

System Testing Process Behavior Prediction at Sun Microsystems

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Abstract

The state variable model of the Software Test Process captures the dominant behavior of the process while allowing certain customization due to the calibration procedure in place. The application of the model to a release of a product at Sun Microsystems and the use of the results to plan the test cycle for the subsequent release is the subject of this paper. The model application has presented encouraging initial results and has also served to further validate the assumptions the model is built upon.

1 Introduction

A test manager is always facing the competing issues of cost, schedule and quality. Some techniques have predictive capabilities with respect to helping on budget constraints and schedule issues [1] while others have support for the release-decision problem [2]. The state variable model of the Software Test Process (STP) appears to be a solution for combining both issues and its application on a case study at Sun Microsystems is addressed here. In general, the goal of the test process can be stated as: “*Deliver releases on schedule, within budget constraints and with a known quality.*” This goal leads test managers to focusing on answering the following question:

What are the development and test factors, relationships and processes that a test group needs to address to meet schedule, budget and quality commitments?

The state variable model, referred to hereafter as the CDM Model¹, of the Software Test Process is used here as one alternative to answer the question above and to help in the accomplishment of the stated goals. The test process of a

¹CDM stands for Cangussu, DeCarlo, and Mathur, the developers of the state variable model of the STP.

release of a product, referred hereafter as P1.1, under development at Sun is being used as a first case study. The results from the application of the CDM Model on P1.1 are then being used to plan the test cycle for the new release of the product, P1.2.

2 Points to Consider

In order to really help a test manager to control cost, schedule, and quality within his/her test process, a technique must be able to fulfill a few requirements. First, the technique should be able to provide managers with feasible and quantifiable solutions (actions to be taken) to correct deviations in the process. This is achieved by the CDM Model through a closed feedback loop solution that quantitatively determines changes in the size of the test team, in the quality of the test process, or a combination of both.

The changes and predictions made by the model need to be analyzed in order to determine the likelihood of success for each alternative solution. Constraints such as budget and time limits as well as risk factors can be associated with the changes and predictions of each alternative. Based on this association, optimization can be used to determine the best alternative. Though not addressed yet for the CDM Model, optimization techniques are available in control theory to help managers in this analysis.

An understanding of the dynamics of the system and the relationships among the variables affecting the system is another requirement for the technique to be useful in accomplishing the goals of the test process. The CDM Model captures the relationship among variables representing the size of the test team, the complexity of the product, and the quality of the test process. These relationships do not represent all possible combinations but are believed to capture the dominant aspects of the test process. The modeling of the test process of P1.1 supports this assumption.

Finally, predictive capability must be available to help managers in the decision-making process. The availability of the state model allows for the prediction of future behav-

ior of the process, with or without changes in the variables. The predictions for one release of the product can then be extrapolated to the subsequent release to help in planning the test cycle for follow-on releases.

3 Confirming Model's Validity

The state variable model of the STP as described by Cangussu, DeCarlo and Mathur [3] is based on assumptions leading to an overall exponential decay on the number of remaining defects. Except for the first four weeks (not depicted in Figure 1) where issues related to installation prevented the test process from proceeding continuously, the overall behavior of the Test Process for the case study at Sun Microsystems has presented an exponential decay as assumed by the model. Furthermore, researchers have provided evidence of test processes presenting an exponential behavior. For example, the error log reported by Knuth [4] has a clear exponential decay during the test phase. In addition, the accumulated number of faults plotted in Dalal's work [5] presents an exponential behavior which is also observed in the Razorfish project [3].

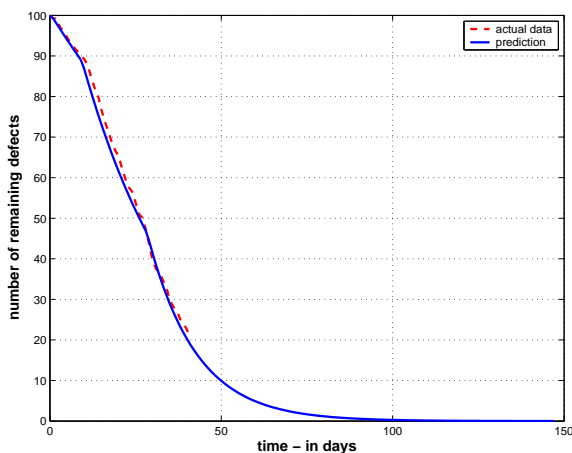


Figure 1. Normalized results from the application of the CDM Model to the test process of P1.1.

The decision when to stop testing can be based on technical aspects such as reaching a failure intensity goal or the number of remaining defects. Similarly, the decision can be based on market aspects when the release is meant to satisfy a market demand. Here, we are interested in the technical aspects of this decision. Though the CDM Model can be applied to the control of the test process using failure intensity as the control variable, here we focus on the number of remaining defects. The calibration procedure of the CDM Model is not only used to calibrate the model as actual

data becomes available but is also used to compute an estimate of the total number of defects. As more data from the process becomes available a recalibration of the model improves this estimate. The manager can then use a desired defect reduction percentage to determine when stop testing. The recalibration procedure increases the accuracy of the estimates and consequently the manager's confidence in making the decision.

As stated before, the CDM Model is being used for the current release of P1.1 and the results are being used to predict the test cycle for the next release of the same product. The use of the CDM Model for the current release of the test process has presented very good results when comparing the actual data from the test process with the predictions made by the CDM Model as can be observed in Figure 1.

The calibrated model for P1.1 is used to predict the behavior of the process for P1.2 under the assumption that the initial installation problems will not be an issue for the second release. With an defect reduction goal, the changes in the process to reduce the testing cycle are being analyzed and will be validate when the process starts.

4 Conclusions

The application of the CDM Model at Sun Microsystems is at an initial stage and more case studies need to be conducted to properly evaluate the results. However, the preliminary on the prediction of the test process behavior for the current release of P1.1 is encouraging and we believe will lead to further development and consequently to an increase in the applicability of the model.

References

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