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Innovative Approach in Web Application Effort & Cost Estimation using Functional Measurement Type

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***Abstract*—Software cost models and effort approximations support project supervisors to distribute resources, control budgets and agenda and develop modern practices, leading to projects completed on time and within financial plan. If cost and effort are determined suspicious in software projects, suitable occasions can be missed; whereas expectant predictions can be affected to some resource losing. In the context of web development, these issues are also vital, and very challenging given that web projects have short schedules and very fluidic opportunity. Since software projects are continually changed in nature, earlier projects may not necessarily cover all aspects of a new project when used as a basis for cost estimation. Preliminary software estimation models are constructed on regression analysis or mathematical sources. This paper aims to propose an approach to develop the correctness of software effort and cost estimation using the structure of data set of a web application. All the measures collected, apart from total effort, were introduced using the original web hypermedia applications to ensure that functional measurement types were precisely measured.**

***Index Terms*—Software Effort & Cost Estimation, Web Application, Functional Measurement Type etc.**

I. Introduction

The cost of software projects and the quality of products are affected by the correctness of software effort estimation. Accurate cost estimation of a software development effort is critical for good management decision making. Predicting software development effort with high precision is still a great challenge for project supervisors. On the otherhand, accurate estimation of the effort and cost of a software system is one of the vital and challenging tasks for software project management. It aids in agreement negotiations, project planning and effective distribution of resources. However, estimates at the introductory stages of the project are the most difficult to acquire because the primary source to estimate the cost comes from the requirement specification documents[1][2][3].

A number of pointers should be measured to estimate the software cost and effort.A number of pointers should be measured to estimate the software cost and effort. One of the utmost vital pointers is the size of the project.The approximation of effort and cost governed by the exact prediction of the size[4]. In general, the effort and cost approximations are challenging in the software projects. Because, software projects are often not exclusive and there has no experience or previous knowledge about them. So, prediction appears convoluted.Moreover, production of projects is not touchable so the amount of effort, cost and the amount of enhancement in the software project is very challenging.

Nowadays, web sites and web portals are more and more complex, and have to control and deliver to their visitors vast amounts of information. Unfortunately, developing web applications through PHP(Hypertext Pre-processor) is not discharged from cost, time and effort estimations, as in traditional software projects.Many estimation models are available, but currently there is no model able to effectively measure the effort of a Web application[5].

The main objective of this paper is demonstrating the abilities of the web application cost estimation methods and clustering based on sub-functional measurement, functional measurement and complexity calculation which helps project supervisor to better understanding.

II. Cost and Effort Estimation Model

Exploration on effort and cost estimation of software development has been plentiful and expanded since the end of the Seventies[6]. This arena is still very much buzzing, as shown by the numerous works existing in the literature. In this arena, experts have extensively investigated the topic, in relation to both approximation approach and investigation approach[5]. These studies were carried out in both industrial and academic contexts. A number of cost estimation methods exist and they can be classified into three main categories [5]. These categories are:

1) Expert Judgment: In expert judgment, a software project estimate the cost and effort established on chronological data and related projects to estimate software. This technique is very subjective and it absences adjustments and thus, cannot be returnable[9].

2) Algorithmic Models: This models is widespread category in the effort and cost estimation technique[8].

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These prototypes include FPSE, LM, MM, COCOMO, SLIM, SEER-SEM, SLOC and PM [7].

3) Machine Learning: Newly, this techniques are being used in aggregation or as replacements to algorithmic models. These methods include neuro-fuzzy, genetic algorithm ,neural networks, fuzzy logic and regression trees.

III. Background and nature of web applications

Web Applications Effort and Cost Estimation is a complex task due to a number of different but compelling reasons compared to traditional software engineering effort and cost estimation techniques[9].Listed a number of factors that makes web application development slightly different from traditional web application development, indicates that there is no standard to sizing web applications given that there is a wide and diverse set of technologies that can be used to develop web applications e.g. Java (Servlets, Java Beans, Applets, Java Server Pages), HTML, JavaScript, XML, XSL, PHP, ASP.NET etc.

Many different metrics have been used to estimate the size and therefore the effort required to complete a web application project. Examples include the number of web pages, the number of multimedia elements, and the number of links and so on. Additionally, there have been attempts to apply Function Point principles to sizing web applications[3][4]. This approach seeks to derive from a combination of size metrics, a number of functional requirements that would be needed in order to develop the application[23].

