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Software Metrics Required to Measure Maintainability

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***Abstract*—In software projects, many points that are overlooked such as time constraints and human factors are causing great problems in the future. By measuring the quality of software projects, problems that may arise in important parameters such as maintenance-repair, functionality and reliability can be eliminated. In this study, metrics that can be used for measuring maintainability quality attribute within the scope of ISO 9126 Quality Standard are examined. In order to perform the study, 40 open source object-oriented software was selected and code complexity analysis was performed. Values of metric sets such as Chidamber and Kemerer (CK), Lorenz and Kidd (LK) and McCabe's complex Suite were determined by the Understand Code Analysis tool. It was determined whether the obtained values exceeded the threshold values indicated in the literature. Frequencies of metrics passing threshold values were determined for 40 open source object-oriented software projects, and the consistency among the metrics was evaluated using WEKA Machine Learning Software and EXCEL Data Analysis Tool. When the results were evaluated, it was observed that in addition to CK metrics such as WMC, CBO, and RFC, which measure the maintainability quality attribute, NOC (CK), NIM (LK), and the ratio of comment/code metrics have been observed to yield significant measurement results.**

Keywords—software quality metrics; software quality measurement; maintainability; CK; JK; McCabe; ISO 9126; Understand; WEKA

I. INTRODUCTION

As the technology sector becomes a big part of daily life, the software used is constantly expanding as code and manpower. The growth in the software project leads to a significant increase in maintenance costs, project costs and software development time. If these and similar factors cannot be correctly predicted and carried out from the beginning, it is inevitable that problems that cannot be corrected afterwards are encountered. Economic loss of software projects that are rejected by customers, unavailable to use efficiently, canceled due to increased costs, require high maintenance and repair costs may be far higher than those predicted. As an example, according to 2002 data, the annual loss of failed software projects to the American economy is around $ 59 billion [1]. In addition, according to Tricentis 2017 research, the loss of failing software in the global economy is around $ 1.7 trillion [2]. By measuring the software quality; early decision can be made for factors that need to be calculated and implemented at early stages such as the ratio of customer needs met by software, the clarity of the software for the developers, the structural quality of the software and the cost and price balance of the software.

Since it is not possible to perform individual code analysis in large projects, there are tools and add-ons that can perform these analyzes in a short time. In this study, 40 open source object-oriented software projects written in Java programming language belonging to Space and Aviation domain were examined with static code analysis tool called Understand. In the scope of ISO 9126 quality standard, the object-oriented metric values which are recommended in the literature are calculated for maintainability quality characteristic and the metric probabilities which are possible to be used in addition to the literature are investigated with the help of WEKA machine learning software.

The rest of paper is organized as follows: Section II presents an overview of the related work. In Section III, the metric values analysis and metric threshold exceeding frequencies of 40 open source object-oriented software projects are evaluated. Section IV discusses additional metrics that can be used under the Maintainability quality characteristic. Section V concludes with research results.

II. RELEATED WORKS

A. ISO 9126 Quality Standart

For software quality measurement, various metric clusters are presented by people working in this field. With the help of these metrics, quality requirements are measured. Quality requirements for the ISO 9126 quality standard are shown in Table I [3].

TABLE I. ISO 9126 QUALITY STANDART AND CHARACTERISTICS[3]

Characteristics	Sub-characteristics
Functionality	Suitability, accuracy, interoperability, security
Reliability	Maturity, fault tolerance, recoverability
Usability	Understandability, operability, attractiveness etc.
Efficiency	Time behavior, resource utilization
Maintainability	Analyzability, changeability, stability, testability
Portability	Adaptability, installability, replaceability e.g.