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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

ACKNOWLEDGMENTS

REFERENCES

APPENDIX/ANNEXURE

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AN EFFECTIVE TOOL FOR BETTER SOFTWARE PRODUCT

DR. V.S.P. SRIVASTAV
HEAD (COMPUTER DIVISION)
INDRA GANDHI NATIONAL OPEN UNIVERSITY
NEW DELHI

PIYUSH PRAKASH
RESEARCH SCHOLAR
SCHOOL OF COMPUTER & INFORMATION SCIENCES
INDRA GANDHI NATIONAL OPEN UNIVERSITY
NEW DELHI

ABSTRACT

Metrics are more accurate when they are derived from well defined completion criteria for software products and their intermediate modules. Product metrics are also known as quality metrics and are used to measure the properties of the software. Weighted defect are derived from defect information. Weighted defects are calculated with the help of severity of errors found in the software. Each open defect is associated with a number as its severity.

KEYWORDS
Software Testing Metrics, Software Testing Product Metrics, Weighted Defect.

INTRODUCTION
Measurement activities must be designed and targeted to support the business goals and they must provide effective and economical information for decision making . Technology or software product per se can neither be effective nor practical without measurements. We analyze the software in order to understand its behavior with respect to both time and space to improve, if derived so. Software metrics are used to quantify software products, software development resources, and/or the software development process. This includes items which are directly measurable, such as lines of code, as well as items which are calculated from measurements, such as software quality. Metrics must have well defined goal and must be reviewed regularly and acted upon. Metrics will be maintained and not perceived as a burden when the raw data, used to construct the metrics, are recorded as a natural part of work/process. In the field of software development, software metrics are collected at various stages in the development cycle, and utilized to evaluate the quality of a software product. They are also considered as the most critical factors to identify potentially error-prone modules in software systems, so that extra development and maintenance effort can be measured in those modules.

METRICS
A. DEFECT FIXED % METRICS (DF%)
It shows the relation between the defects which are Fixed with respect to the total number of defects in the project. The relation is expressed as
DF%=((TD - TDNF) / TDNF)*100
Where TD stands for Total Number of Defects and TDNF stands for Total Number of Defects Not fixed.
B. CHANGED OR ADDED CODE METRICS (COAD)
It shows the relation between the actual numbers of SLOC changed or added with respect to the total number of SLOC in the project. The relation is expressed as
COAD = TCAC / (TCAC – TBLC)
Where TCAC stands for Total Changed or Added Code and TBLC stands for Total Blank Line of Code.

WEIGHTED DEFECTS
Weighted defect data are derived from defect information. Through real life explanation, it is found that the severity of defects (i.e. how important or serious the defect is) is a very important factor for software quality. When a defect is opened, it is associated with a number as its severity. This number is an integer between one to five, one corresponds to the most serious defects whereas five for the least serious defects. We define each and every severity in Table 1.

TABLE 1: DESCRIPTION OF EACH SEVERITY

SEVERITY	WHAT IT MEANS
1	The basic product functionality failing or product crashes.
2	Unexpected error condition or a functionality not working.
3	A minor functionality is failing or behaves differently than expected.
4	Cosmetic issue and no impact on the users.
5	Least Serious Defects

To incorporate this aspect, weighted defect numbers instead of merely defect numbers were used. A weight to each severity is assigned, i.e., weight of severity level one is 5, weight of severity level two is 4, weight of severity level three is 3, weight of severity four is 2, and weight of severity five is 1 .The weighted defect number W is the sum of number of defects multiplied by associated weights for each severity level. Table 2 contains the data to explain how to calculate W. For example, assume the product has the following distribution of defects:

.TABLE 2: EXAMPLE OF WEIGHTED DEFECT NUMBER

Severity Level	**1**	**2**	**3**	**4**	**5**
Weighted Assigned	5	4	3	2	1
Number of Defects	20	18	25	12	65

The calculated value of weighted defect number W based on the above Table 2, is:
W = (5*20) + (4*18) + (3*25) + (2*12) + (1*65) =336

THE METRICS

Proposed Metric:

Definition: It is the metrics that captures the relation between the total number of weighted defects that are fixed and the total number of weighted defects. The relation may be expressed as $[W_p/(W_p+W_v)]*100$

Where W_p denotes the number of weighted defects that are fixed and W_v denotes the number of weighted defects that are not fixed. Above relation shows the formula about 'How Defects Found and Fixed'.

Calculation of W_p and W_v are as follow:

For W_p

Fieldname Used: DEFECT_ID, SEVERITY
CLOSE_REASON, HOW_FOUND

(i) Find the number of fixed defects for each severity level (X_i)
(ii) Multiply X_i with weights (assigned on the basis of severity) W_i
(iii) Calculate $W_p=\sum X_i W_i$

For W_v

Fieldname Used: DEFECT_ID, SEVERITY
CLOSE_REASON, HOW_FOUND

(i) Find the number of defects for each severity level which are not fixed (Y_i)
(ii) Multiply X_j with weights (assigned on the basis of severity) W_j
(iii) Calculate $Wv=\sum Y_i W_j$

There are three major phases in our project: (i) data collection phase, (ii) metrics calculation phase, and (iii) result analysis phase.