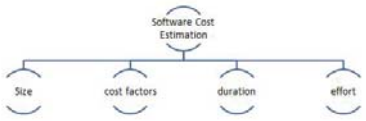


Fig. 1: Software Cost Estimation

IV. Proposed Approach

The proposed approach combines the concepts of Functional Measurement Type and Linear Algebra Rules. The functional measurement Type is used to represent the corresponding linguistic requirement variables for each interval instead of representing them as crisp interval. Thus, this should help us to derive the final prediction. Determining the corresponding Software Effort & cost estimation is performed by using association rule. The approach is described by following as explained below:

A. Dataset Description

The Proposed approach has dataset includes 9 basic requirements of projects with 5 Functional Measurement types and 4 complexity Factor of the software development effort. So, using dataset for evaluating the proposed model is based on Algorithmic model. The second attempt was to create an all requirement dataset based on one of requirement, Table 1, based on this model and algorithm.

TABLE I: Web Application Dataset Structure Development

SFMT	Description
SD	Defines the framework, MVC based development of a project.
LgD	Defines the development issue of logical term
LoD	Defines the development of conditional statement with Looping Condition
FD	Defines the logical separate code development using Multiple Parameter Development
AcD	Defines the development of form connectivity among forms
AD	Defines the issues of accessibility issue of the project
SeD	Defines the development of authorization, authentication etc.
CD	Defines the Page transfer Development of a project
RD	Defines the development of easier communication with a project

Where, SFMT means Sub Functional Measurement Type, SD means Structure Development, LgD means Logical development, LoD means Looping Development, FD means Functional Development, AcD means Action Development, AD means Additional Development, SeD means Security Development, CD Connectivity Development, RD means Readability Development.

B. Step wise development of approach

Step 1: define or specify one of your criteria for each requirement in dataset, then asserts it into several equal intervals (lengths). After that, each requirement should be partitioned into a number of equal to others intervals where the number and length of intervals should be predefined by estimator. Assuming n is the number of intervals then the length of interval metrics are calculated as follows:

$$\text{DD(Metrics)} = SD(Metrics) * \frac{10}{\sqrt{3}}$$
$$\text{LD(Metrics)} = SD(Metrics) * \frac{10}{\sqrt{2}}$$
$$\text{FD(Metrics)} = SD(Metrics) * \frac{3}{\sqrt{3}}$$
$$\text{AD(Metrics)} = SD(Metrics) * \frac{3000}{\sqrt{2}}$$

Where SD means Structural Development, DD means Decisional Development, LD means Looping Development, FD means Functional Development, AD means Advance Development.

