WHITEPAPER

Usage of defect capturing effectiveness as process performance model

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Abstract

Process performance models are techniques used to estimate or predict the performance of a process based on historical data. Process performance models have been defined to facilitate the project teams in predicting/estimating projects' performance in the areas of various process performance objectives. PPM's typically use process and product measurements collected throughout the life of the project to estimate progress toward achieving objectives.

In general, for building PPM's, business goals, Sub-process and Processes should be identified. Also, influencing factors (X's) should be identified to predict the outcome (Y). Once data is collected, the quality of data is analyzed and integrated by selecting proper analytical technique such as ANOVA-type of regression, Monte - Carlo Simulation. Tools like Minitab and Excel Add-ins can be used to arrive at the suitable prediction equation.

The defect capturing effectiveness prediction model is used to predict the defect capturing effectiveness (in %) of the project. This PPM is applicable for all types of Embedded, Software and Hardware projects. Optimum values of inputs that are required for the prediction of the model can be derived by using data available from Process Capability Baselines available in measurement repository or by any other methods like brain storming, Simulation techniques etc. Based on the predicted outcome, the actual outcome and the prediction can be compared and suitable corrective or preventive actions can be taken to improve the process performance.

Defect Capturing effectiveness can be predicted by the influencing factors such as Domain experience of PL, Understanding of Application under test, Process planned for carrying out code reviews, likely review efficiency, Latest estimated or actual efforts for the entire project and testing activities.

Actual DCE can be calculated as below.

*DCE (%) = (Errors + Bugs)*100 / (Errors + Bugs + Defects)*

PPM Models defined in the organization that supports the project teams in achieving the Process performance objectives either directly / indirectly. Indeed Organization's vision/business objectives can be achieved by the effective utilization of PPM's.

INTRODUCTION

Process performance models are techniques used to estimate or predict the performance of a process based on historical data. Process performance models have been defined to facilitate the project teams in predicting/estimating projects' performance in the areas of various process performance objectives. PPM's typically use process and product measurements collected throughout the life of the project to estimate progress toward achieving objectives.

The defect capturing effectiveness prediction model is used to analyze and enhance project's capability in capturing problems before delivering the work product to the Customer.

Beyond the fundamentals of the defect tracking process, best practices to be implemented to maximize overall product development and quality assurance. The idea behind these best practices is that with proper processes, checks, and testing, a project can be rolled out and completed with fewer unforeseen complications.

This PPM is applicable for all types of Embedded, Software and Hardware projects. Optimum values of inputs that are required for the prediction of the model can be derived by using data available from Process Capability Baselines available in measurement repository or by any other methods like brain storming, Simulation techniques etc. Based on the predicted outcome, the actual outcome and the prediction can be compared and suitable corrective or preventive actions can be taken to improve the process performance.

For Defect capturing effectiveness, Process performance mean trends set for the period of Jan-Jul'13 – 98.33%

LITERATURE REVIEW

More and more organizations are striving for and achieving high maturity status, yet there is still an insufficient shared understanding of how best to implement measurement and analysis practices that is appropriate for high maturity organizations.

The process-performance models are used as follows:

1. The organization uses them for estimating, analyzing, and predicting the process performance associated with the processes in the organization's set of standard processes.
2. The organization uses them to assess the (potential) return on investment for process improvement activities.
3. Projects use them for estimating, analyzing, and predicting the process performance for their defined processes.
4. Projects use them for selecting processes or sub processes for use.

PROBLEM STATEMENT/PROBLEM FORMULATION/MODEL SET-UP

To determine the defect capturing effectiveness for embedded, software and hardware projects (Predicted and Actual values)

PROPOSED TECHNIQUE/METHOD & APPLICATION OF THE TECHNIQUE

Calculating predicted DCE for different projects depends on the influencing factors defined for the type of the project. These factors are different for Software, Hardware and Embedded projects. In turn, Formula deployed for each type differs.

Let us concentrate on influencing factors and formulae used for each type of projects as explained below.

Equations for the PPMs will be derived with the help of tools like Minitab, JMP etc. Depending on the nature of influencing factors, techniques like ANOVA, Regression are used.

Case 1: DCE Calculation for Software project

Predicted value:

Influencing factors for the calculation of DCE are:

1. Technical complexity
2. Likely review efficiency
3. Actual/Planned efforts spent in the project (whichever is higher)
4. Actual/Planned efforts spent in the testing phase of the project (whichever is higher)

Formula 1 - Defect Capturing effectiveness = 0.987103+0.0144099*Review efficiency+0.000053*Testing efforts-0.000025*actual efforts-0.002126*Tech Complex

Let us consider the following values to calculate the DCE.

Technical Complexity Moderate / low: 0 High: 1	1
Likely review efficiency	80%
Actual/Planned efforts spent in the project (whichever is higher) (person days) Ranges from 55 person days to 850 person days	567
Actual/Planned efforts spent in the testing phase of the project (whichever is higher) Ranges from 15 person days to 406 person days	105

So, the predicted Defect Capturing Effectiveness using the above formula = 98.79%

Actual value:

Now, let us move on to Actual Defect Capturing effectiveness and can be calculated using below formula.

