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A Fuzzy based Approach for Function Point Analysis

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Abstract—*Function point analysis (FPA) is used to estimate functional size of software projects. There are different releases of FPA like COSMIC FFP, FPA, NESMA, Feature Points, 3D-FPA and MK-II. Based on our literature review, we identify that in FPA, crisp data is used to estimate the unadjusted function point and the value of the fourteen general system characteristics. In practical applications, several stakeholders participate during software requirements elicitation and functional size measurement activity; and they may use linguistic terminology to specify their opinion for the same base function component like external input, external output, external query, internal logical files and external interface files. Therefore, in order to address this issue, in this paper, we present a fuzzy based approach for function point analysis.*

Keywords*: FPA; NESMA; COSMIC; MK II; UFP; GSC; data movement; FSM; FUR; triangular fuzzy numbers.*

1. FUNCTION POINT ANALYSIS

Before FPA method, the size of software was measured in terms of the lines of code (LOC). To overcome the limitation of the LOC method FPA method was proposed by Alan Albrecht in late 1970's. It was the first approach to calculate software size on the basis of functionality it provides i.e., function delivered to the users. Goal of FPA is to calculate the functional size of the application from the user's point of view [11]. It is a technology independent method that easily calculates functional size of the business application and management information system. The function components are called base functional components (BFC) or measuring parameters [2, 6]. External Input (EI), External Output (EO), External Input (EI), Internal Logical Files (ILF) and External Interface Files (EIF). Each BFC is further subdivided into three categories on the basis of complexity, i.e., simple, average and complex. Each BFC is given a value on the basis of its complexity and type [2, 6]. The value of all the five BFC are then summed to give the Unadjusted Function Point (UFP) count [6].

External Input (EI) is the data that comes from external environment from the user. External Output (EO) is the information that is given to the external environment or outside the system. Eternal Queries (EQ) are combinations of question that is asked by the user. Internal Logical Files (ILF) stores logical information. External Interface Files (EIF) also stores logical information or refers to other systems. The size of the software is measured as the product of Information Processing Size and Technical Complexity Factor or Complexity Adjustment Factor (TCF or CAF). The information processing size is measured in Thousands of Lines of Code (KLOC) [13]. The total number of FP is calculated by multiplying UFP with CAF (Complexity Adjustment Factor). Fig.1 demonstrates five BFC of FPA.

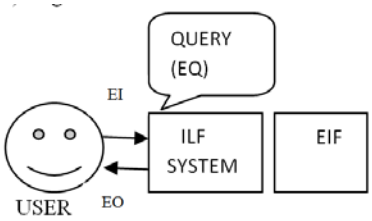

Fig. 1: FPA method showing five base function components

Complexity adjustment factor is calculated using equation (1) and the final value of the FP is calculated using equation (2).

In equation (1), DI is degree of influence that is determined on the basis of 14 General System Characteristics(GSCs) which are further rated on the scale of 0 to 5 [6]. Function Point Analysis is widely applicable to Business Applications and Management Information Systems (MIS). Weighting factors of BFC are given in Table 1.

Table 1: Weighting factors of BFC

BFC	LOW	AVERAGE	HIGH
EI	3	4	6
EO	4	5	7
EQ	3	4	6
ILF	7	10	15
EIF	5	7	10

$$CAF = 0.65 + 0.01 * DI$$

$$FP = UFP * CAF$$

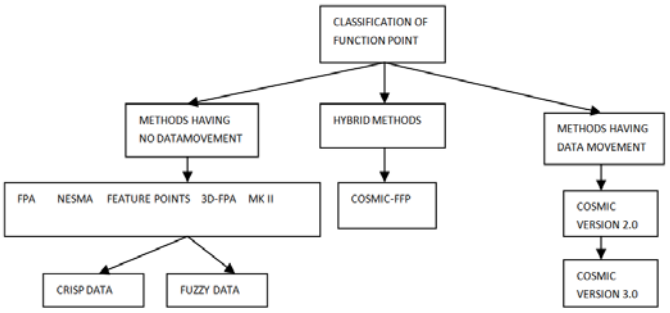

Fig. 2: Classification of FSM methods

On the basis of literature, we identify that there is a lack of classification of FSM methods. Therefore, in this section we present the classification of FSM methods on the basis of the following: (i) FPA methods that don't have data movements, (ii) FPA methods that have data movements, and (iii) Hybrid methods. In Fig.1 we visualize the proposed classification of FSM. From Fig. 2, it is clear that FPA, NESMA, 3D-FPA, Feature Points and IFPUG (all versions) do not support data movements. These methods can be called as near black box techniques as the stakeholders have no idea about their inside processes [11]. COSMIC is a method that support data movements and it is also called near white box technique. FFP is a hybrid method.

