CSE4708: Software Project Management

Unit II : Project Evaluation & Estimation

Topic: Cost Benefit Analysis Techniques, Albrecht Function Point Analysis

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Economic Assessment

Time Value of the Profit

Calculating the Current Worth

- Assume that you invest 100,000 USD in a project. You expect to earn a 10,000 USD profit after one year.
- Considering a yearly inflation of 5%, what will the current value be?

Time Value of the Profit

- The formula to find the Current Value is
  - FV = CV x (1+r/100)^n
  - Here, FV = Future Value, CV = Current Value, r = Inflation, n = time
  - Given values,
  - FV = 10,000 USD
  - r = 5 , n =1
  - Putting these values in the formula,
  - 10,000 = CV X (1+0.05)^1
  - CV = 10,000/1.05
  - CV = 9,523.80
  - Therefore, the current value of your profit is 9,523.80 USD.

Internal rate of return

- Internal rate of return (IRR) is the discount rate that would produce an NPV of 0 for the project
- Can be used to compare different investment opportunities

Function Point Analysis

Albrecht Function Point Analysis

- Allan J. Albrecht initially developed function Point Analysis in 1979 at IBM.
- it has been further modified by the International Function Point Users Group (IFPUG).
- FPA is used to make estimate of the software project, including its testing in terms of functionality or function size of the software product.

Albrecht Function Point Analysis

- The basic and primary purpose of the functional point analysis is to measure and provide the software application functional size to the client, customer, and the stakeholder on their request.
- Further, it is used to measure the software project development along with its maintenance, consistently throughout the project irrespective of the tools and the technologies.

Albrecht Function Point Analysis

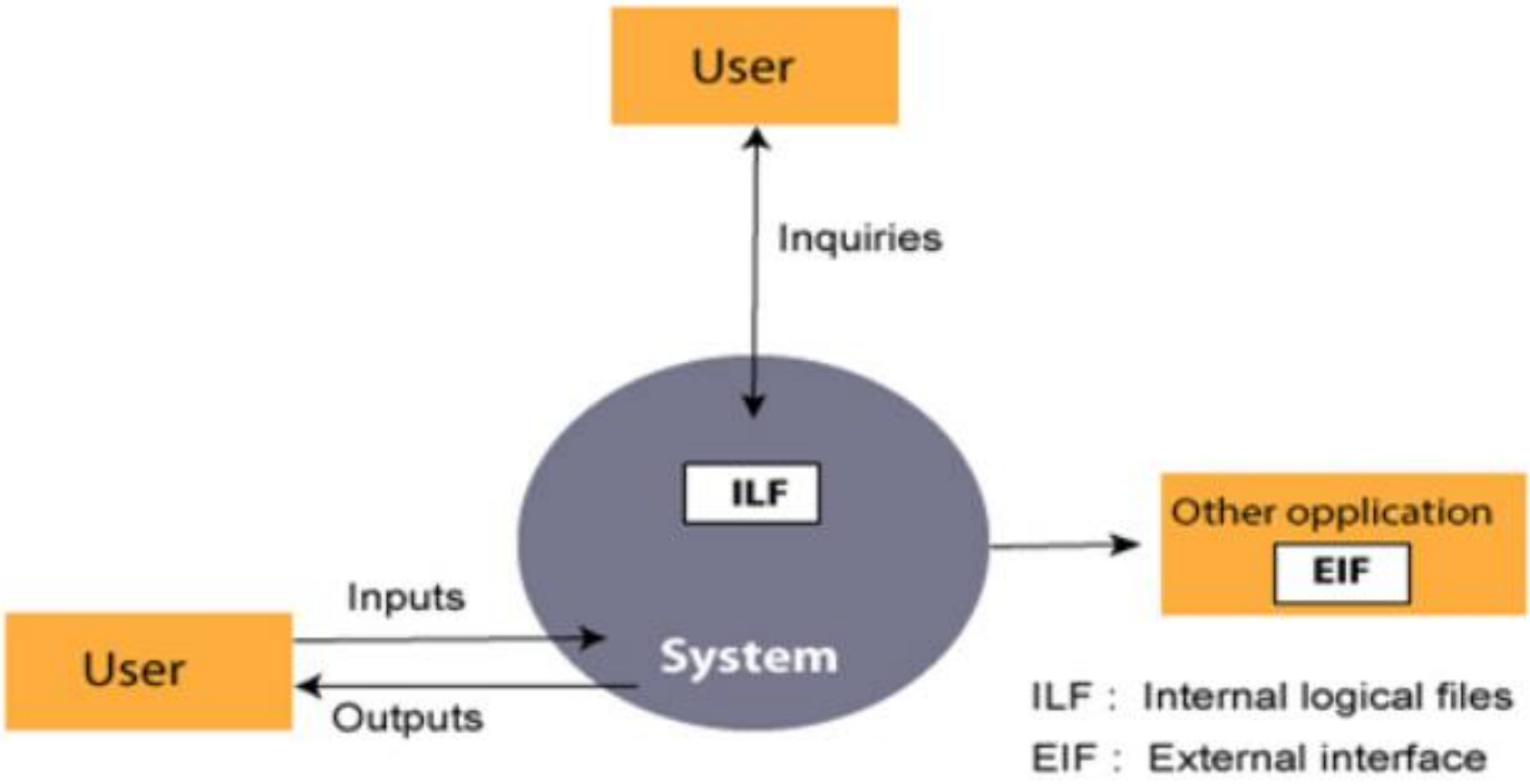
- FPs of an application is found out by counting the number and types of functions used in the applications. All these parameters are then individually assessed for complexity.