Formula 2 - DCE (%) = (Errors + Bugs)*100 / (Errors + Bugs + Defects)

Let us consider, there are 27 errors and 16 bugs. No defects reported so far.

So, with the above formula, actual defect capturing effectiveness is 100%

Consider if there is a defect reported, then using the above formula actual DCE would have been 97.78% i.e. DCE = (27+16)/ (27+16+1)*100 = 97.78%

Case 2: DCE Calculation for Hardware project

Influencing factors for hardware projects are

1. Possibility of resource shift (Yes: 0 No: 1)
2. Likely review efficiency
3. Latest estimated or actual efforts (in person days) whichever is higher (Ranges from 45 person days - 5000 person days)
4. Technical Complexity (Low: 1 Moderate or High: 0)

Formula used:

0.96307 - (0.000034*Latest estimated / actual efforts) + (0.003574*Technical Complexity) - (0.003046*Resource shift Expected in the project) + (0.04809*Review Efficiency)

Case 3: DCE calculation for embedded project

Influencing factors for embedded projects are

1. Domain experience of PL (Insufficient: 0, Sufficient: 1)
2. Understanding of Application under test (Sufficient : 0, Insufficient:1)
3. Process planned for carrying out Code reviews (Non Formal peer review : 0, Formal Peer review : 1)
4. Likely Review efficiency in % (Ranges from 48%-100%)
5. Latest estimated or actual efforts (in person days), whichever is higher (Ranges from 128 person days - 2588 person days)
6. Latest estimated or actual efforts for testing (in person days) ,whichever is higher. (Ranges from 26 person days - 1381 person days)

Formula used:

0.94305+ (0.007946*Code Review Process)+(0.06094*Review Efficiency)+(0.000021*Actual Efforts)-(0.000094*Testing Efforts)+(0.009867*Domain Experience of PL)-(0.003676*Understanding of Application under test by Testing team)

Factors to be included for the calculation of DCE for all types of projects:

1. Errors are problems reported from all types of Reviews.
2. Problems reported on work products where the work product is not formally released, but sent to the customer "for review / information" in advance before completing the formal process upon request from the customer. In such cases, it is expected that customer has given this instruction in writing.
3. Bugs are problems reported after all types of testing.
4. Bugs reported in
    a) S/W unit testing, H/W module testing, Integration testing, System testing
    b) Validation testing (if it is part of overall project plan).
5. Findings reported on work products where the work product is not formally released, but sent outside Embedded Systems and Software Centers of IES premises or to client location "for testing" in advance before the formal release of the work product. In such cases, it is expected that these testing activities are planned and are in line with customer needs.

Factors to be excluded for the calculation of DCE for all types of projects:

1. Suggestions
2. Errors found in the review of "Others"
3. Defects categorized as SG – suggestions
4. Requirement changes reported along with the defects and logged in Change request log.
5. Defects discovered by the customer during acceptance testing and which have originated from the base source code (cause - SC) provided by the customer for use in this project.
6. Defects reported on work products where the work product is not formally released, but sent to the customer "for review / testing / information" in advance before completing the formal process, upon request from the customer. In such cases, it is expected that customer has given this instruction in writing.

RESULTS & DISCUSSION (include comparisons if any)

With the study of predicted and actual DCE calculation described in section 4.0, Results can be compared and analyzed. Appropriated actions could be taken if there is predicted value is exceeding the actual value. Indeed, if the actual value is in line with the predicted one, would help the team in moving ahead with the same methods followed erstwhile.

The values obtained from the above formulae are analyzed as below:
Consider a software project which has predicted and actual DCE, with no defects reported by the customer.

Predicted value	98.79%
Actual value	100%

Suppose, in case of a defect reported by the customer, Actual DCE will get reduced to 97.78% from 100%.

Predicted value	98.79%
Actual value	97.78%

In the above case, where defect is being recorded by the customer, appropriate actions have to be taken from the team.

Taking initiatives would lead the team in going ahead in much more refined way so that defects could be uncovered in the design/development stages itself. Eventually, proper steps in gaining back the DCE throughout all phases in the project would definitely assure the zero defects by the customer.

CONCLUSION (with reference to L&T TS business relevance)

PPM Models defined in the organization that supports the project teams in achieving the Process performance objectives either directly / indirectly.

By implementing the defect tracking best practices highlighted in this article, organizations will maximize overall product development while developing the agility necessary to overcome tomorrow's challenges.

Adopting Process performance models would assist the team in predicting the various technical/process related observations upfront. Indeed Organization's vision/business objectives can be achieved by the effective utilization of PPM's.

FUTURE WORK

Across organization, all the applicable project teams can go for phase wise defect capturing effectiveness. Because, Phase wise capture of values will lead to compelling and adequate process flow in subsequent phases of the project.

Higher the value, the more effective the development process and fewer defects escaping to next phase or the field

Significance:

1. Phase defect removal effectiveness and related metrics are useful for quality management and planning.
2. Measurements that indicate clearly which phase of the process needs improvement and should be focused on.

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