(i) DATA COLLECTION

Based on the definitions of the metrics, a list of variables has been derived for which the collection of data is required in this phase. They have been extracted from the website of NASAs Metric Data Program — Repository access where data for certain projects are available. The Metrics Data Repository has been used for three projects i.e. KC 1, KC3 and KC4 for the calculation and analysis of the proposed metrics. KC1, KC3 and KC4have been used to represent thousands of source line of codes written in C++, JAVA and PERL respectively. KC1 denotes43 thousands line of source code in C++, KC3 denotes 18 thousands line of source code in JAVA where as KC4 denotes 25 thousands of source code in PERL.NASA use KSLOC to denote thousands source line of codes to explain KCs.

(ii) METRIC CALCULATION

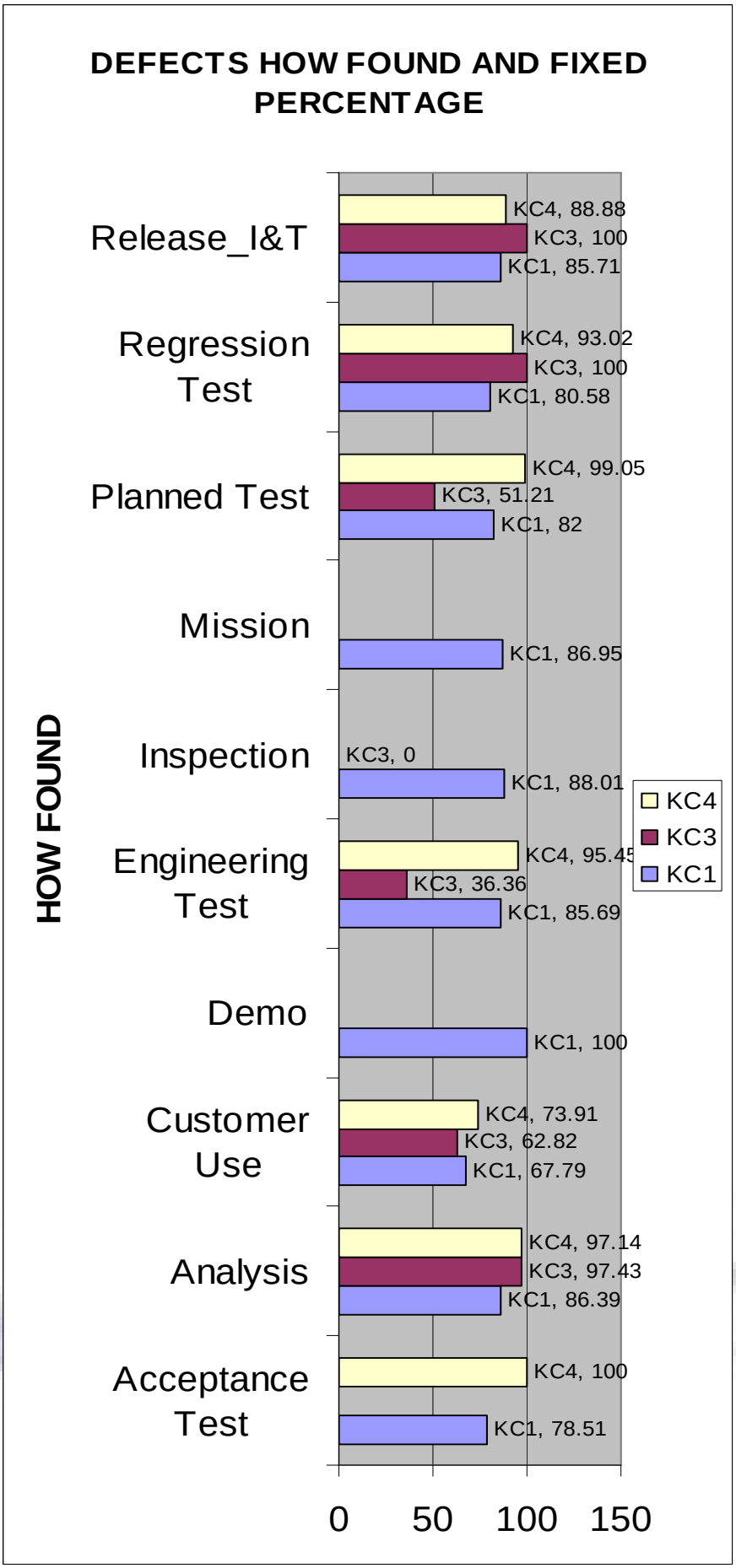
In the data collection phase, we have collected information for all the variables required to calculate the metrics. After all the metrics have been calculated, Table 3 created as below represents the values obtained for all the three projects