Types of FP Attributes

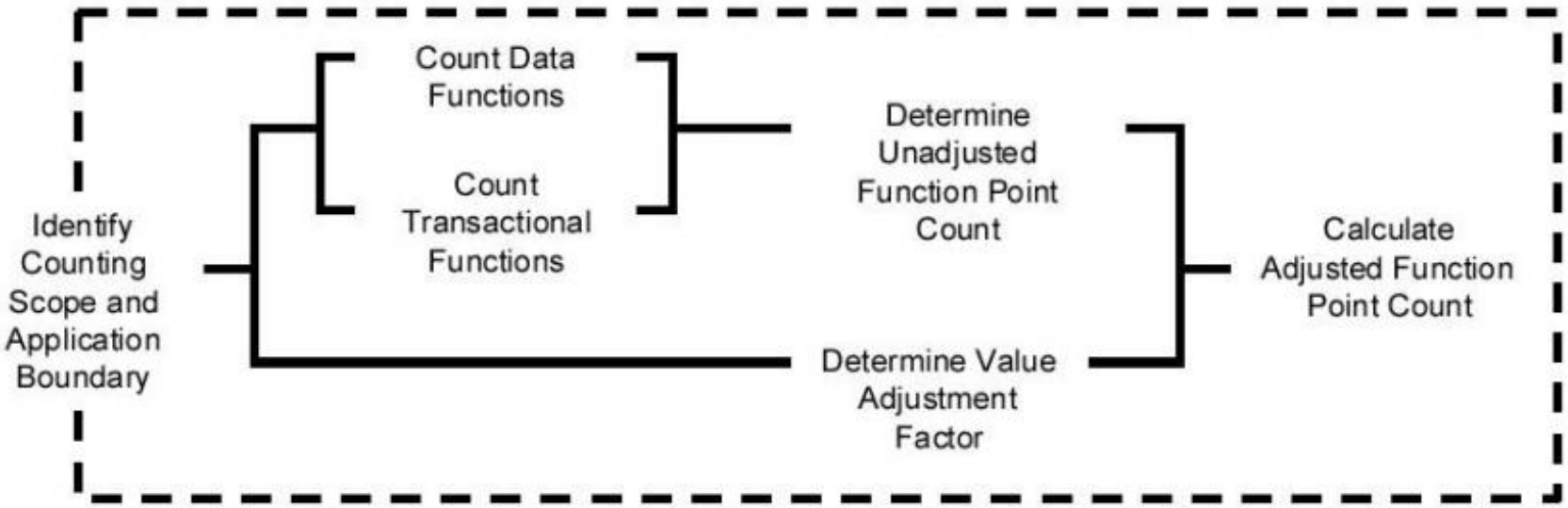
Measurements Parameters	Examples
1.Number of External Inputs(EI)	Input screen and tables
2. Number of External Output (EO)	Output screens and reports
3. Number of external inquiries (EQ)	Prompts and interrupts.
4. Number of internal files (ILF)	Databases and directories
5. Number of external interfaces (EIF)	Shared databases and shared routines.

