Limitations of Function Point Analysis in E-Learning System Estimation

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Abstract

Function Point Analysis (FPA) is a widely accepted size estimation technique in the world. FPA is good for estimating the size of application software. In software system development process, estimation is playing very important role. The success of any software project largely depends on effective estimation of project size, effort, time and cost. Estimation helps in setting realistic targets for completing the project. E-Learning system is one of the application software packages that supports for teaching the subject. It includes assessment, testing, simulation, discussion and other significant aspects. Estimating the size of E-Learning system using FPA leads some problems. The characteristics and specifications of subject oriented software like E-learning systems not fully come under the limit of FPA specifications. So it provides wrong estimates and lead customer dissatisfaction due to incompleteness, loss and delay. This research paper focuses the limitations of FPA based on deeper analysis.

Key Words: FPA- Function point analysis, UFP- Unadjusted function points, CAF –Complexity adjustment factor, External Input(EI), External output(EO), External Inquiry(EQ), Internal logical files(ILF), External logical files(ELF).

A. Introduction

E-Learning is essentially the computer and network enabled transfer of skills and knowledge. E-Learning refers to using electronic application and process to learn. E-Learning system can have the following features. They are Document for teaching part (DTP), Assessment part, database management, security setups, etc. The document for teaching part consist of learning document which includes text, images, links, animations, simulations, Video and audio data. The existing estimation technique FPA is good for estimating the size of normal computational part of the E-Learning application. But it is not good for estimating the size of DTP. The following sections analyses the functions of FPA with the features of E-Learning system and state the limitations.

B. Function Point Analysis (FPA)

Function Point Analysis was developed first by Allan J. Albrecht in the mid 1970s. It was an attempt to overcome difficulties associated with lines of code as a measure of software size, and to assist in developing a mechanism to predict effort associated with software development. The method was first published in 1979, then later in 1983. FPA measures functionality from user's point of view. That is on the basis of what the user request and receives in return from the system. The formula for calculating function point is

FP= UFP*CAF
CAF-Complexity adjustment factor
UFP- Unadjusted function points
The calculation of CAF and UFP are shown below.

UFP- Unadjusted function points Calculation

The Unadjusted Function points can be calculated based on the counts of following five functional components. They are

1). *External Inputs (EI),*
2). External Outputs (EO),
3). External Inquiry (EQ),
4). Internal Logical Files (ILF's),
5). External Interface Files (EIF's).

External Inputs (EI): is an elementary process in which data crosses the boundary from outside to inside. This data may come from a data input screen or another application. The data may be used to maintain one or more internal logical files. The data can be either control information or business information.

External Outputs (EO): is an elementary process in which derived data passes across the boundary from inside to outside.

External Inquiry (EQ): an elementary process with both input and output components that result in data retrieval from one or more internal logical files and external interface files.

Internal Logical Files (ILF's) : a user identifiable group of logically related data that resides entirely within the applications boundary and is maintained through external inputs.
External Interface Files (EIF's): a user identifiable group of logically related data that is used for reference purposes only. The data resides entirely outside the application and is maintained by another application. The external interface file is an internal logical file for another application.

Rating of components
After the components have been classified as one of the five major components (EI's, EO's, EQ's, ILF's or EIF's), a ranking of low, average or high is assigned. The following table 1 shows functional components, weighting factors and the rate of weights.

(Table 1: Functional Units and Weighting Factors)

Functional Units	**Weighting factors**		
	LOW	**AVERAGE**	**HIGH**
EI	3	4	6
EO	4	7	7
EQ	3	4	6
ILF	7	10	15
ELF	5	7	10

The counts for each level of complexity for each type of component can be entered into Table 2,ie shown below. Each count is multiplied by the numerical rating shown to determine the rated value. The rated values on each row are summed across the table, giving a total value for each type of component. These totals are then summed across the table, giving a total value for each type of component. These totals are then summed down to arrive at the Total Number of Unadjusted Function Points.

Table 2. Table Used for calculating UFP

Type of Component	Complexity levels			
	LOW	Average	HIGH	Total
EI	__*3=__	__*4=__	__*6=__	
EO	__*4=__	__*5=__	__*7=__	
EQ	__*3=__	__*4=__	__*6=__	
ILF	__*7=__	__*10=__	__*15=__	
EIF	__*5=__	__*7=__	__*10=__	
Total Number of Unadjusted Function Points				

CAF-Complexity adjustment factor Calculation
The complexity adjustment factor (CAF) is based on 14 general system characteristics (GSC's) that rate the general functionality of the application being counted. Each characteristic has associated descriptions that help determine the degrees of influence of the characteristics. The degrees of influence range on a scale of zero to five, from no influence to strong influence. The table 3 is intended to provide an overview of each GSC.

Table 3 Description of Complexity Adjustment Factors

General System Characteristic		Brief Description
1.	Data communications	How many communication facilities are there to aid in the transfer or exchange of information with the application or system?
2.	Distributed data processing	How are distributed data and processing functions handled?
3.	Performance	Was response time or throughput required by the user?
4.	Heavily used configuration	How heavily used is the current hardware platform where the application will be executed?
5.	Transaction rate	How frequently are transactions executed daily, weekly, monthly, etc.?
6.	On-Line data entry	What percentage of the information is entered On-Line?
7.	End-user efficiency	Was the application designed for end-user efficiency?
8.	On-Line update	How many ILF's are updated by On-Line transaction?
9.	Complex processing	Does the application have extensive logical or mathematical processing?
10.	Reusability	Was the application developed to meet one or many user's needs?
11.	Installation ease	How difficult is conversion and installation?
12.	Operational ease	How effective and/or automated are start-up, back-up, and recovery procedures?
13.	Multiple sites	Was the application specifically designed, developed, and supported to be installed at multiple sites for multiple organizations?
14.	Facilitate change	Was the application specifically designed, developed, and supported to facilitate change?

