

# INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

WINGS TO YOUR THOUGHTS.....

## A Framework for Software Engineering Metrics for Software Development Firms

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**Abstract:** Software metric is a measure of some property of a piece of software or its specification. There are two types of metrics, product and process metrics. Currently in Information Technology (IT) field, many IT firms use software metrics for process and project management. The aim of this research paper is to build a framework using the commonly used software metrics for the upcoming IT firms. The software metrics for that framework will be chosen by analyzing the commonly used software metrics in the IT firms. The availability of metrics helps managers in the staffing, costing, scheduling and controlling activities of the development life cycle and contributes to the overall objective of software quality. To conduct the research paper research team has selected a few maturity IT firms. Most of these IT firms use similar kind of software metrics and infrastructures, though the procedures differ from each other. This research paper will give a best opportunity for new IT firms to select best software metrics and researches who are interested in software metrics to develop this kind of framework further.

**Keywords** – Software Metrics, Framework, Process, Project Management, Development Life Cycle, Software Industry

### 1. INTRODUCTION

Software metrics is used to measure the software. Software metrics and quantitative measurement provides the estimation of software complexity. Today, many organizations, which develop software using software metrics to improve their software development process in various ways. Those are [1].

- Minimum resource usage (Time and cost)
- Improve reliability of a software product
- Improve quality of a software product

The first software metrics were suggested in the mid of 70s and since then, a great number of metrics have been recommended in the following years for software products. A software development process can be defined as a set of activities, methods, practices, and transformations that people use to develop and maintain software and the associated products.

Through metrics can be used in several ways, in IT firms. Use them for three main uses. Those are,

- Project planning
- Monitoring a project
- Controlling a project

In this research, research team analyzes the software metrics that are used by the high maturity IT firms in Sri Lanka. Then choose the commonly used software metrics and build a frame work that can be used in the future by upcoming IT firms. The main objective of this research is to build a framework using software metrics.

This paper is organized as follows: section 2 describes Literature Review background of the research and section 3 includes Objectives of the research. In section 4 describes methodology of the research. Section 5 includes results and discussion. In section 6 describe the conclusion of the research paper.

### 2. LITERATURE REVIEW

Software industry is using software metrics since when “source lines of code” or SLOC was developed for quantifying the output of a software project. Vendor organizations use metrics to improve its quality by measuring its capabilities and efficiencies. The use of appropriate software metrics at right time helps the organization’s to achieve their required and expected outcomes [2]. This literature review covers previous contribution of the authors and existing systems.

According to the cem kaner there is a measurement called “Direct Measurement”. Direct Measurement is a metric that does not depend upon a measure of any other attribute. As well as there are some common derived metrics in software engineering [3].

- Programmer productivity (code size/ programming time)
- Module defect density (bugs / module size)
- Requirements stability (number of initial requirements / total number of requirements)
- System spoilage (effort spent fixing faults / total project effort)

A research which was done by Elvira Rolon and team in 2006, defines a set of metrics for the evaluation of conceptual models of business processes. Research Team developed the framework for the modeling and evaluation of software processes [4].

A research which was done by Norman E Fenton and Martin Neil developed a decision support tool that combines different aspects of software development and testing and enable managers to make many kinds of predictions, assessments and trade-offs during the software life cycle. Research team developed this by using relatively simple existing metrics. A key reason for this is that most software metrics activities have not addressed their most

# INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

## WINGS TO YOUR THOUGHTS.....

important requirements to provide information to support quantitative managerial decision-making during the software lifecycle [5].

A research which was done by Hisham M. Haddad, Nancy C. Ross, and Donald E. Meredith developed A Framework for Instituting Software Metrics in Small Software Organizations. It is yet to be widely recognized that metrics are valuable tools for a software organization. They provide measurement about schedule, work effort, and product size among many other indicators. The more they are utilized, the more effective and productive the organization becomes. They also provide better control over projects and a better reputation for the organization and its business practices. Software metrics are utilized during the entire software development life cycle [6].

Global Software Development (GSD) is increasingly common practice in industry due to the expected benefits, such as lower costs and utilising resources globally. From the viewpoint of project management, the measurements and metrics are important elements for successful product development. In 2012, Maarit Tihinen , Parviainen and their team developed a research that focused on describing a set of essential metrics that are successfully used in GSD[7].