Albrecht Function Point Analysis

The FPA functional units are shown in Fig:

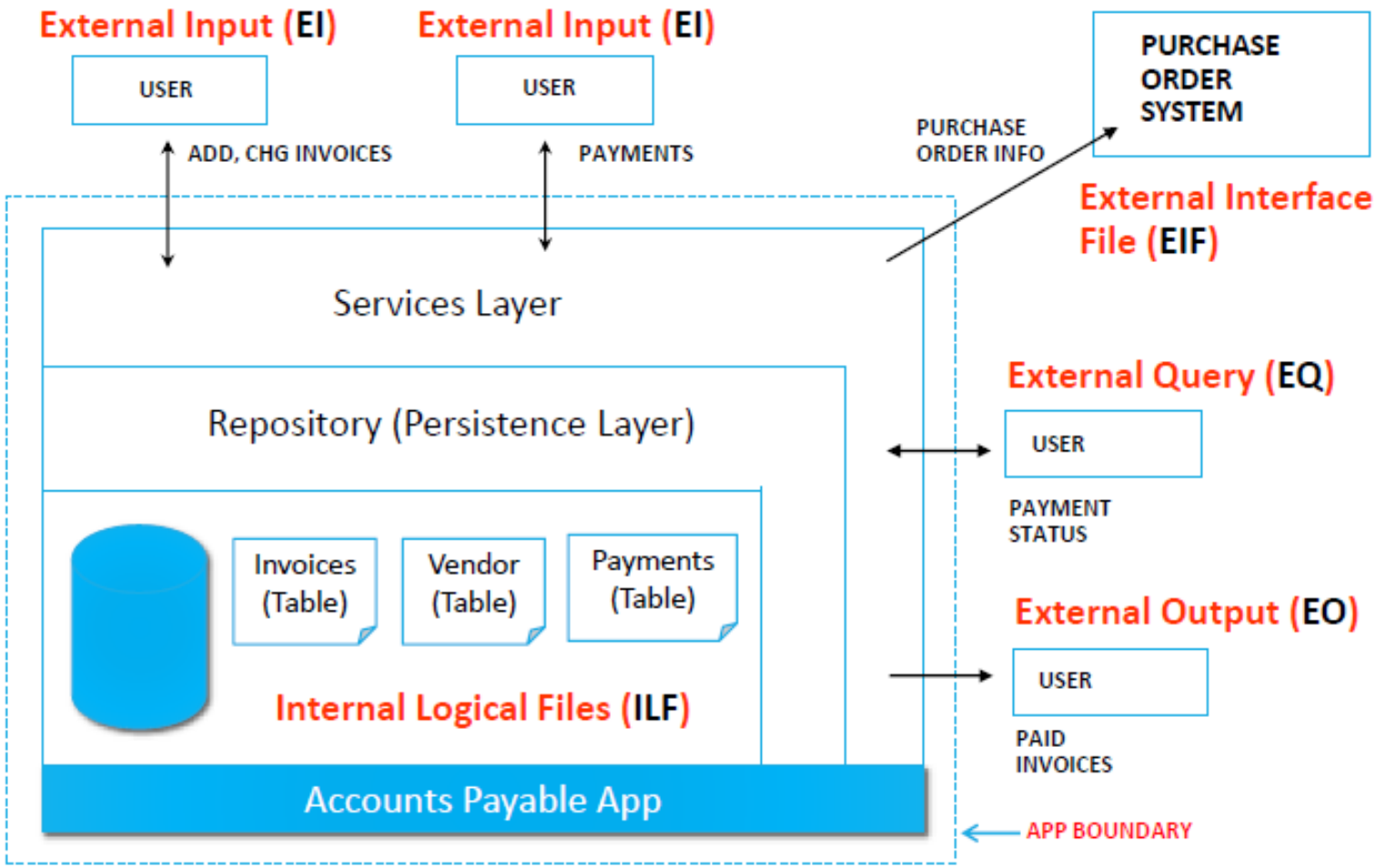


Albrecht Function Point Analysis



Albrecht Function Point Analysis

FP Data & Transaction Functionality



Albrecht Function Point Analysis

1. All these parameters are then individually assessed for complexity.
2. FP characterizes the complexity of the software system and hence can be used to depict the project time and the manpower requirement.
3. The effort required to develop the project depends on what the software does.
4. FP is programming language independent.
5. FP method is used for data processing systems, business systems like information systems.
6. The five parameters mentioned above are also known as information domain characteristics.

Albrecht Function Point Analysis

7. All the parameters mentioned above are assigned some weights that have been experimentally determined and are shown in Table

Weights of 5-FP Attributes

Measurement Parameter	Low	Average	High
1. Number of external inputs (EI)	7	10	15
2. Number of external outputs (EO)	5	7	10
3. Number of external inquiries (EQ)	3	4	6
4. Number of internal files (ILF)	4	5	7
5. Number of external interfaces (EIF)	3	4	6

Albrecht Function Point Analysis

- The functional complexities are multiplied with the corresponding weights against each function, and the values are added up to determine the UFP (Unadjusted Function Point) of the subsystem.
- Here that weighing factor will be simple, average, or complex for a measurement parameter type.
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Measurement Parameter	Count		Weighing factor			
			Simple	Average	Complex	
1. Number of external inputs (EI)	—	*	3	4	6 =	—
2. Number of external Output (EO)	—	*	4	5	7 =	—
3. Number of external Inquiries (EQ)	—	*	3	4	6 =	—
4. Number of internal Files (ILF)	—	*	7	10	15 =	—
5. Number of external interfaces(EIF)	—	*	5	7	10 =	—
Count-total →						

Albrecht Function Point Analysis