Step 2: Cost Factor matrix development:
See Table 2

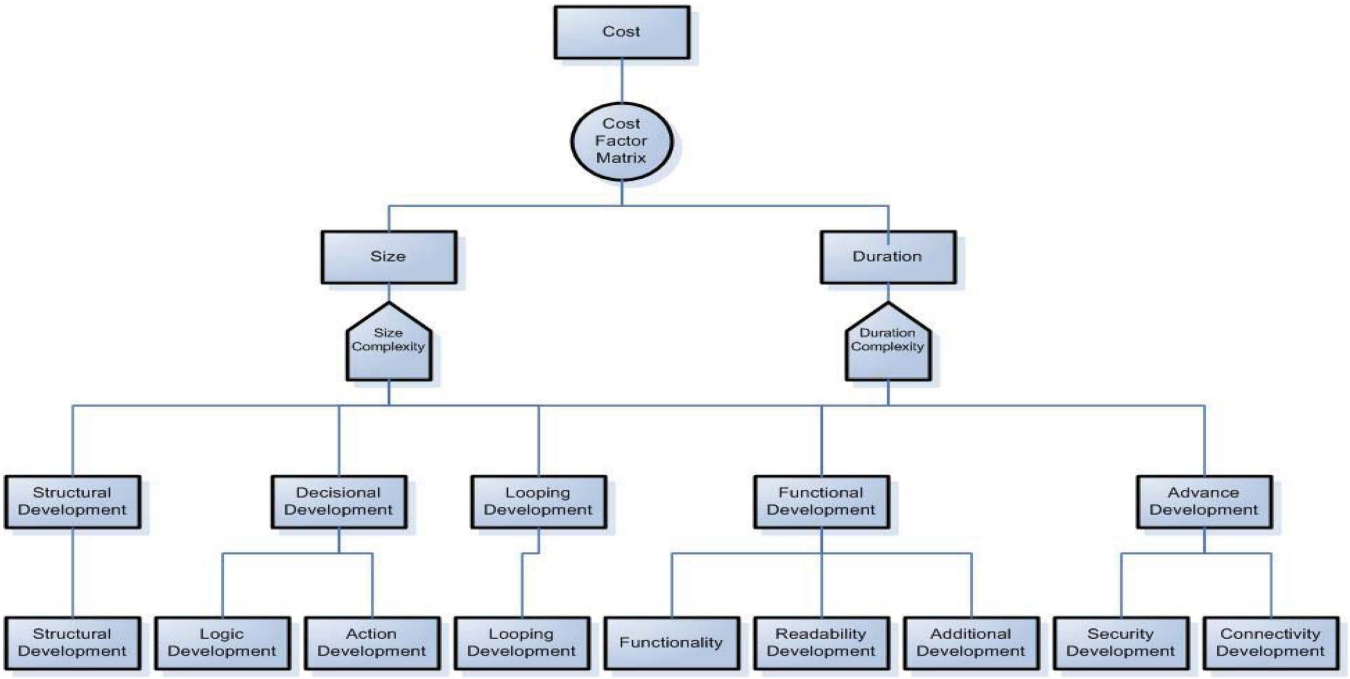


Fig. 2: Functional Measurement Tree

TABLE II: Cost Factor Matrix

	SD	DD	LD	FD	AD
SD	1	$\frac{\sqrt{3}}{10}$	$\frac{\sqrt{2}}{10}$	$\frac{\sqrt{3}}{3}$	$\frac{\sqrt{2}}{3000}$
DD	$\frac{10}{\sqrt{3}}$	1	-	-	-
LD	$\frac{10}{\sqrt{2}}$	-	1	-	-
FD	$\frac{3}{\sqrt{3}}$	-	-	1	-
AD	$\frac{3000}{\sqrt{2}}$	-	-	-	1

Step 3: Define a corresponding extra linguistic variable for each interval of requirement of Functional Measurement Type. This step has been used intensively to get the prediction cost value.

These linguistic variables can be divided into 5 categories

- Context And Peripheral Environmental Analysis
- Site Arrangement
- Graphics And Plots
- Multipleinstance Common Elements
- Reporting And Query

This variables will help the users to predict software effort estimation.

Step 4: Project management software caters to the following primary functions:

Web Application Project development: To explain a Web application project agenda, a project executive can practice the software diagram of a web application project jobs and visually define assignment communications[**?**].

Task supervision: Lets user to generate and assigned of responsibilities, goals and status intelligences.

Document allocation and teamwork: Efficiency is amplified via a principal manuscript repository retrieved by development stakeholders.

Time Constraint and communication development: Web Application Project timelines comprise planned meetings, activity periods and links that should automatically inform through all Project Executive and stakeholder schedules.

Bug and error supervision: Web Application Project management software enables bug and error reporting, observing, informing and apprising for stakeholders.

Period Analysis: Software need to have the capability of tracking period for all tasks preserve histories for third-party specialists.

Step 5: Calculate all the basic sub functional requirement to calculate Software effort and cost estimation.

$$Effort = \sum_{i=1}^{n} F_m * C_f \tag{1}$$

where,
F_m= Functional Measurement type,
C_f= Complexity factor for those sub functional measurement,
n = number of functional measurement type.

$$Cost = \sum_{i=0}^{n} C_F(F_m + L_v + P_{mc}) + M \qquad (2)$$

Where,
L_v = Linguistic Variable Cost,
P_{mc}= Project Management Cost,
M = Miscellaneous cost.

C. Algorithm Development

The proposed method is a combination of analogy method and Linear algebra, in which clustering has been used to make the data as high-normal as possible. In fact, the data analysis is improved by using the smooth and consistent data sets. The consistency of a dataset is measured by the level of normality that exists among the projects[17].

Data: Data is collected from user.
Result: Summarize the Predicted Software Effort and cost estimation.
Process the data known as WEB APPLICATION DATA SET take proper decision
while *taking data from user/project managers* **do**
  read sub functional measurement value;
  if *measurement is positive value* **then**
    show other values of sub functional measurement type and calculate effort;
    if *linguistic variables and project management metrics value provide* **then**
      Calculate software cost.;
    else
      request to provide one of sub functional measurement value;
      break;
    end
  else
    request to provide one of sub functional measurement value;
  end
end

Algorithm 1: Algorithm for Predicted Software Effort & Cost.

