how satisfied is the user with the software product.

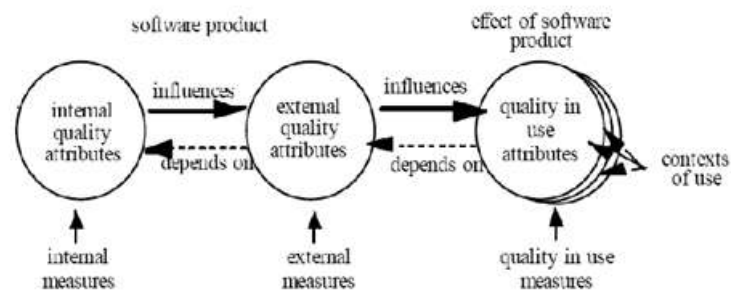


Fig 1: relationship between software product quality metrics[5].

Software product metrics are related to each other as follows:

- Effectiveness is obtained only when software is developed with accuracy and completeness.
- A product’s productivity depends on its efficiency which can be achieved with sufficient resources.
- Satisfaction is achieved only when product Fulfills the user’s requirements. It depends on product’s functionality, usability.

5. Conclusion

Evaluation of software quality products to satisfy software quality needs is very simple and easy through these quality metrics. Software product quality can be measured by its internal attributes by its static measures and external attributes by measuring the behavior of the code when executed. By using these quality metrics, software product quality can be measured precisely. These product quality metrics are related to each other. As a future work, it is a good idea to investigate where to collect the data for each of the ISO 9126 quality metrics in the software life cycle processes and activities. This will save time and assure that the data have been completely collected before the measurement of the metrics is performed.

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