### 3. OBJECTIVES

The general objective of this research paper is to analyze the software metrics that are used in high maturity organizations and evaluate the commonly used metrics and build a framework for IT firms. The following is a list of specific objectives based upon the material in this paper:

- Search the software metrics used in IT industry.
- Validate the software metrics.
- Build a framework for IT firms.

### 4. METHODOLOGY

The main target of this research paper is to analyze the software metrics that are used by the high maturity IT firms and choose the commonly used software metrics build a framework for upcoming IT firms. The paper consist the effort of the software metrics from a software development project perspective. The research questionnaires are based on: What is the software metrics used in successful projects in IT industry.

In order to answer this question, an online survey using questionnaire was carried out among project managers, system architects and system development from various software houses and other IT related individuals in Sri Lanka during April 2014 – June 2014.

The method used to collect was by online questionnaires, which is comprised of 8 questions. The questions was mostly close-ended and few open-ended. To make those questions the research team used research papers and lecture-in-charge guidelines.

The feedbacks were entered in to spreadsheet and calculations were done. All of the data were represented using pie charts and bar chart with help of Microsoft Excel. The final results were categorized as follows.

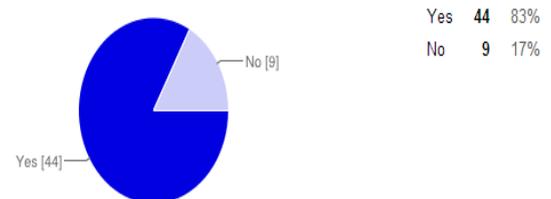
- The percentages of respondents are working in high-maturity IT firms.

- The percentages of respondents classified according to the roles.
  - The percentages of respondents that use software metrics in software development process.
  - The percentages of different software metrics used by the respondents.
  - The percentages of reasons for not using software metrics.
  - The percentages of reasons for considering software metrics as important and vice versa.
  - The percentages of respondents who think software metrics is increase productivity.
  - What are the unique software metrics used by the respondents.
  - The percentage of respondents who like to use framework which is build using commonly used software metrics.
  - The percentage of respondents who think this framework will be useful for upcoming IT firms.
- The assumptions research team made are sample used were clearly representing the population, the respondents having given truth information, no invisible innervation for the respondents in providing trustful facts were used to support the research in order to get more precise results.

### 5. RESULT AND DISCUSSION

This section will describe about the outcome of the

#### 01) Are you working at a high-maturity IT firms?

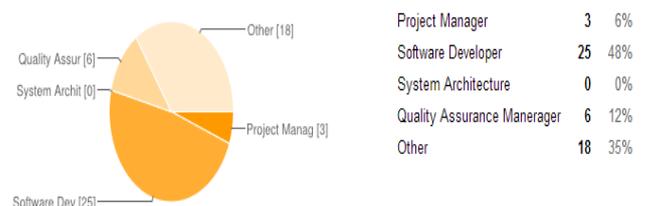


**Figure 1:** Proportion of respondents working at IT firms

feedbacks of the questionnaire. A total of 53 responses were gathered from responds. All the information from the responses is studied analyzed and respondent as follows.

- 1) High-maturity IT firms respondents. Research team gathered 83% of responses from people who are working at a high maturity IT Firms.
- 2) Sample categorized by positions of the respondents.

#### 02) What is your position in your company?



**Figure 2:** Proportion of respondents position in IT firms

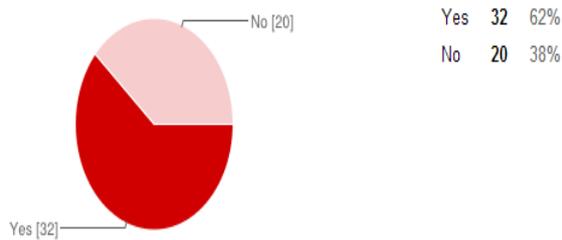
Using above question research team got idea about respondent's position in IT firms.

- 3) Use of software metrics

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03) Do you use software metrics in software development process?

