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Three Layer Based Approach for the Cost Estimation Measurement in Software Development

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Abstract: **Software function size dimension methods are regularly used worldwide as a source for estimating the software. Function point (FP) is the process of measuring the size of software. In existent life function, software engineer uses function point parameters as inside and outside inputs for cost estimation. That comprise input, output, inquiries, internal logic files, and external files, for the duration of unadjusted function point calculation. On the other hand, in literature less attention is given to the estimation of the cost of the requirements. The purpose of this paper is to make upgrading in precise cost estimation of software based on function point analysis. Here, we have projected a three layer based approach to assess the cost estimation of the program or software. In new age cost estimation may include a lot of other phases in the growth. In this paper we have using a case study the projected mode is explained. The outcome of the proposed work is analyzed and indicates that better results have achieved by using three layer based approach.**

Keywords: **Software Requirements, Cost Estimation, LOC, Function Point, layered approach and Goal Oriented Requirements Elicitation Methods.**

I. INTRODUCTION

Allan Albrecht, in 1979 was the initially personality who developed function point at international business machine (IBM). Afterwards on functional point was harmonized by ISO/IEC 20926:2010 [1,2]. IFPUG, is stand for “International Function Point User Group”, i.e., a, non-profit society, encourage and scatter the valuable organization of software development and protection using FPA [1,2,4]. More than 25 methods based on FP have been projected by the research commune and among these methods, only five methods, i.e., IFPUG FP, Mark II, NESMA FP method, COSMIC FP, and FiSMA FP method, have received the recognition by the International Standardization Organization (ISO) and International electro technical commission (IEC) because it conform with the rules contained in the ISO/IEC 4143 norm.

FP is software metric which is used to describe the functionality of the software. This metric is also used to register the "development effort", “productivity”, and "cost" [1] Furthermore, requirement specification, design specification, source listing or live system is necessary for determining FP. It helps in schedule effort, defect estimation and setting project scope. It can keep away from source code mistake when selecting dissimilar programming languages.

Function point is a programming language autonomous, making supreme for applications with conventional and nonprocedural languages.

In programming improvement organizations, expectation of the cost of programming estimation in early period of programming advancement causes the product organizations to choose which necessities must to be executed [3]. Basically, we can't actualize the whole requirements because of the spending issue. In this way, it is critical to evaluate the cost of every product requirements with the goal that the customer can choose that from the given arrangement of the necessities which requirements must to be executed [5,6].

There are distinctive techniques for the estimation of the cost of the product like lines of code (LOC), function point (FP), demonstrate. Lines of code (LOC), or else called "source lines of code", is programming metric which is utilized to quantify the measure of the PC program by checking the quantity of lines accessible in a program [7]. This metric is additionally used to evaluate the exertion required for the improvement of a product extend.

All things considered applications, LOC got less consideration by the product designing group since it changes starting with one programming dialect then onto the next program for a similar application. For instance, in the event that you have built up a venture "S" in C dialect and furthermore in C++, at that point it has been watched that in both the cases the LOC would be extraordinary however the usefulness of the S would be same. Accordingly, to address this issue distinctive sorts of the product frameworks were created like "function point" and "COCOMO model", and so forth [7].

Layer based strategies in the area of programming designing have been well-known for the growth of the software manufactured goods. For instance, Lin et al. [9] proposed a "layer based technique for the fast improvement of the software product. In their work creators have utilized the rules proposed by the Extreme Programming (XP). Distinctive strategies have been created on the premise of layer based ideas [8, 9,10,11].

In light of our survey, we recognize that in writing less consideration is given to the estimation of the cost of the requirements and how these necessities are utilized to discover the diverse parameters which are utilized for the estimation of the cost of the product, on the off chance that it is created by the Indian software industries.

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Along these lines, keeping in mind the end goal to bargain this issue, we proposed a three layer based model for the estimation of the cost of the product. Finally, the proposed method is explained by the case study.

The rest of the piece of this document is sorted out as takes after: In segment 2, related work is given. We clarify the proposed method in Section 3. In area 4, case study is used to describe the projected method. Finally, conclusions and the future job are given in segment 5.

II. Related Work

A layer based development method proposed by Lin et al. [9] includes three ladder, i.e., (i) the use case identification (ii) the architectural specification, and (iii) architectural component construction. In their method, use case was used to represent the customer requirements. Architectural framework was used to identify the view layer components, control layer components, and model layer components. Waheed *et al.* [10] apply the enhanced model concept in the web services in which the authors deal the issue of the security. Authors have divided the layers into low level to high level. The objective of the low level is to provide more interaction; and high level is used to provide the less attention among the services. In their work, they have included a layered model between service and service consumers. Junior *et al.* [13] conducted a systematic literature review (SLR) on the improvements of the FPA method. They discuss the issues related to the following: (i) "*weight and complexities*" (ii) "*adjusted functional size*", and "*technical independence*". Bharadwaj and Nair [12] identify that IFPUG FP does not contain the non-functional requirements (NFR). In the related area issues on the GSC was raised by Ahn *et al.* [14] as well as Abdullah *et al.* [16] As per them, IFPUG FP does not include the security related issues and the features of the maintenance issues. In function point testing there are a number of countable process of information sphere and calculation of software density like: internal files, external files, internal and external outputs and finally external enquiries. These requests made it complex but necessary for the precise for the cost estimation [15].