- The Function Point (FP) is thus calculated with the following formula.

$$FP = \text{Count-total} * [0.65 + 0.01 * \Sigma(f_i)]$$

$$= \text{Count-total} * CAF$$

where Count-total is obtained from the above Table.

$$CAF = [0.65 + 0.01 * \Sigma(f_i)]$$

- CAF - Complexity Adjustment Factor

Albrecht Function Point Analysis

- and $\sum(f_i)$ is the sum of all 14 questionnaires and show the complexity adjustment value/ factor-CAF (where i ranges from 1 to 14).
- Also note that $\sum(f_i)$ ranges from 0 to 70, i.e.,

$$0 <= \sum(f_i) <= 70$$

and CAF ranges from 0.65 to 1.35 because

- When $\sum(f_i) = 0$ then CAF = 0.65
- When $\sum(f_i) = 70$ then CAF = 0.65 + (0.01 * 70) = 0.65 + 0.7 = 1.35

Albrecht Function Point Analysis

- General System Characteristics

Data communications
Distributed functions
Performance
Heavily used configuration
Transaction rate
On-line data entry
End-user efficiency
On-line update
Complex processing
Reusability
Installation ease
Operational ease
Multiple sites
Facilitate change

Albrecht Function Point Analysis

- General System Characteristics

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

General System Characteristics (GSCs)	Degree of Influence (DI) 0 - 5
1. Data Communications	_____
2. Distributed Data Processing	_____
3. Performance	_____
4. Heavily Used Configuration	_____
5. Transaction Rate	_____
6. Online Data Entry	_____
7. End-User Efficiency	_____
8. Online Update	_____
9. Complex Processing	_____
10. Reusability	_____
11. Installation Ease	_____
12. Operational Ease	_____
13. Multiple Sites	_____
14. Facilitate Change	_____
Total Degree of Influence (TDI)	_____
Value Adjustment Factor (VAF)	_____
	VAF = (TDI * 0.01) + 0.65

Albrecht Function Point Analysis

Based on the FP measure of software many other metrics can be computed:

- Errors/FP
- $/FP.
- Defects/FP
- Pages of documentation/FP
- Errors/PM.
- Productivity = FP/PM (effort is measured in person-months).
- $/Page of Documentation.