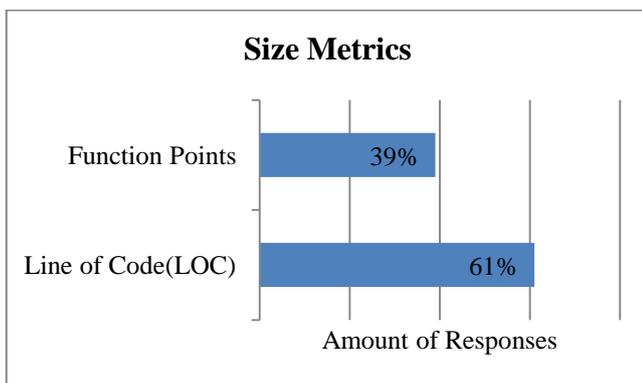


**Figure 3.1:** Respond

Figure 3.1 says most of respondents used software metrics for their software development process. So using above question researches clearly understood about essentiality of framework about software metrics for software development firms.

Following figures are explains the software metrics which are used by the respondents who says that they using software metrics [8].

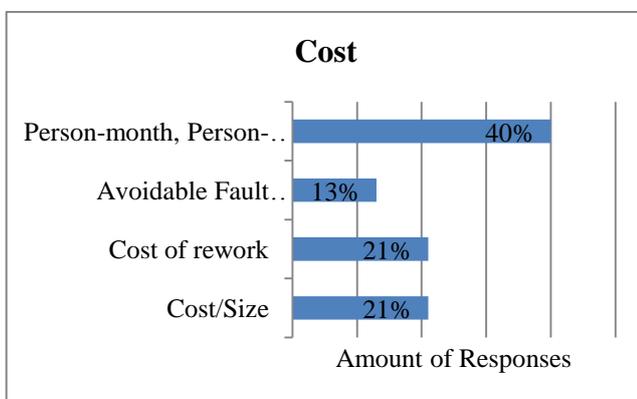
### A. Size Metrics



**Figure 3.2:** Proportion of usage of Size Metrics

As the above figure 3.2, says most of respondents were commonly used Lines of Code as the size metric.

### B. Cost Metrics

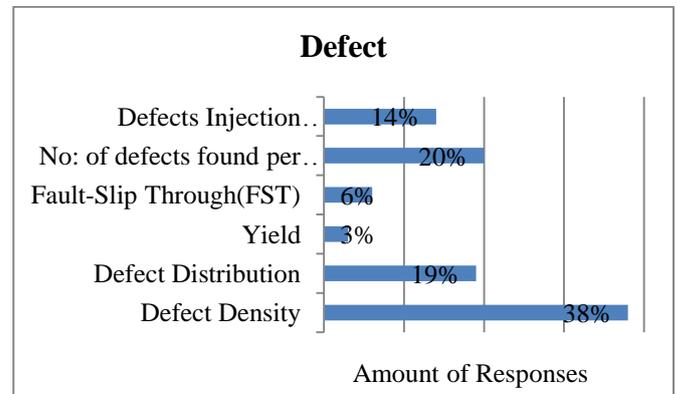


**Figure 3.3:** Proportion of usage of Cost Metrics

As in figure 3.3, says most of the firms use Person-month, Person-hour, and Staff-hour as the cost metric.

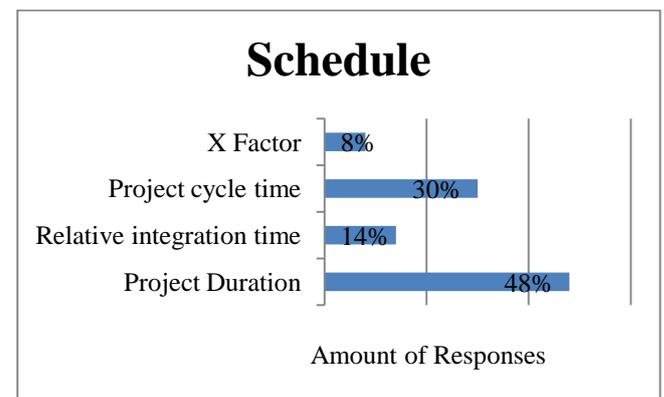
### C. Defect Metrics

As in below figure 3.4, most of IT firms use Defect Density as commonly used software metric.



