Applying Software Metrics on Web Applications

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Abstract- **Web Applications Automates many daily business activities . User Interact with these web applications by the interface which these applications provides . Web applications are different from normal applications . The traditional software metrics can be applied to web applications . but some new metrics which are made only for web applications are important and increase the performance of web applications. In this paper traditional software metrics as well as some new web metrics are described . In new approach I have described the performance metric for web applications and security measures and navigability metric which are useful to improve the web applications . In the beginning I have given basics of measurements which are required for better understanding of this paper .**

*Keywords-*Web Metric ,Navigability Metric , Performance Metric , Security Metric

I. INTRODUCTION

Measurement is the process by which numbers or symbols are assigned to attributes of entities in the real world in such a way as to describe them according to clearly defined rules [2]. Software Metric is a term that embraces many activities , all of which involves some degree of measurement . Software Metrics provides a basis for improving the software process, increasing the accuracy of project estimates , enhancing project tracking , and improving software quality . There are many type of Software Metrics present out of which some are in the area of

1. Cost and Effort Estimation
2. Productivity Measure and Models
3. Data Collection
4. Quality Model and Measures
5. Reliability Models
6. Performance Evaluation and Models
7. Structural and Complexity metrics
8. Capability – Maturity Assessment

II. THE BASIC OF MEASUREMENT

There are several theories of measurement, which will work like for e.g. Representational Theory of Measurement will work [2]. The Representational Theory of Measurement seeks to formulize our intuition about the way world works. that is , the data we obtain as measures should represent the attributes of the entity. Our Intuition is the starting point for all measurements.

Empirical Relation : Given any two peoples x and y , we can observe that x is taller than y or y is taller than x therefore we say that "Taller than is a empirical relation for

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height . where height is an attribute

Mapping: After finding the Empirical Relation one should go for mapping from Empirical Relation to Numerical Relation .

A is taller than B if and only if $M(A) > M(B)$

If we convert that type of relation to some mathematical form then such form is called mapping .

The stages for measurement are

- Identify attribute for some real world entities.
- Identify empirical relation for attributes.
- Identify numerical relations corresponding to each empirical relation.
- Define Mapping from real world entities to numbers.
- Check that numerical relations preserve and are preserved by empirical relation.

A. Direct and Indirect Measurement

Once we have a model of entities and attributes involved , we can define the measure in terms of them . Direct measurement of an attribute of an entity involves no other attribute or entity for example length of a physical object can be measured without reference to any other object or attribute . on the other hand , density of a physical object can be measured only in terms of mass and volume , we then use a model to show us that the relationship among the three is density = mass / volume . some direct measures in software engineering are length, duration of testing process , number of defects discovered ,time a programmer spends on the project. Indirect measurement is often useful in making visible the interactions between direct measurement [1] .

Example of Common Direct Measurement

Length
Width
Line of Code

Example of Common Indirect Measurement

Program Productivity: LOC produced / person months efforts

Module Defect Density: Number of Defects /module size

Requirements Stability: Number of initial requirement/ total number of requirements.

Test Effectiveness Ratio: Efforts spent fixing faults / total project effort

B. Measurement Scales and Scale types

There are five major type of scales .

- Nominal
- Ordinal
- Interval
- Ratio
- Absolute

C. Classifying Software Measures

Software measurement needs entities and attributes , we can divide our software to these three classes .

Processes : are collection of software-related activities.

Products : are any artifacts , deliverables or documents that result from a   process activities

Resources : are entities required by the process activities.

With in each class of entities we distinguish internal and external attributes

Internal attributes : of a product , process or resources are those that can be measured purely in terms of the product , process or resources itself.

External attributes : of a product , process or resources are those that can be measured only with respect to how the product , process or resources relates to the environment .

Entities	Attributes	
Product	Internal	External
Specification	Size, Reuse, Modularity, Redundancy Functionality, Syntactic Correctness	Comprehensibility, Maintainability
Designs	Size , Reuse, Modularity, Coupling , Cohesiveness, Functionality	Reliability, Usability, Maintainability.
Code	Size, Reuse, Modularity, Coupling, Functionality, Algorithmic complexity, Control Flow Structure ness	Reliability, Usability, Maintainability,
Test data	Size , Coverage level	Quality
Processes		
Constructing Specification	Time, Effort, No of Requirements Changes ,	Quality , cost, Stability
Detailed Design	Time , Effort, No of Specification Faults Found	Cost, Cost Effectiveness
Testing	Time , Effort, No of Coding Faults Found	Cost, Cost Effectiveness, Stability
Resources		
Personal	Age, Price,	Productivity Experience, Intelligence
Teams	Size, Communication level, Structure ness	Productivity, Quality
Software	Price, size ,	Usability, Reliability
Hardware	Price, Speed , Memory Size,	Reliability,
Offices	Size, Temperature, Light	Comfort , Quality