2. PROPOSED METHOD

In this section we present a fuzzy based approach for FPA. The block diagram of proposed method is given in Fig. 3.

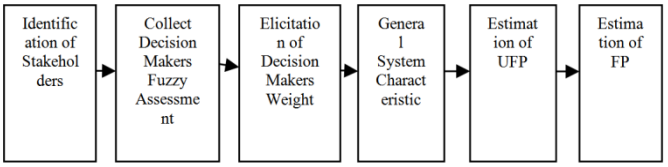

Fig. 3: Proposed Method

Step 1: Identification of stakeholder

Stakeholder identification is an important activity of a requirements elicitation process. These stakeholders may be requirements analysts, decision makers, and developers etc.

Step 2: In this step decision maker (DMs) fuzzy assessment are collected.

Step 3: To elicit the DMs weight vectors we use the $L^{-1} - R^{-1}$ inverse function arithmetic principle and graded mean integration representation [4].

Step 4: In this fourteen general system characteristic values are identified. If these values are in linguistic terms then use the $L^{-1} - R^{-1}$ inverse function arithmetic principle and graded mean integration representation [4], otherwise compute the sum of the fourteen GSC values.

Step 5: Estimation of UFP

In this step, we will estimate the unadjusted function point.

Step 6: Estimation of FP

To calculate the value of the FP, equation (1) and equation (2) would be used.

3. CASE STUDY

In this section we have applied the proposed method to estimate the size of software. This project has the following measuring parameters: EI = 5, EO = 3, EQ = 7, ILF = 4, EIF = 2. In our case study, we assume that three DMs are participating during FPA, i.e., DM_1, DM_2, and DM_3. In this case study, five ranks are used evaluate the importance of each BFC, i.e. Very Low (VL), Low (L), Average (A), High (H), and Very High (VH) (Step 1). The TFNs of linguistic values of BFC is given in Table 1.

Table 1: TFNs of linguistic values of BFC

LINGUISTIC VARIABLE SET	ABBREVIATION	TFN
VL	VERY LOW	(0.00, 0.191, 0.255)
L	LOW	(0.255, 0.321, 0.495)
A	AVERAGE	(0.495, 0.501, 0.599)
H	HIGH	(0.599, 0.655, 0.787)
VH	VERY HIGH	(0.787, 0.884, 1)

Step 2: In this DMs fuzzy assessment are collected. In Table 2, we present the fuzzy assessment of three DMs on BFC

Table 2: Fuzzy assessment of DMs

FPA ATTRIBUTES	DM1	DM2	DM3
EI	VL	L	A
EO	L	A	L
EQ	A	H	A
ILF	H	VH	H
EIF	H	A	A

Step 3: For the elicitation of the weight vectors of DMs we use the equation (3) [4].

$$TFN(w) = \frac{1}{6}(a + 4b + c) \quad (3)$$

After applying equation (3), we have identify the weights of different measuring parameters, i.e.,

EI = 0.335, EO = 0.398, EQ= 0.566, ILF=0.740, and EIF = 0.566.

Step 4: In our case study, DMs provided their preferences of fourteen GSC in linguistic terms. In Table 3, we present the evaluation of GSC by three DMs.