Once all the 14 GSC's have been answered, they should be tabulated using Complexity Adjustment Equation (CAE) .Rate of factors varies from 0 to 5. The given factor not used in system then rate is 0. Otherwise the rate of a given factor is represented based on its influence.

0 - No influence
1 - Incidental
2 - Moderate
3 - Average
4 - Significant
5 - Essential

$$\mathbf{CAF = 0.65+0.01(\sum Fi)}$$

i = is from 1 to 14 representing each GSC.

where: Fi = degree of influence for each General System Characteristic. It is summation of all 14 GSC's

C. E-Learning System Features vs FPA

E-Learning is essentially the computer and network enabled transfer of skills and knowledge. It refers to using electronic application and process which is Web based learning, Computer based learning, Virtual class rooms and digital collaboration. E-Learning content is delivered via the internet, intranet/ extranet, audio/video tape, satellite TV and CD-ROM. It includes media in the form of texts, animation, simulation, streaming video and audio. A Plenty of benefits can be provided for the organizations and individuals through E-Learning. They are

a) Improved performance

A 12 year Meta analysis of research by US department of education found that higher education students in online learning generally performed better than those in face to face course.

b) Increased access

Instructors of the highest caliber can share knowledge across borders, allowing students to attend courses across physical, political and economic boundaries.(Ex. MIT Open Course Ware)

c) Convenience and flexibility to learners

Learning sessions are open in all time (24*7).

d) To develop the skills and competencies needed in the 21st century. (People must need computer skills in their discipline-[Bates 2009].)

e) No need to travel for study. It reduces cost and save time.
f) Access public content.
g) Access courses from variety of locations.

Market of E-Learning system is growing year by year. But the growth rate will be varying based on countries like technically and economically developed and developing[17,18]. But E-Learning system development process is in crises because under estimation or over estimation. FPA also not considered the needful features to be estimate. The following table 4 shows the features of E-Learning system and FPA.

Table 4: Considerable Features needed for E-Learning system Estimation with FPA.

Features	FPA
Technology	Parametric / Proxy based / Algorithmic method
Past project experience	Necessary for producing effective parameters for estimation
Time	Time reduced
Accuracy	Accurate according to the specifications of FPA. but for Web/GUI based applications it is not good
Dependency	Language Dependent
cost	Cost is less for estimation
quality	Good for procedure oriented programming
Reusability	Little bit considered
GUI support	Little bit Supported
Database	Little bit considered
Networking	Little bit considered
Storage	Little bit considered
Distribution	Little bit considered
Multimedia specialization	Nil
Effort of special effects	Nil
Consideration of animation	Nil
Simulation	Nil

D. Case Studies

Project 1: Other than E-Learning System

Consider a software project with the following functional units No of user inputs(EI) = 50, NO of outputs (EO) = 40, No Inquires (EQ) = 35, ILF = 06, El F = 04. Assume all complexity adjustment factors and weighting factors are average. Compute FP

Calculating Unadjusted Function Points are shown below

Functional Units	Weighting factors			
	LOW	AVERAGE	HIGH	Total
EI	0 * 3 = 0	50 * 4 = 200	0 * 6 = 0	200 (0+200+0)
EO	0 * 4= 0	40 * 5 = 200	0 * 7 = 0	200
EQ	0 * 3 = 0	35 * 4 = 140	0 * 6 = 0	140
ILF	0 * 7 = 0	6 * 10 = 60	0 * 15 = 0	60
ELF	0 * 5 = 0	4 * 7 = 28	0 * 10 = 0	28
		Total		628

Calculating complexity adjustment Factors are shown below

All complexity adjustment factors are average.

Therefore CAF = 0.65+0.01(∑Fi)

i= 1 to 14

= (0.65+0.01* (14*3) : Rate for average is 3

= 0.65 + 0.42 = 1.07

Calculating FP

FP = UFP * CAF

= 628 * 1.07

= 672

Project 2: E-Learning System

Consider an E-Learning software project with the following functional units. No of user inputs(EI) = 50, NO of outputs (EO) = 40, No Inquires (EQ) = 35, ILF = 06, El F = 04. Assume all complexity adjustment factors and weighting factors are average. It has 3 minutes of animation and 5 minutes 0f video clips. Compute FP.

Sol.:

It will calculate FP as 672

But it never considers the animation and video clips size.

So these case studies justifies FPA is not opt for E-Learning system estimation .

E. Limitations

- **Calculate Function points but not good for all programming languages**
- **Again LOC is good for estimating the size of system programs, scientific programs and networking programs**

- **Incase of E-Learning system, FPA not considered the size of simulations, animations and additional document effects.**
- **E-Learning system holds huge volume of data. FPA Little bit considered the data storage**
- **E-Learning system need high end networking facilities with full synchronization. FPA not much considering data transfer facilities.**
- **E-Learning system has fund transfer facilities. So high end security codes are necessary. Each line of this code has much weight. FPA does not provide importance to this code.**
- **So we may use FPA for E-Learning system estimation, ie leads wrong estimates.**

VI. Conclusion

The above stated analysis and case study describes that FPA is not fully supporting for estimating E-Learning system. So for E-Learning system we need a special Sizing approach or modifications needed in FPA.

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