Table 1

III.   WEB METRICS

A.   Web Engineering Fundamentals

Web Engineering is the implementation of engineering principals to obtain high quality web applications . Similar types of processes will be followed to make web applications as in traditional software's but with new ideas . now a day when the platform of programming has changed then it is difficult to develop the software only with traditional models . some changes in models needs to be required for the development of online applications. In the Previous years the web site consist of little more than a set of hypertext files that present information using text and limited graphics . as the time passed , HTML was augmented by development tools that enabled web engineers to provide computing capability along with information . As in traditional projects attributes are needed for software metrics either   they are internal attributes or external attributes. Similarly attributes are needed by web metrics for the improvement of online projects or web applications . some of the attributes which are useful for web metric are

Network Intensiveness : A Web App resides on a network and must serve the needs of a diverse community of clients . Web Applications are network dependents [5].

Concurrency : A Large no of users may assess the Web Application at one time [5].

Unpredictable Load : At one time 1000 users can assess the web application or 10 users may assess the web application [5].

    a.   Performance : If a user wait for too long then , he or she may decide to go else where [5].

Availability : Web Application should be available for maximum time like 24/7/365 basis [5] .

    b.   Data Driven : The primary function of many web application is to present Hypermedia files as well as to display the graphics But web applications may also be able to assess the database [5].

Content Sensitive :The text present on the web sites should be of high quality . Because the contents always represent the quality of web sites [5].

Continuous Evolution : Web Applications evolves continuously. Some web applications may be updated after each hours ,some may be updated after each minutes .

Security : Web applications are on world network then there is need for securing the contents of web applications . strong security measures are to be taken for protecting the information and data of web applications

Meet the Business requirements   web applications should solve the purpose of business for which they are made .

Various Types of Web Applications are

- Informational
- Downloads
- Customizable
- Interaction
- User Input
- Transaction Oriented
- Portal
- Database Access
- Data Warehousing

Table 2

B.   Planning For Web Engineering Projects

In Table 2 the comparison of the traditional projects with

	Traditional Projects	Small e-Projects	Major e-Projects
Requirement Gathering	Rigorous	Limited	Rigorous
Technical Specifications	Robust: Models spec	Descriptive Overview	Robust UML Models
Project Duration	Measured in month or years	Measured in days weeks or months	Measured in months and years
Testing & QA	Focused on achieving quality targets		
Risk Management	Explicit	Inherent	Explicit
Half Life Deliverables	18 months or longer	3 to 4 months	6 to 12 months
Release Process	Rigorous	Limited	Rigorous
Post Release – customer feedback	Requires Proactive efforts	Automatically obtained from user interaction	Obtained both automatically and solicited feedback

small e- Projects and Major e-Projects has been carried out. Traditional Software Projects and Major e- Projects have substantial similarities . small e-projects have special characteristic which differs them form traditional projects . Even in case of small e-Projects planning must be occurred and risk must be considered , a schedule must be established and control must be defined so that confusion , frustration, and failure are avoided

C. Project Management Issues for web applications

1) A Business must choose from one of the two web engineering issues (1) The web application is outsourced –The web Engineering is performed by some third party who has the expertise , talent and resources that may be lacking with in the business , (2) or the web application is developed in-house using web engineers that are employed by the business . A third alternative is there in which some work is carried out In-House and some work is outsourced [4] .

D. Our Approach Towards Web Metrics

Web Engineering uses metrics to improve the overall process for the development of web applications. These metrics provide the way how these web applications behaves and what is the quality of these online applications .
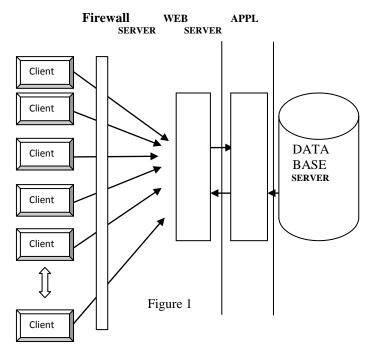
Software Metrics provides a basis for improving the software process, Increasing the accuracy of project estimates , enhancing project tracking , and improving software quality . Web Metrics if properly characterized , achieve all these benefits also improve the usability , web Application performance , and user satisfaction [5].