Table 3*:* Evaluation of weights for general system characteristics

14 GENERAL SYSTEM CHARACTERISTICS	DM1	DM2	DM3	WEIGHTS
DATA COMMUNICATION	VL	L	VL	0.226
DISTRIBUTED DATA PROCESSING	L	A	L	0.308
PERFORMANCE	H	VH	H	0.740
HEAVILY USED CONFIGURED	L	A	A	0.457
TRANSACTION RATE	H	H	A	0.616
ONLINE DATA ENTRY	L	VL	L	0.282
END USER EFFICIENCY	H	A	H	0.724
ONLINE UPDATE	L	L	VL	0.282
COMPLEX PROCESSING	A	A	L	0.457
REUSABILITY	VH	VH	H	0.813
INSTALLATION EASE	A	A	H	0.566
MULTIPLE SITES	A	H	A	0.566
FACILITATE CHANGE	H	H	VH	0.740
OPERATIONAL EASE	L	VL	VL	0.225

Step 5: The general system characteristics are assigned weights using TFN (triangular fuzzy number) as shown in Table 3. The value of UFP in our case study is 10.923.

After applying step 6, we get the value of FP = 7.176.

4. CONCLUSION AND FUTURE WORK

In this paper we present a method for estimating the value of FP under fuzzy environment when several DMs participate during FPA process. Proposed method includes the six step process, i.e., identification of stakeholder, collect decision makers fuzzy assessment, elicitation of decision maker's weight vectors, GSC, estimation of UFP, and estimation of FP. In our case study we assume that three DMs are participating in FPA process. For the given following set of information, i.e., EI = 5, EO = 3, EQ = 7, ILF = 4, EIF = 2, the value of FP = 7.176. Future work includes the following agenda:

1. To apply the proposed method on real case study
2. To apply the fuzzy based approach for other FPA methods like NESMA, COSMIC FFP, and FFP etc.

REFERENCES

[1] Ahmed M.A, Ahmed I, AlGhamdi, "Probabilistic Size Proxy for Software Effort Production: A Framework", Information and Software Technology, Elsevier, pp. 241-251, 2013, Vol. 55.

[2] Al Hajri, M Abdullah et al, "Modification of Standard Function Point Complexity Weights System", The Journal Systems and Software, Elsevier, pp 195-206.

[3] Bajaj N, Tyagi A, and Aggarwal R, "Software Estimation a Fuzzy Approach", ACM System Software Engineering Notes, Vol. 31, pp. 1-5, 2006.

[4] Cho C. C., "The Canonical Representation of Multiplication Operation on Triangular Fuzzy Numbers", The International Journal of Computers and Mathematics with Applications, pp. 1601-1610, 2003.

[5] Lee J, Lee W.T, and Kuo J.Y, "Fuzzy Logic as a Basic for Use Case Point Estimation", IEEE, International Conference on Fuzzy System, pp. 2702-2707, 2011.

[6] Lima Junior et al, "A fuzzy Model for Function Point Analysis to Development and Enhancement Project Assessments".

[7] Marin Beatriz, Pastor Oscar, Abran Alain, "Towards an Accurate Functional Size Measurement Procedure for Conceptual Models in an MDA Environment", Data and Engineering, Elsevier, Vol. 69, pp. 472-490.

[8] Morrow P, Wilkior F.G, and Mehseney I. R, "Function point Analysis Using NESMA; Simplifying the Sizing without Simplifying the Size", Software Quality Journal, Springer, Vol. 22, pp. 611-660, 2014.

[9] Sadiq Mohd, Jain S.K, "Applying Fuzzy Preference Relation for Requirements Prioritization in Goal Oriented Requirement".

[10] Sadiq Mohd, "Prediction of Software Project Effort Using Fuzzy Logic", IEEE 3rd International Conference on Electronics, Computer Technology, pp. 353-358, 2014.

[11] Santilo Luca, "Seizing and Sizing SOA Application with COSMIC Function Point".

[12] Symons Charles, "Come back Function Point Analysis (Modernised)-All is fore given.

[13] Whitmire Scott. A, "An Introduction to 3D Function Point".

[14] Xia Wei et al, "A New Calibration for Function Point Complexity Weights System", The Journal of Systems and Software, Elsevier, pp. 195-206.

[15] Ya-Fang F et al, " A Software Size Estimation Method Based on Improved FPA", 2nd Word Congress on Software Engineering, pp. 238-233, 2010.

[16] Zhu Ming-Xun et al, "A Non-Functional Requirements Trade-off Model in Trustworthy Software", IEEE, Journal of Information Sciences, pp 61-75, 2012.