Albrecht Function Point Analysis

8. LOCs of an application can be estimated from FPs. That is, they are inter-convertible. **This process is known as backfiring**. For example, 1 FP is equal to about 100 lines of COBOL code.

9. FP metrics is used mostly for measuring the size of Management Information System (MIS) software.

10. But the function points obtained above are unadjusted function points (UFPs). These (UFPs) of a subsystem are further adjusted by considering some more General System Characteristics (GSCs). It is a set of 14 GSCs that need to be considered.

Albrecht Function Point Analysis

The procedure for adjusting UFPs is as follows:

- Degree of Influence (DI) for each of these 14 GSCs is assessed on a scale of 0 to 5. (b) If a particular GSC has no influence, then its weight is taken as 0 and if it has a strong influence then its weight is 5.
- The score of all 14 GSCs is totaled to determine Total Degree of Influence (TDI).
- Then Value Adjustment Factor (VAF) is computed from TDI by using the formula:

VAF = (TDI * 0.01) + 0.65

Albrecht Function Point Analysis

- Remember that the value of VAF lies within 0.65 to 1.35 because
  - When TDI = 0, VAF = 0.65
  - When TDI = 70, VAF = 1.35
- VAF is then multiplied with the UFP to get the final FP count: **FP = VAF * UFP**

Albrecht Function Point Analysis

Compute the function point, productivity, documentation, cost per function for the following data:

- Number of user inputs = 24
- Number of user outputs = 46
- Number of inquiries = 8
- Number of files = 4
- Number of external interfaces = 2
- Effort = 36.9 p-m
- Technical documents = 265 pages
- User documents = 122 pages
- Cost = $7744/ month
- Various processing complexity factors are: 4, 1, 0, 3, 3, 5, 4, 4, 3, 3, 2, 2, 4, 5.

Albrecht Function Point Analysis

Measurement Parameter	Count		Weighing factor
1. Number of external inputs (EI)	24	*	4 = 96
2. Number of external outputs (EO)	46	*	4 = 184
3. Number of external inquiries (EQ)	8	*	6 = 48
4. Number of internal files (ILF)	4	*	10 = 40
5. Number of external interfaces (EIF) Count-total →	2	*	5 = 10 378

Albrecht Function Point Analysis

So sum of all f_i ($i \leftarrow 1$ to 14) = 4 + 1 + 0 + 3 + 5 + 4 + 4 + 3 + 3 + 2 + 2 + 4 + 5 = 43

FP = Count-total * [0.65 + 0.01 *$\Sigma(f_i)$]

= 378 * [0.65 + 0.01 * 43]

= 378 * [0.65 + 0.43]

= 378 * 1.08 = 408

$$\text{Productivity} = \frac{\text{FP}}{\text{Effort}} = \frac{408}{36.9} = 11.1$$

Total pages of documentation = technical document + user document

= 265 + 122 = 387pages

Documentation = Pages of documentation/FP

= 387/408 = 0.94

Albrecht Function Point Analysis

$$\text{Cost per function} = \frac{\text{cost}}{\text{productivity}} = \frac{7744}{11.1} = \$700$$

Albrecht Function Point Analysis

Differentiate between FP and LOC

FP	LOC
1. FP is specification based.	1. LOC is an analogy based.
2. FP is language independent.	2. LOC is language dependent.
3. FP is user-oriented.	3. LOC is design-oriented.
4. It is extendible to LOC.	4. It is convertible to FP (backfiring)