The goal of web metrics is to provide better quality of web applications from technical and business point of view . Web Metric provides the measures of effort, time and complexity of web applications . Some of the measures of web applications are
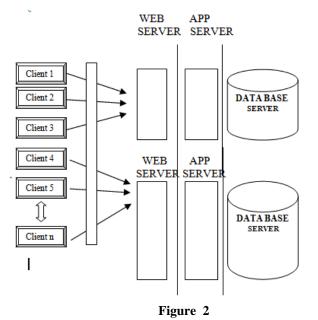
E. Performance Metric

Performance is related to availability and concurrency of web applications . when end user require the service of web applications and web applications get fail such condition reduces the performance of Web applications . The cause of failure may be any thing either due to network failure or heavy load on servers Fig 1 shows an example of a typical web application architecture . in which web server take request from users and passes the request to database server through application server . and then result of database query will be shifted to client machine [8].

Single set of web server, application server and database server is giving the service to no of clients . with such type of architecture it is difficult to improve performance of web applications.

Figure 1

But if we improve such model and new model we make as shown in fig 2 in which two set of web server application server and database server give service to the clients then load on each server reduces our performance metric says that response time decreases if total no of servers increases To reduce the response time increase the no of servers.

Response Time α 1/ Total no of Servers

Figure 2

F.   Security Metric

Web application are on world network then there is need for securing the contents of web applications [6]. Strong security measures should be taken to protect the information and data of web applications.

Inputs from user is the way through which security can be reduced . while coding the web applications appropriate checks should be implemented on user inputs to maintain the security of web applications .

e.g an input which is ready to take character type data should not take numeric data or any other special characters. Apply user ID and password on secure information .SQL Injection attacks which are done by hackers should be avoided by positive tainting techniques [2].

HTTP Cookies and server variables can be the cause for poor security . if user may not perform any action for some period of time then cookies should get expired and application should ask for relogin and password .Defensive programming reduces the attacks

IV.   Measurement of Time and Efforts

A Few measures of efforts and time are given below Structuring efforts: Time to Structure Web Application Interlinking effort: Time to interlink pages to build the web applications, Interface Planning : Time taken to plan web application Interface, Interface Building : Time Taken to Implement interface for web applications Link-Testing effort: Time taken to test all links in web applications, Media Testing   Time Taken to test all media in web Applications .

Total Effort:Structuring effort +Interlinking effort +Interface building +link-Testing effort + Media Testing efforts

(1)   Page Authoring

Text Efforts : Time Taken to author or reuse text in   page, Page linking efforts :Time Taken to author link in page, page structuring efforts :Time Taken to structure page.

Total page efforts: Text effort + page linking effort + page Structuring effort.

(2)   Media Authoring

Media efforts: Time taken to author or reuse media files, Media digitizing: Time taken to digitize media Total media efforts: media effort + media digitizing effort [5] .

(3)   Programming Authoring

Programming effort : Time taken to author HTML ,Java or related Language implementations Reuse effort : Time taken to reuse/modify existing programming .

(4)   Navigability Measures

Navigability describe the ease with which user find the desired information . navigability measure is important for usability. A proper model of navigability reduces the access time .there are certain measures through which navigability can be increased e.g. hyperlinks depth ,hyperlinks breadths, topologies in connection with hyperlinks , some study have been done for the examination of hypertext topologies on usability [7] .breadth maximum approach all links are there on a single page or home page so that user can move to the desired page just by single click but this approach is better only for informational websites like Rediff home page .

Depth maximum approach all links are on different pages in a web application .depth is the no of clicks required to get the specific page from the home page . this approach is better where input is required from user by following the specific no of steps . web site navigability can be evaluated in three ways with user survey , with usage analysis , and with navigability measurements [7].

Mainly there are four hyper text topologies present (1) Linear Topology (2) Strictly Hierarchical (3) Mixed topology (Hierarchical Topology with cross –referential hyperlinks) (4) Non linear topology (a complete network based on a large no of cross referential links) .Previous study finds that navigability decreases in the order (1) Linear , (2) Strict (3) Mixed (4) Complex . we can divide the Mixed Topology into three sub categories (1) Mixed Hierarchical with link to Home Page (2) Bottom up approach (3) Mixed Hierarchical with link at the same level . In the first approach a link to home page is present from every page , In second approach a link to previous page is present from every page , and third approach is a link for every page at the same level is present .

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