Defect Detection Effectiveness and Product Quality in Global Software Development

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\textbf{Abstract.} Global software development (GSD) has become a common practice in the software development industry. The main challenge organizations have to overcome is to minimize the effect of organizational diversity on the effectiveness of their GSD collaboration. The objective of this study is to understand the differences in the defect detection effectiveness among different organizations involved into the same GSD project, and how these differences, if any, are reflected on the delivered product quality. The case study is undertaken in a GSD project at Ericsson corporation involving nine organizations that are commonly developing a software product for telecommunication exchanges. Comparing the effectiveness of defect detection on the sample of 216 software units developed by nine organizations, it turns out that there is statistically significant difference between defect detection effectiveness among organizations. Moreover, the defect density serves better as a measure of defect detection effectiveness than as a measure of the product quality.

\textbf{Keywords:} Global software development, defect detection effectiveness, defect density, software quality.

\section{Introduction}

Global Software Development (GSD) is becoming a common practice in the modern software industry, involving software development teams from the organizations that are distributed around the globe to develop a common software product. The main drivers for globalization of software development is in cost benefits, entrance into global market and access to a large multi-skilled resource pool. On the other hand, the main challenge the organizations working in the GSD environment have to overcome is to minimize the influence of its diversity onto GSD project success. The software development project success is highly dependent on the software project team effectiveness in executing the project processes to achieve the project goals. The main identified barriers for teams in GSD environment are coordination, communication and control \cite{11}.

The researchers and practitioners effort have been focused on defining general processes and providing guidelines to overcome these barriers. Besides having
implemented the general processes that are highly supported with collaboration tools and following guidelines for distributed work, the main concern is whether the impact of the organizational distribution is significant or not. The objective of this study is to explore differences in the defect detection effectiveness among different organizations involved into the same GSD project and how these differences, if any, are reflected on the delivered product quality.

The rest of the paper is organized as follows. In Section 2 the metrics used for evaluating the defect detection process is introduced. In Section 3 the related work is reviewed. Section 4 describes the research context and methods used in the case study. The results of the study are presented in Section 5. Finally, in Section 6 the results are discussed, and we conclude the paper in Section 7.

2 Metrics

There exists a variety of metrics defined for measuring software quality [9], [10], [13]. Still, the most dominant metric that is used in the empirical studies for evaluation of software quality is the number of detected defects [3], [5]. The size of software, on which the number of defects in reported, is used for the comparison purposes. The defect density is defined in [12] as the ratio of the number of defects found and the software size involved into defect detection. The aim of defect detection activities is to deliver software product with zero remaining defect density. Therefore, the defect density is also considered as a measure for defect detection effectiveness [17].

The defect detection effectiveness may be used as a process control measure. Comparing this measure with the average from the history projects or with the project goal, one could bring decision about additional investment into defect detection process, as suggested for example in [8], [7] for the purpose of software inspection. The problem with defect density as a defect detection effectiveness measure lies in the fact that it is hard to distinguish if the number of defects identified by defect detection process is due to bad design, coding or good defect detection process. A number of defect injection and defect detection factors have been identified in [21]. Nevertheless, a number of studies have used defect density measure for the purpose of comparison of defect detection technique effectiveness in a given environment. The defect seeding technique is commonly used in these cases to increase the reliability of the study. Furthermore, the defect density considered “in time”, that is as a function of invested testing effort, is used in reliability growth modelling [14]. The control of defect detection process is based on the trend of the defect density curve.

In this study we are neither interested into reasons for the amount of defects detected, nor to control the defect detection process. Instead we are analyzing the differences in the effectiveness of completed defect detection activities among distributed organizations that were supposed to apply the same general defect detection process for GSD project. Therefore, in this study the defect density was used as measure to determine differences in defect detection effectiveness among organizations involved into GSD and influence of the organizational diversity on the defect detection effectiveness and the product quality.