**Figure 3.4:** Proportion of usage of Defect Metrics

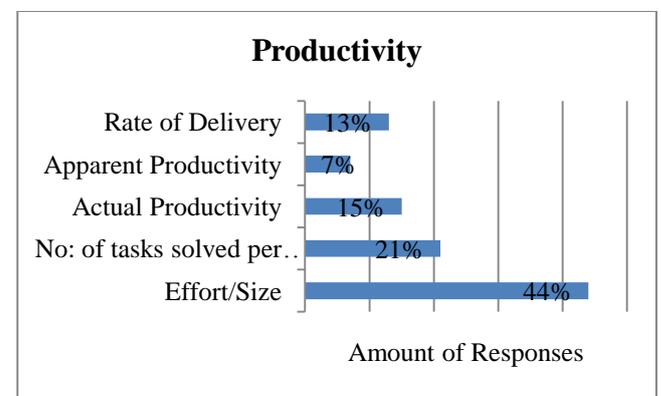
### D. Schedule Metric



**Figure 3.5:** Proportion of usage of Schedule Metrics

As in figure 3.5, says most of the firms use project duration as the schedule metric.

### E. Productivity Metrics



**Figure 3.6:** Proportion of usage of Productivity Metrics

As explain in figure 3.6, most of the firms use Effort/Size as productivity Metric.

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## F. Reliability Metrics

As in figure 3.7, most of the firms use Rate of occurrence of failure (ROCOF) as a Reliability Metric.

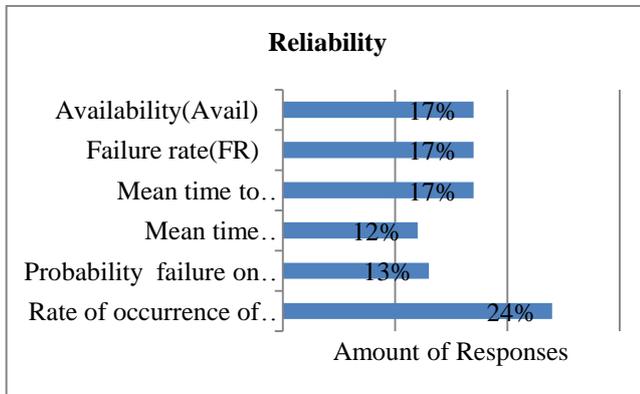


Figure 3.7: Proportion of usage of Reliability Metrics

## G. Maintainability

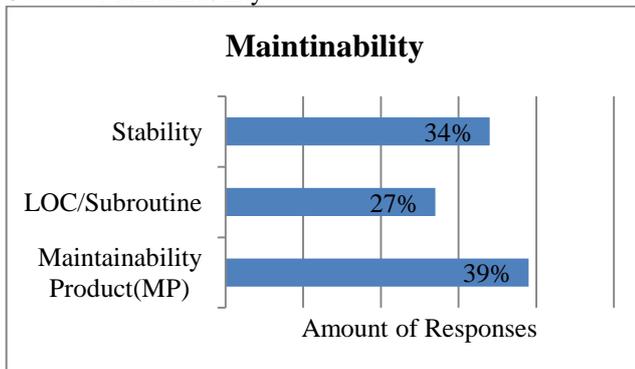


Figure 3.8: Proportion of usage of Maintainability Metrics

As in figure 3.8, most of the firms use Maintainability Product (MP) and Stability as a Maintainability Metric.

## H. Reusability Metrics

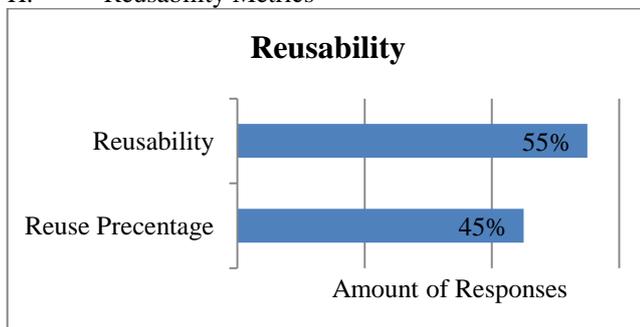


Figure 3.9: Proportion of usage of Reusability Metrics

As in figure 3.9, most of firms use Reusability as Reusability Metric. The analysis shows that most of the respondents like to use a frame work which is build using commonly used software metrics. Also they say that frame work will be useful for upcoming IT firms.

Following figure 3.10 describes what the reasons for not using software metrics are.

If answer is "NO",

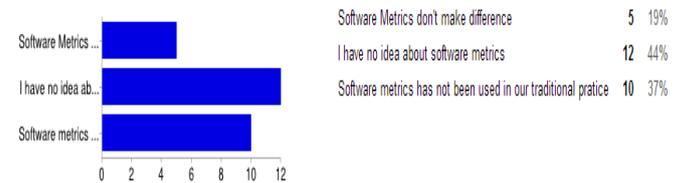


Figure 3.10: Proportion of negative factors contributing to non-software Metrics users

## 4) Reasons of using software metrics

04) Why does your company use software metrics?



