A Review of Software Metric and Measurement

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Abstract:

Software engineering is one of the dominant areas for Computer Science researchers. It is difficult to cover the complete aspects of any domain in a single review paper. Software metric is an important concept that is used to determine the performance, cost and efficiency of different aspects related to software development process. In this paper, I have tried to demonstrate the research related to different software metrics and measurements. Moreover, the metric of latest software approaches are also briefly mentioned. I have discussed the role of different key researchers who worked in the field of different static, dynamic and object oriented metrics. The study shows that metric are very helpful in making quality oriented software product.

Keywords: Software Metrics, Software Engineering and Software Measurement.

1. Introduction.

Software engineering is one of the dominant research subjects in the field of computer science. Numbers of researchers have carried out their research work in this field. Some of the key areas of software engineering are software agents, software metrics, software testing, SQA (Software Quality Assurance), Software reliability etc. As per existing literature, one may define a metrics as an indicator for software quality. The credit of software metrics is goes to Wolverton, who performs a research on production ratio of the programmer by using the concept of LOC i.e. line of code. In general, the metric can be classified into two categories i.e. control metric and predictive metric. In simple words, with software metric, one is able to understand the important concepts in the field of software engineering[1][2].

Computer science researchers are putting all their efforts in measuring quantitative information from software component. Software metric is associated with diverse measurements of computer software and its development. It assists us evaluating efficiency of different features of the software. A software measurement process should have optimal methodological process that measures, evaluates, adjusts, and finally improves the software development process. Software metrics deals with the measurement of software product and software product development process and it guides and evaluating models and tools [1,4,7].

As shown in Figure 1, perception, software inspection, planning, optimization and quality improvement are some of the major objectives of software metrics. With the help of predictive metric one is able to determine both static as well as dynamic characteristics of the software. Metrics can identify potential areas of problems that may lead to problems or errors. Finding these areas in the phase they are developed decreases the cost and avoids major ripple effects from the changes, later in the development life cycle [1,2,5,6,7].

Figure 1 represents the properties acquired by software metric. Predictive metric are normally associated with software product
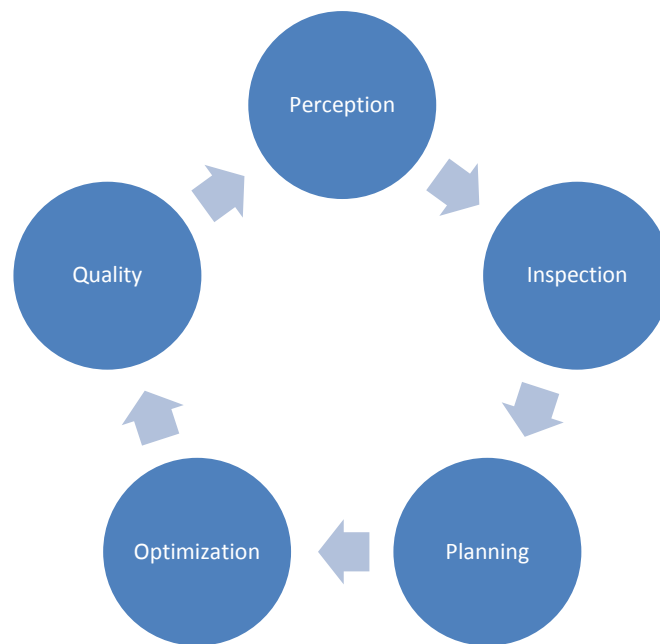
Figure 1: Features of Software Metrics

2. Objectives of Research Paper

Some of the major objectives of this research study are:

- To briefly explain the meaning of software metric
- To study the role of software metric
- To determine the number of research paper published in the field of software metrics

3. Review of Existing Literature

Ming Chang Lee and To Chang [4] have elucidated the role of software measurement and software metrics. Authors have given a list of notable software metrics and their brief description. Authors categorize the different metrics based upon different perspective viz. commercial, observation, significance, measurement and software development. Moreover, the different types of methodologies with their application have also been mentioned. Authors discussed 15 different types of measurement methodologies. In addition, they also discussed 24 type of testing metrics with their definition, formula and effects.

K.P. Srinivasan and T. Devi [5] stated that is it is very difficult to assess the validation of software metrics. Authors tried to validate the metrics using the different attributes of software measures. Authors have also discussed the role of empirical and theatrical validation models. In addition, various properties of Wicker, Kitchenham and Briand have been discussed.

Amrit and Amrinder Singh [6] have studied the metric analysis for two different sorting algorithm viz. bubble sort and selection sort. Authors have compared different metrics like LOC, n1,n2,N1,N2, execution time, program length, control density etc. They found that both algorithm takes almost same LOC. However, the values for different metrics like program vocabulary, program length and volume is lesser in selection sort as compared to bubble sorting algorithm.

