1991

Report on the IEEE Standard for a Software Quality Metrics Methodology (Draft) P1061, with Discussion of Metrics Validation

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IEEE

http://hdl.handle.net/10945/45150
Abstract: This standard provides a methodology for establishing quality requirements and identifying, implementing, analyzing and validating software quality metrics.

Keywords: Standard, Software, Quality, Metrics.

1. Scope

This standard provides a methodology for establishing quality requirements and identifying, implementing, analyzing and validating software quality metrics. This methodology applies to all software at all phases of any software life cycle structure. This standard does not prescribe specific metrics.

2. Audience

This standard is intended for those associated with the acquisition, development, use, support, maintenance or audit of software. The standard is particularly aimed at those measuring or assessing the quality of software.

This standard can be used by:

An acquisition or project manager to identify and prioritize the quality requirements for a system.

A system developer to identify specific traits that should be built into the software in order to meet the quality requirements.

A quality assurance organization and a system developer to evaluate whether the quality requirements are being met.

A system maintainer to assist in change management during product evolution.

A user to assist in specifying the requirements of the requested system.

3. Purpose Of Software Quality Metrics

Software quality is the degree to which software possesses a desired combination of attributes. To achieve high software quality in a system, this desired combination of attributes must be clearly defined; otherwise, assessment of quality is left to intuition. For the purposes of this standard, defining software quality for a system is equivalent to defining a list of software quality attributes required for that system. An appropriate set of metrics must be identified in order to measure the software quality attributes.

The purpose of software quality metrics is to make assessments throughout the software life cycle as to whether the software quality requirements are being met. The use of metrics reduces subjectivity in the assessment of software quality by providing a quantitative basis for making decisions about software quality. However, the use of metrics does not eliminate the need for human judgement in software evaluations. The use of software quality metrics within an organization or project is expected...
to have a beneficial effect by making software quality more visible.

4. Purpose of Metrics Validation

The purpose of metrics validation is to identify both product and process metrics that can predict specified quality factor values, which are quantitative representations of quality requirements. If metrics are to be useful, they must indicate accurately whether quality requirements have been achieved or are likely to be achieved in the future. When it is possible to measure factor values at the desired point in the life cycle, these direct metrics are used to evaluate software quality. At some points in the life cycle, certain quality factor (e.g., reliability) values are not available; they are obtained after delivery or late in the project. In these cases, other metrics are used early in a project to predict quality factor values. The history of the application of metrics indicates that metrics were seldom validated (i.e., it was not demonstrated through statistical analysis that the metrics measured software characteristics that they purported to measure.) However, it is important that metrics be validated before they are used to evaluate software quality. Otherwise, metrics might be misapplied (i.e., metrics might be used that have little or no relationship to the desired quality characteristics). Quality factors may be affected by multiple variables. A single metric, therefore, may not sufficiently represent any one factor because it ignores these other variables.

5. Validity Criteria

To be considered valid, a metric must demonstrate a high degree of association with the quality factors it represents. This is equivalent to accurately portraying the quality condition(s) of a product or process. A metric may be valid with respect to certain validity criteria and invalid with respect to other criteria. The following criteria are used:

5.1 Correlation

The variation in the quality factor values for a product or process explained by the variation in the corresponding metric values must exceed a specified threshold.

5.2 Tracking

If a metric is related to a quality factor for a product or process, then a change in a quality factor value must be accompanied by a corresponding change in metric value.

5.3 Consistency

If quality factor values are rank ordered for products or processes then the corresponding metric values must have the same ordering.

5.4 Predictability

If a metric is used to predict a quality factor for a product or process, it must predict within a specified accuracy.

5.5 Discriminative Power

A metric must be able to discriminate between high quality and low quality products or processes.

5.6 Reliability

A metric must demonstrate the above correlation, tracking, consistency, predictability and discriminative power properties for a specified percentage of the applications of the metric.

Numerical examples of the application of the criteria are provided.

6. Summary

In summary the standard provides a methodology for an organization to implement a metrics program. This involves the following steps:

- Establish Software Quality Requirements
o Identify Software Quality Metrics

o Implement the Software Quality Metrics

o Analyze the Software Metrics Results

o Validate the Software Quality Metrics

Acknowledgement

This standard was developed by a broad-based committee consisting of representatives from industry, government and academe. I want to thank the members of the IEEE Standard for a Software Quality Metrics Methodology Working Group for many useful discussions and debates that helped inspire this work.