Figure 4: Proportion of reasons for use software metrics

As in figure 4.0, describes what are the reasons for use software metrics, Most of the people say they use software metrics to improve quality of a software product.

## 5) Sample view of how company productivity increase by using software metrics

05) Do you think that your company productivity will be increase by using software metrics?

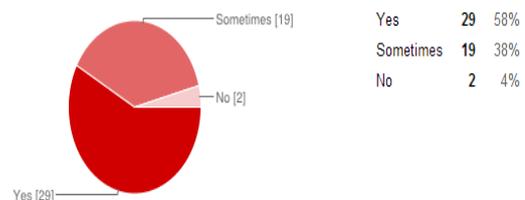


Figure 5: Proportion of increase company productivity by using software metrics

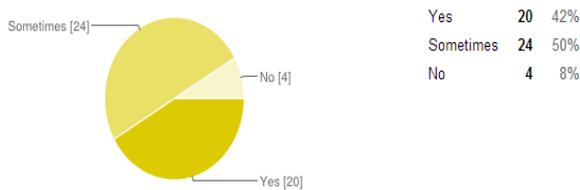
Above figure 5, most of the respondents say by using software metrics there company productivity increased. Only few people say software metrics not effort to their company productivity. So using above data research team make conclusion software matrices is very important for company productivity.

6) By using question 6, research team got some idea about what are the unique metrics that used in IT industry. After analyzing these data team members found unique metrics. These are 3 point estimation, Line of Code (LOC), Disaster Risk Reduction (DRR) [9], Process/Project/Product, Code Coverage, DNK, Quality Improvement (QI) Metrics [10], Function Point Analysis and Effort.

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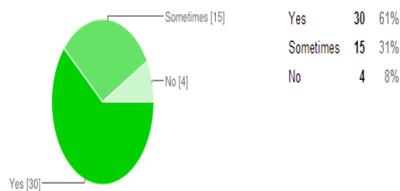
7) Likeness of use a framework  
07) Do you like to use framework which is build using commonly used software metrics?



**Figure 7:** Proportion of likeliness to use framework

As explain in the figure 7, most of respondents like to use framework which was built using commonly used software metric.

8) Usefulness of framework for upcoming IT firms  
08) Do you think that a framework build using commonly used software metrics will be useful for upcoming IT firms?



**Figure 8:** Proportion of usefulness of framework in upcoming IT firms

As explain in the figure 8, large amount of respondents clearly say the framework will be useful for upcoming IT firms.

The final stage of this research is to build a framework of software metrics which can use by the upcoming IT firms. So the research team developed a framework by analyzing the above responds. So the upcoming IT firms can use this framework in their companies to get their works successful. As the framework following metrics can use as software metrics.

To measure size metrics can use Lines Of Code (LOC) by counting the lines of the code in the project. Person-month, person-hour and Staff-hour can use as cost metrics by tracking the project team working rate per function.

Most of the companies use Defect Density metric as a commonly using software metrics. Defect Density metric calculates the defect of the project. It is suitable to use Project Duration as schedule Metric.

Duration of the project can use to measure the schedule metrics. As to measure productivity can use Effort/Size metric. Rate of occurrence of failure (ROCOF) can use as the Reliability metrics. By calculating the rate of failure occurrence of the project can measure the Reliability of the software product.

To measure the maintainability of the software product can use Maintainability Product (MP) and Stability as the maintainability Metrics. By calculating reusability can use reusability as the Reusability Metrics.

## 6. CONCLUSION

In this paper, the research team reviews the software metrics that were used in high-maturity IT firms in Sri Lanka and how software metrics affect the software development process. Then research team evaluates the commonly used metrics and built a framework for IT firms.

This paper has described result obtained from questionnaires. The paper is of significance because it extends our knowledge and understanding of the commonly used software metrics which can be used by upcoming IT firms.

Research team initial results presented in this paper are based only on IT related individuals involved in random software development in Sri Lanka, which limits our possibility to draw for researching conclusions.

In the future research team plan to study additional projects which are used the software metrics in various countries. The research team that it is important to get deeper on this research which will give knowledge about various software metrics in IT industry.

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