Quality Estimation of Object Oriented Code – A Design Metrics Perspective

Scholor
Raees Ahmad Khan

Supervisor
Dr. K. Mustafa
Department of Comp.
Science.
Jamia Millia Islamia
New Delhi-25
Co-Supervisor
Prof. S.I. Ahson
Department of Comp.
Science.
Jamia Millia Islamia
New Delhi-25

This study was undertaken in view of the significance of quality estimation of object oriented software and the development of a good quality design metric. In the first instance it was considered necessary, in the absence of any standard framework, to propose a framework for the development of quality metrics. Subsequently, a review of related literature on object oriented metrics, their development methodologies and quality models was undertaken. It was clearly revealed that the available metrics do not fulfill the needs in the software industry and there is a scope for evolving new metrics. The metrics are reported to be deficient at least with respect to their usability in later phases of development life cycle. This, along with other supplementary reasons, emphasized the need for the development of an *integrated* metric to be used in design phase. Thereby, with considerable development and established metrics in the object oriented field, it appeared feasible to first propose a metric development framework (MDF) and then develop an integrated design metric using the MDF. It was also considered necessary to evaluate the effectiveness of MDF for developing good quality metrics and also the reliability of the proposed integrated metric. The current research is quasi-experimental in nature with three components, each encompassing study, development and validation tasks in one or the other form.

The first component referred to as the '*Development of MDF*', has been accomplished through literature survey, gathering opinion from experts, needed developments, validation and review. This development has been pictorially represented, in context, through seven phases including Conceptualization, Planning, Designing, Validation, Testing, Review and Revision, and Packaging. The Conceptualization phase is a brainstorming activity to precisely understand the problem and to gather related facts. Planning provides the guidance to the metric developer as it works as a road map to the design based on information from conceptualization phase. Designing is the most important and critical step towards the development of a metric, where the architecture of metric is finalized. Validation provides the supporting evidence as to whether a measure really captures the internal attributes that it purports to measure. Testing further assures the reliability of the proposals and provides the evidence about its

usability in practice. The sixth phase, Review and Revision, is a bit informal in nature. This facilitates the activity of 'look back and change, if required' with a free-to-enter option to any of the earlier phases. In the last Packaging phase, the developed metric is prepared with the needed accessories to become a self-composed and ready-to-use product by its prospective users.

The second component of the study implements the framework to develop an integrated design metric. In order to provide the significant and improved measurement of object oriented software, it is required to relate the measurable object oriented characteristics and the high-level desirable software quality attributes. A similar approach has been used as the basis for the development of integrated design metric. The metric development process prescribed in MDF has been followed, in spirit, to develop the required metric as for as possible. The proposed metric, named WCC (Weighted Class Complexity) may be used in early stage of development life cycle to improve the quality of software prior to the completion of software. WCC has been validated with ten industrial software projects and it has been found that it gives the same results regarding quality for all the projects, as it was obtained by using full-scale code analyzer. Further, proposed metric may also be used to set the quality benchmark specific to any organization. This may lead to reduce the efforts and cost for quality estimation. The estimated value of WCC may be interpreted qualitatively by comparing it with the industry-specific preset threshold value.

In third and the last component of study a model MQMOOD (Metrics Based Quality Model for Object Oriented Design) has been proposed. It is evident from literature survey that there is no known comprehensive and complete model or framework for evaluating the overall quality of design using an object oriented approach based on its internal design properties. As a result, Dromey's generic quality model has been taken as a basis to develop the MQMOOD. Proposed model, for the assessment of high-level design quality attributes in object oriented design, has been experimentally validated using structural and functional information through six object oriented software. The proposed model is able to estimate overall design quality from design level information about an object oriented software project. It is also apparent from the validation of model that it may be used effectively in monitoring and hence controlling the quality of software right from the design phase in SDLC.

Apart from these, some of the primary research questions for the study were also addressed during the course of study and certain inferences are drawn with regard to the same. Therefore, on the successful completion of study, the researcher reflects upon some important observations and contextual inferences as follows:

1   There is a need for reduced and minimal set of object oriented design metrics to estimate the quality of software.

2   The framework, MDF, may be adapted to develop good quality metrics that may provide reliable estimates.

3   WCC may be used effectively in early phase to predict the software quality that may be helpful to developers to fix the problems and to the designer to improve the

design.

4	MQMOOD may be used to assure favorable internal properties that may lead to the development of quality end product.
5	The quality benchmark may be set for any industry as its quality level using the proposed metrics WCC and MQMOOD model.
6	Predicting the quality of software in early stage of development life cycle by using the proposed metric WCC may reduce the testing and maintenance cost.
7	The use of WCC as it is integrated in nature, may lead to reduction in effort for the quality estimation.

Early quality estimation of software systems, highly emphasized in the study, is considered important for the success of the software industry. WCC and MQMOOD has been proposed and validated in this regard. Since the findings of study do address the key areas in this respect such as description of WCC, MDF and MQMOOD, it is likely to have several applications with regard to the industry professional and academicians. Some of these are 'predicting the quality of software in a quantitative manner by taking HLD/LLD (High Level Diagram/ Low Level Diagram) as input', and 'use of MQMOOD's to set the BQ (Quality Benchmark) for the industry as its quality level'. Even though the proposed metric WCC and model MQMOOD uses simple and straightforward assumptions, the correlation with a limited set of projects has been found to be high. This gives an indication that model and metrics of this type can be effectively used in monitoring the quality of software. Another minimal set of object oriented metrics may be developed by using the MDF. The work may be extended to estimate the efforts reduced on using the integrated metric in quality estimation. MDF may be generalized to validate the metrics available in the literature. Like any other study, it cannot be argued that the current work does not suffer from certain limitation and delimitations. Therefore, in order to generalize the results, further study on large sample of data is needed.