Similarly advantages and disadvantages of different software cost estimation methods has been discussed exclusively Sweta et al.[17] In similar studies, Rijwani and Jain [8] apply the multi-layered feed forward artificial neural network technique for the enhancement of software effort estimation. In 2008, Gupta *et al.* [11] proposed a "*Software Estimation Tool Based on Three-Layer Model for Software Engineering*".

In the first layer, i.e., basic metrics, FP was used for object oriented system. General software metrics was used as second layer.

In this layer authors have computed LOC, effort, time, and cost using COCOMO II. In the third layer, maintenance and quality were used as advanced software metrics. Based on our literature reassess, we find out in these studies less attention is given to the estimation of the cost of the requirements. Therefore, in-order to deal with this issue, in this paper we proposed a three layered approach for the estimation of the software cost with MNC as a model.

III. Proposed Method

In this segment, we display the three layered move towards for the estimation of the software cost. The piece chart of the proposed approach is given in Fig. 1.

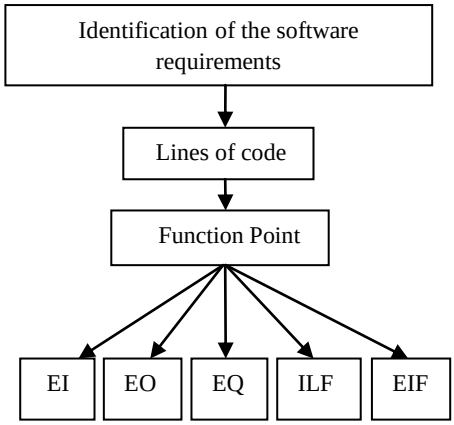

Fig. 1. Three layered approach for the estimation of the software

Layer 0: The target of this layer is to distinguish the software requirement. There are different methods to distinguish the desires resembling "traditional method", "group elicitation method", "cognitive method", "contextual method", and "goal oriented requirements elicitation method (GOREM)", and so forth. In our work, we utilized GOREM to distinguish the requirements of the product. In GOREM, the high level intention of an association are refined and disintegrated into sub-goal. These sub-goals ate additionally refined and deteriorated into sub-goals; and this procedure proceeds till the responsibility of the last sub-goals are allocated to a few specialists or some stakeholders [5, 6,18]. In GOREM, we discover the necessities by developing AND/OR diagram of the considerable number of goals and sub-goals [5].

Layer 1: In Fig.1, the Lines of Code (LOC) is at the primary layer. The target of this layer is to compute the cost of the product based on the estimations of the LOC.

Layer 2: In this layer, the function point (FP) is utilized to describe the functionality of the systems form the user's point of view.

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Albrecht's proposed the concepts of FP in which the system is decomposed into the following units: (i) "*External Inputs*" (EI), (ii) "*External Outputs"* (EO), (iii) "*External Queries*" (EQ), (iv) "*Internal Logical Files*" (ILF), and (v) "*External Interface Files*" (EIF). After identifying the above five parameters, the unadjusted FP (UFP) are calculated by utilized the weights factors, as appeared in Table 1.

Table 1:
Well-designed Units with weighting factors

Well designed Units	Weighting Factors		
	Low	Average	High
EI	3	4	6
EO	4	5	7
EQ	3	4	6
ILF	7	10	15
EIF	5	7	10

The FP is calculated by multiplying the UFP with "*complexity adjustment factor*" (CAF), as shown in following equation:

$$FP = UFP \text{ X } CAF \quad (1)$$

Where CAF is computed by using the following equation:

$$CAF = \left[0.65 + 0.01X \sum_{i=1}^{i=14} F_i\right] \quad (2)$$

In condition (2), F_i are the general system characteristics. The detailed descriptions about these characteristics are given below:"

(F-1) *Does the structure have need of reliable backup and mending?*
(F-2)*Is the data communication essential?*
(F-3) *Are there circulated dealing out functions?* (
F-4) *Is presentation critical?*
(F-5) *Will the structure run in an active heavily utilized operational atmosphere?*
(F-6) *Does the structure require online data entry?*
(F-7) *Does the online data entry require the input operation to be built over several screens or operations?*
(F-8) *Are the master files modernized on line?*
(F-9) *Are the inputs, outputs, files, ore inquiries difficult?*
(F-10) *Is the internal processing complex?*
(F-11) *Is the code planned to be reusable?*
(F-12) Are the translation and installation integrated in the design?
(F-13) *Is the structure designed for multiple installations in dissimilar organizations?*
(F-14) *Is the application designed to smooth the progress of change and ease by the user?"*

IV. Case Study

In this area, we clarify the projected process by considering the Multinational Company (MNC).The objective of MNC is to give all the facilities to the employees related to the organization.

Layer 0: In this layer, we distinguish the requirements of MNC with the help of GOREM. In this way, to recognize the necessities, we initially refine and decomposed the MNC into sub-task and as a result we have identified the following sub-tasks:

Sub-task 0.1: Login module.