TABLE 3: PROPOSED METRICS RESULT

Name of Proposed Metric			
Defect How Found and Fixed Percentage = $[W_p/(W_p+W_v)]*100$			
HOW FOUND	**Project KC 1 (%)**	**Project KC 3 (%)**	**Project KC 4 (%)**
a) Acceptance Test	78.51	--------	100
b) Analysis	86.39	97.43	97.14
c) Customer Use	67.79	62.82	73.91
d) Demo	100	--------	------
e) Engineering Test	85.69	36.36	95.45
f) Inspection	88.01	0	------
g) Mission(Critical, Success, Essential)	86.95	--------	------
h) Planned Test	82	51.21	99.05
i) Regression Test	80.58	100	93.02
j) Release_I&T	85.71	100	88.88

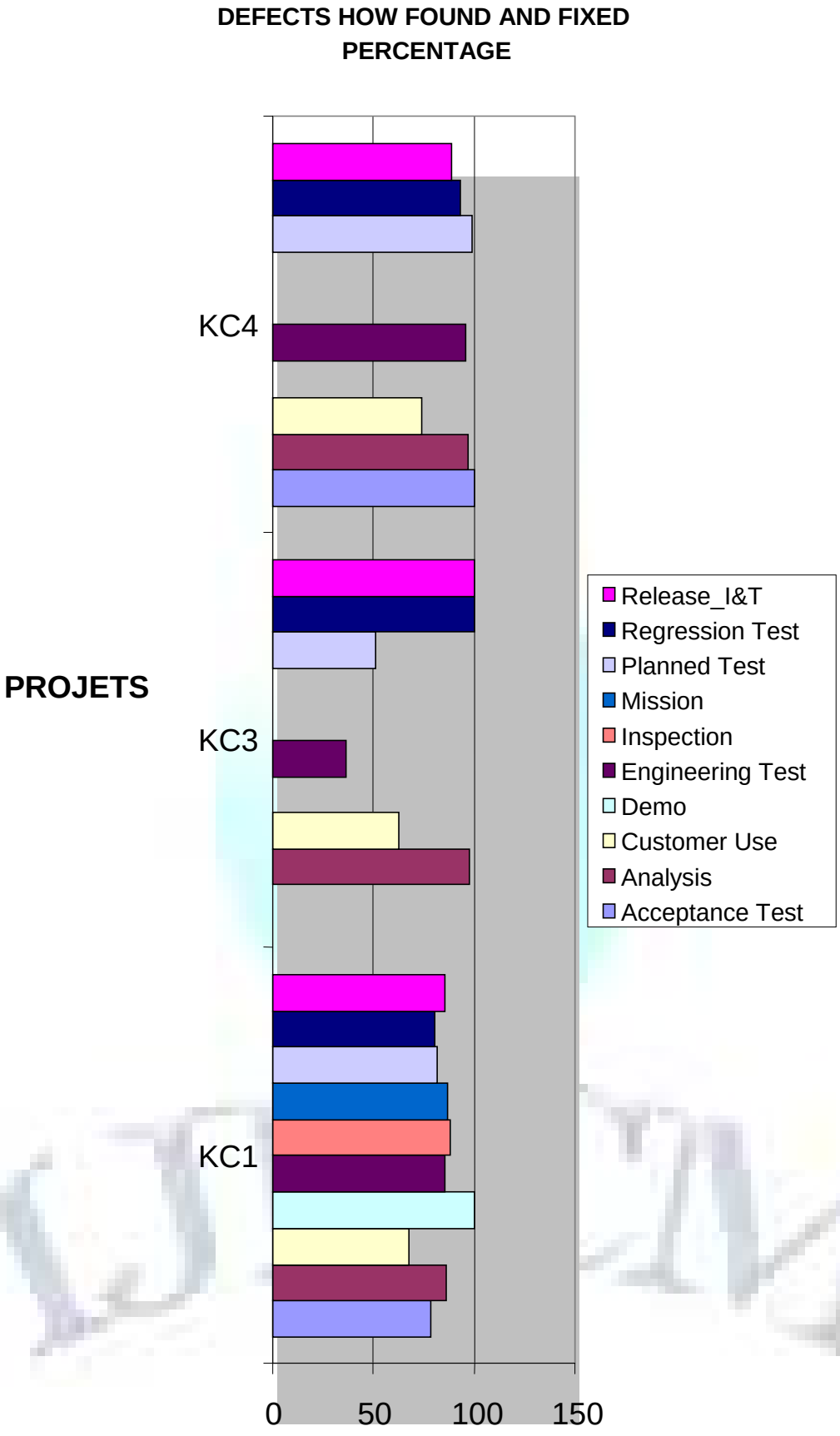
The graphical presentation shown in Figure 1 represents the 'Defect How Found and Fixed Percentage' of three projects according to 'How Found Defects':

FIGURE 1: DEFECT HOW FOUND AND FIXED PERCENTAGE



The graphical presentation shown in Figure2 represents the 'Defect How Found and Fixed Percentage' of three projects according to projects:

FIGURE 2: DEFECT HOW FOUND AND FIXED PERCENTAGE



(iii) RESULT ANALYSIS

The above metric states that value of the percentage is proportionate to the ratio of defects fixed. That is higher the percentage, we have higher ratio of defects fixed. Amongst the three projects i.e. KC1, KC3 and KC4 on C++, JAVA and PERL respectively, project KC4 has the maximum defects removed.

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