Manik Sharma and Gurdev Singh [7] have performed analysis of static and dynamic metrics used for time and productivity analysis. Authors discussed static and dynamic metrics with context a simple C++ program. Authors have studied the variation between number of characters and line of code used in three different approaches viz. iterative, functional and recursive approach. Authors have also developed on dynamic metrics called DECT stands for dynamic execution character time.

Gurvinder Singh, Manik Sharma [8] has discussed brief information about the predictive metrics. Authors stated that a predictive metric can be categorized as static and dynamic metric. Authors have also discussed the fivefold objective of software metrics. Authors differentiate the working of static and dynamic metric by taking a suitable example in C++ program.

Amjan Shaik et al.[9] has discussed the OO software metrics and quality assessment. Authors state that the right studies of object oriented metrics play a significant role in the current state of art i.e. object oriented programming. Authors suggested that one may use the software metric to analyze the risk, the cost and the quality of the software. Authors have discussed different object oriented metrics viz. WMC, RFC, MIF, AHF, CTA, CIM etc. authors concluded that the new direction in the field of software metrics is significantly enhanced the quality of object oriented software.

Rani Geetika, Paramvir Singh [10] has written a survey paper to study the dynamic coupling metric for OO software system. Authors state that coupling is one of the major parameter to find the dependency between two or more objects. Authors have discussed different coupling metrics designed by different key researcher's viz. Yacaub et al., Mitchell and Power Metric, Hassoun et al Metric, Zaidman and Demeyer Metric etc.

RA Vivanco, NZ Pizzi[11] have used genetic algorithm to measure the optimal combination of different software metrics that can be used for object oriented metrics. Authors found that by using genetic algorithm one is able to effectively classify the different software metric used in object oriented programming as compared to other used techniques.

Cristian CUERIA [12] has designed genetic algorithm for building metrics for collaborative system. Authors has used genetic algorithm to the measure the complexity of collaborative banking system.

Mringal Singh Rawat, Arpita Mittal and Sanjay Kumar Dubey [13] have written a survey paper to determine the impact of different software metrics on the quality of software process and products. Authors concluded that in future the use of software metrics will significantly improve the quality of the software.

M.P Thapaliyal, Garima Verma[14] has empirically study the software defects and OO metrics. Authors have focused on two different object oriented metrics namely Weighted Method per Class (WMC) and Coupling between Object Classes (CBO). Authors have also found the correlation of these two object oriented metrics with context to size of class.

Chen Huei Chou [15] states that in software development, software defects lies on the top of the cost of software development. Authors has studies static and object oriented metrics. Author has discussed several software metrics used to measure the defects in the software development model.

Varun Gupta, Jitender Kumar Chabbra [16] stated the dynamic analysis plays major role in measuring the dynamic software metric. First of all, authors have differentiated static and dynamic analysis. In addition, different types of static and dynamic analysis approaches are discussed. Authors found that with dynamic analysis, one is able to effectively measure different object oriented metrics. Finally, authors compared the performance of different dynamic analysis techniques used to measure the software metric.

Manik Sharma, Gurdev Singh [17] has discussed the role of different parallel task scheduling algorithm. They have studied the different metric related to the task scheduling algorithm. Authors studied two different approaches of task scheduling algorithm viz. DLS and HLFET. They studied different metrics like execution time, static b-level, t-level, b-level, ALAP time and dynamic level of DLS and HLFT. Authors found that by using HLFET and DLS, the makespan of the problem can be reduced as compared to sequential processing.

Kunal Chopra, Monika Sachdeva [18] has considered three different projects for the evaluation of software metrics. By using one of the software metric tool called NDepend, authors have compute and analyze different software metrics viz. LOC, NBMETODS, afferent and efferent coupling, DIT, NOC, LCOM etc. Authors found that the tool NDepend is effective in analyzing the different types of code analysis.

Year	Number of Research Papers Published
2007	174000
2008	185000
2009	197000
2010	205000
2011	198000
2012	185000
2013	152000
2014	95500
2015	61900
2016	33200

Table 1: Features of Software Metrics

Table 1 shows the year and number of research paper published in the field of software metrics. Figure 2 graphically represents the publication scenario. It is observed that a huge research for software metrics has been carried out in the year 2010. From 2010 onward, a downfall in the published research paper has been observed.

Figure 2: Software Metric based research paper published in last years

4. Conclusion

Software metric plays major role in software engineering research and in evaluating the performance of the software and the techniques used. This review has been written to briefly discuss the work of some of key researchers who have contributed in terms of software metrics. In general, the predictive metric is categorized as static or dynamic metrics. Static metric deals with the static properties of the software like line of code, volume, size etc. On the other hand, the dynamic metric deals with the runtime properties of the software or code. Numbers of authors have devised their own static or dynamic metrics for the different purposes. Authors have used the concept of software metric in different application like to measure the performance of task scheduling algorithm, to access the quality of the software, to test the functionality of the software etc.

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