Sub-task 1.1: To Assign Employees id.

Sub-task 1.2: To generate and assign assets.

Sub-task 1.3: To assign domain and projects as per skills and the experiences.

Sub-task 1.4: To Open a salary account.

Sub-task 1.5: To Provide avail transport.

Sub-task 1.6: CEO, to examine growth and promotion of employees.

Sub-task 1.7: To Acknowledge employees effort and efficiency for appraisals and project deliverables.

Layer 1: The objective of this layer is to find out the LOC in the developer module. As we know that LOC vary from one language to another language. Therefore, to find out the LOC in the module, we will have to primary calculated the FP of the developer module. The calculation of the FP of the developer module is given in the next layer, i.e., layer 2.

Layer 2: In our study, we compute the cost of the sub-task 0, i.e., login module; and sub-task 1, i.e., To Assign Employees id.To find out the cost of the function point (FP), we identify the value of the EI, EO, EQ, ILF, and EIF. To find out the cost of these parameters, we first visualize the sub-task 0 and sub-task 1 in the same way as it would be represented on the computer screen after the implementation, as shown in Fig. 2.

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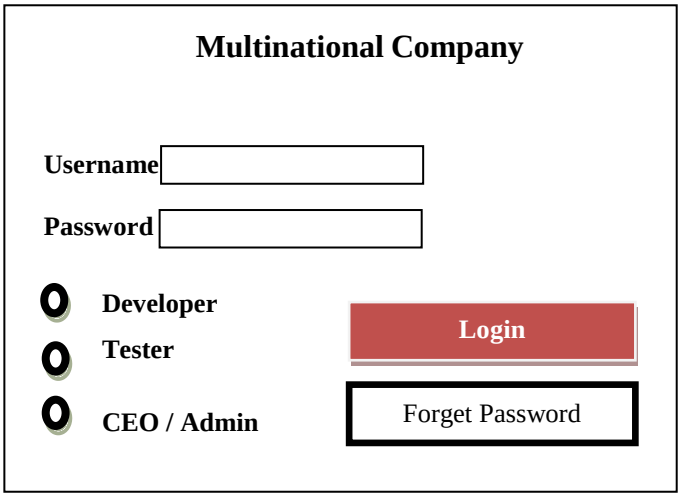

After visualizing the sub-task 1.0, the next step is to find out the value of the EI, EO, EQ, ILF, and EIF. As a consequence, we have recognized the following values for the given two sub-task:

For Sub-task 1.0: There are seven inputs, i.e., Username, Password, Developer, Tester, CEO/Admin, Login, and Forget Password (if already a employee). For new employee eight new inputs would be used, i.e., Name, Fathers Name, Date of Birth, Designation, Date of Joining, Permanent Address, Correspondence Address, Employee name. There would be three outputs depending on the type of employee. There would be one query, i.e., are you a developer or tester of this MNC? There would be one database to store the record of the developer. There is one external interface file. Finally, we have got the following values:

EI = 15; EO = 3; EQ = 1; ILF = 1; EIF = 1

For Sub-task 1: In the similar way, we have computed the following values for sub-task 1:

EI = 20; EO = 4; EQ = 1; ILF = 1; EIF = 1

In our study, we assume the average weighting factors; and the values of the general system characteristics are also average. The value of the unadjusted weighted factors for sub-task 0 and sub-task1 are given in Table 2.

Table 2:
Calculations for the UFP for sub-task 0 and sub-task 1

Functional Units	Sub-task 0		Sub-task 1	
EI	15	4	20	4
EO	3	5	4	5
EQ	1	4	1	4
ILF	1	10	1	10
EIF	1	7	1	7
UFP	96		121	

Finally, the values of the CAF for the sub-task 0 and 1 are given below:

CAF = [0.65+0.01X56] = 0.65+0.56 = 1.21 (for sub-tasks 0 and 1)

Finally, the value of the FP for sub-task 0 = 96 X 1.21 = 117 (approximately); and the value of the FP for sub-goal 1.1 = 121X1.21 = 146.

On the basis of the case study of the Chrobot [1], we identify that the cost of the implementation of the one FP in Indian software industries is $125. Therefore, on the basis of this result, we compute the cost of the sub-goals 1.0 and 1.1. As a consequence, we have the following values:

The cost of sub-task 0 = 117 X125 = $14,625 and the cost of sub-task 1 = 146X 125 = $18250.

V. Conclusions And Future Work

In this present paper, we have proposed a three layer based approach for the estimation of the cost of the software. In the proposed method there are three layers, i.e., layer 0-identification of the software requirement, layer 1-lines of code, layer 2-Function point. In our work, we have distinguished 8 sub-tasks. We have connected the proposed method to process the cost of the two sub-tasks, i.e., sub-tasks 0 and sub-tasks 1. After applying the FP, we found that the cost to execute the sub-tasks 0 and 1 are $14,625 and $18, 250, respectively. In the future it is necessary to improve cost of all sub-tasks can be implemented through multiple case studies, experiments and other methods like fuzzy based method.

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