In other words, when the relationship between the independent features and the development effort is the same among different projects, the number of outliers is decreased and the consistency of the data set is increased. This can be achieved by the clustering of projects. The estimation model is constructed in this stage, which includes two main sections as stated in the following. Efficient data needs to consider the sample sets, in which the number of projects is equal or more than the number of features. As the number of features is increased, the number of projects should be increased, and this ensures that the data analysis is completed[13].

Data: Resources are from the Project Document
Result: Summarize the Actual Software Effort and cost estimation.
start:
forall the *directories of Project* **do**
  Iteratively read the Project Directory Folder.;
  if *Check whether is it file or not* **then**
    Get the filename if it is checked as file.;
    if *Check whether file information exists or not* **then**
      Calculate software effort & cost using sub functional measurement type of that file. ;
    else
      return 0;
    end
    if *Check whether folder information exists or not* **then**
      Check that Folder to start iteratively read the directory. go to start. ;
    else
      return 0;
    end
  else
    do nothing;
  end
end

Algorithm 2: Algorithm for Actual Software Effort & Cost.

In proposed approach algorithm, the best number of effort and cost is determined based on the conditions of the dataset. Indeed, the proposed algorithm will identify on how many sub functional measurement type must be considered in the project management process to have the maximum number of Emplyee, Working hours etc, in which the number of projects is equal or more than the number of features. The maximum number of functional measurement type will ensure the high level of consistency for the existing projects. Algorithm 1 shows the procedure for finding the software effort and cost of projects[22].

V. Evaluation Result

After transferring the data, the proposed approach was conducted three main case studies to evaluate result. These cases, which used same datasets , were utilized to perform training on the parameter values. The data points and the project management cost were adopted for testing purposes. The original functional measurement parameter values are calculated in each case [14].

The parameter values of the four cases are different but in linear. This reason causes the prediction performance difference amongst the Project cases . In order to assess the prediction performance of the approach, Calculation effort from functional measurement and Cost factor with the proposed approach framework. Performance metrics were used for the analysis of each project case. Accordingly, Table

3 & Table 4 presents the results from Cases 1 to 3 project data points.

For an example, proposed model is done on three project.

- opencart
- openconf
- sibco

Result based on this model shows that in Table 3 and Table 4.

TABLE III: Result of Proposed Model

Web Application	SD	LOD	LPD	FD
opencart	213327	37168	29679	12391
openconf	41154	6329	5401	2202
sibco	48970	9481	7428	3406

Where, SD means Structural Development,LOD means Logical Development,LPD means Looping Development,FD means Functional Development.

TABLE IV: Result of Proposed Model

Web Application	ACD	AD	SD	CD	RD
opencart	34292	8664	4	26	13574
openconf	34292	8664	4	26	13574
sibco	3502	3336	0	6	10751

Where, ACD means Action Development,AD means Additional Development,SD means Security Development,CD means Connectivity Development,RD means Readability Development.

Case Study 1: This case involved the parameters of opencart projects. This project is one of furnished open source application. This open source application is formed by PHP MVC framework. There are several projects that meet this requirement. Since the proposed approach is to estimate software cost estimation, the project content was done with opencart project data points, while sevral pieces of project data and the functional data points were used for testing.

Case Study 2: This Proposed approach used the data points from an open source application named openconf projects to calibrate the software cost estimation without removing the other data points. The testing was performed with the project dataset used in the prposed approach and with the functional project data points. In comparison to Case 1, this test attempted to ascertain the prediction performance when the result involved in the results.

Case Study 3: In the previous two cases, all data points from the Sibco projects were used for . However, in Case 3, the proposed approach used part of this dataset to calibrate the this approach, and the rest of the data points, along with the project data points, were used for testing. The objective of this case was to determine the impact of the dataset size on the calibration results.

VI. Comparison Between Proposed Approach And Estimation Methods

At this division allowing existing topics, it is conceivable to associate cited estimation methods centered on benefits and drawbacks of them. This evaluation could be suitable for picking a proper technique in a particular web application project. Selecting the estimation method is completed established on abilities of approaches and state of the Web application. Table shows a comparison of declared methods for estimation. For doing comparison, the general surviving estimation methods have been nominated.

A. Comparison with Algorithmic Type

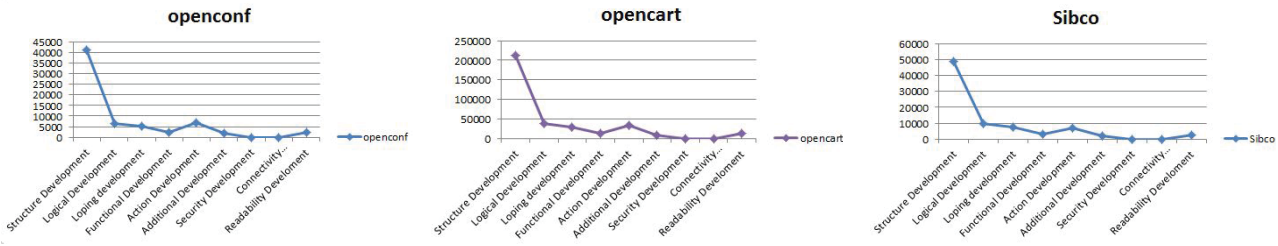
COCOMO, Function Point are Algorithmic Software Effort Estimation Method. COCOMO provides clear results, very common for all Software. For Software Effort Estimation using COCOMO is required much data, It is required historical data for any project. On the Other side, Function Point is Semantic free; Its results are superior than SLOC. in Function point, Computerization is hard to do, excellence of productivity are not considered[4][12]. In this approach, Optimization of this problem is solved. This approach provides better results for all web application. Its required only Web application structures. Historical data is not analyzed in this approach [16][21].

B. Comparison with Non-Algorithmic Type

Expert Judgment, Analogy, Neural Networks, Fuzzy Approach are Non Algorithmic model of Software Cost Estimation. Expert judgment is Fast Predicated estimation method. It has some procedure of adaption of Especial Projects. Its success depend on expert knowledge. Analogy approach Works created on definite practices, having special expert is not essential. A lots of information about past projects is required. Neural Network approaches have guideline of designing[4][21]. This approaches performance depends on large training data. Another popular approach is Fuzzy logic approach. in this approach Training is not require. Flexibility is the main issue of the approach. It is hard to custom, Keeping the degree of importance is challenging. This paper approach is Non-justified to the Non algorithmic Model. Expert Judgment is not stand here for developing the approach[16].

C. Result Comparison

The Appraisal of proposed approach was performed in 3 web applications used in Result analysis. Web application Effort & Cost Estimation was conducted using Schneiders Model, Karners model and proposed approach. Most Specialists use MMRE to calculate the error Percentage of Software Effort & Cost Estimation. MMRE is the mean of the Magnitude of Relative Error. It is very communal principle used to



(a) OpenConf (b) OpenCart (c) Sibco

Fig. 3: Case Study of Three Web Application

evaluate software cost estimation models[3][6][7]. Magnitude of Relative Error (MRE) for each surveillance can be obtained as:

$$MRE_i = \frac{|AE_i - PE_i|}{AE_i} \tag{3}$$

Where, AE means Actual Effort,PE means Predicted Effort. MMRE can be accomplished be an average of the summation of MRE over N interpretations[20][24][11].

$$MMRE = \frac{1}{N}\sum_{i=0}^{n} MRE_i \tag{4}$$

TABLE V: Comparison Between Old Models and Proposed

	OpenConf	OpenCart	Sibco	Kar	Sch
MMRE	27(%)	32(%)	29(%)	34(%)	30(%)

VII. Conclusion

This paper appraised the frame of research on effort and cost estimation models for web applications by scrutinizing the procedures that were castoff to shape approach, the datasets that were castoff and the research types engaged. This was done in the environment of espousing effort and cost estimation practices from traditional software development. Although many revisions have been accompanied by effort estimation models for web applications,There is no strong suggestion that there is a certified method or a set of verified approaches for estimating the effort and cost of web applications. All of the performances used are tailored forms of systems taken from traditional software engineering. No ominously new techniques have been projected. Moreover, there is countless discussion about what scope drivers should be used to originate approximations[15][25].

Supplementary new size metrics are being technologically advanced and tailored from current approaches Object Points, Web Objects, Data Web Points etc. Other frequently used size drivers in traditional software development such as Lines of Code (LOC) are hardly used in Web Application Effort and Cost Estimation Models[19].

Proposed case study displays that significance of the output result and the proposals comprising the premise of linear algebra. Without a doubt, each proposal has a principle. After providing a normal clarification of the principle and output of each linear algebra rule, the proposed approach proposed an details of the Association rule. Each rule can be construed as parallel assertion of software effort and cost estimation in which is informal for users to realize[18].

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