Bahria University-Karachi Campus

Software Project Management

Fall-2024

Week 07

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جامعہ بحریہ، واقعگاہ کراچی

EARNED VALUE ANALYSIS

- EV is the money you *should* have spent on the work that was actually done.
- Example: Imagine a project consisting of 3 activities. You have completed activities 1 and 2 so far. The planned cost for activity 1 is $2,500 and $1,000 for activity 2. You have spent $3,700 up to now. Then the Earned Value for the project at the current point in time is $2,500 + $1,000 = $3,500

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FUNCTION POINT ANALYSIS

- Function Point Analysis (FPA) was developed by Allan Albrecht of IBM, and first published in 1979.
- In 1984, the International Function Point Users Group (IFPUG) was formed in order to create and standardize the rules and promote the system usage.
- The system is analyzed from two sides, always from the *user's point of view*, based on *what is requested* and *received in return*.

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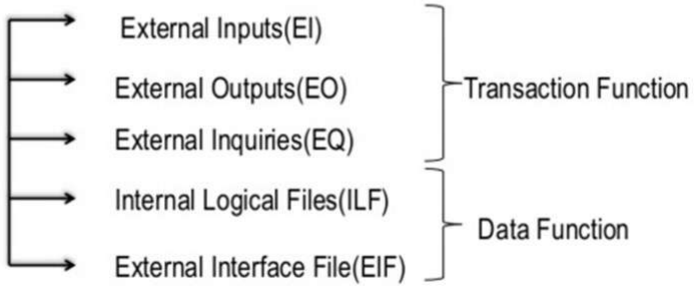
FUNCTIONAL SIZE

- The product of this analysis are the **Unadjusted Function Points (UFP)**.
- It includes both *data* and *transactional* functions.



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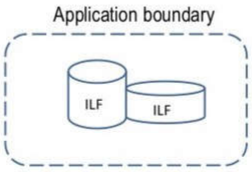
DATA FUNCTIONS

- The data functions are usually classified as:

1. The Internal Logical Files (ILF) which are the *tables* or other *data files* that are *modified* by the application.

ILF is a database entity which resides within the application boundary and which is maintained(added, changed, deleted, updated) by the application itself.



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DATA FUNCTIONS

2. The External Interface Files (EIF) that are *never modified* and only *referenced* by the application.

EIF is any kind of file which the application cannot modify but can use the data for its use or to manipulate the result.
Example : Tax calculation(VAT).

Search results based on the info. processed by external database

External database

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- In web applications, these usually translate to *database tables*, but in some other types of software these can be other types of files.

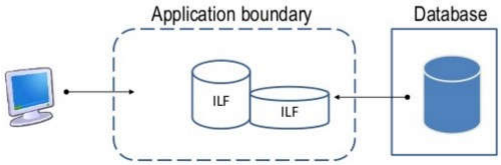
TRANSACTIONAL FUNCTIONS

- There are traditionally three categories for this type of functions:

1. External Input (EI) is a transaction function in which Data goes "*into*" the application from outside the boundary to inside. This data is coming external to the application.

- This data may alter an *ILF* or modify the state or behavior of the system while having meaning in terms of business logic and leaving the system on a *consistent* state when it finishes.

External input, is a process where the data crosses the boundary from outside to inside the application boundary.



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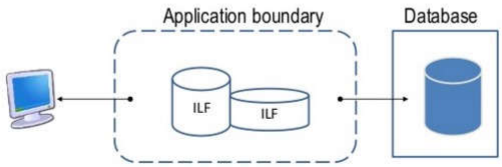
TRANSACTIONAL FUNCTIONS

2. The second type are External Outputs (EO) that calculate a value or update an *ILF*.

- External Output (EO) is a transaction function in which data comes "*out*" of the system.
- Additionally, an EO may update an ILF. The data creates reports or output files sent to other applications.

External Output, is a process where in the data comes "out" of the system.

Means "DATA IS PROCESSED"



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TRANSACTIONAL FUNCTIONS

3. The last type, the External Inquiries (EQ) present data directly from the *ILF* without any calculation.

- External Inquiry (EQ) is a transaction function with both input and output components that result in *data retrieval*.

External Enquiry, is something which is fetched from the database and provided to the user with some sorting, indexing.

Means "DATA IS NOT PROCESSED"

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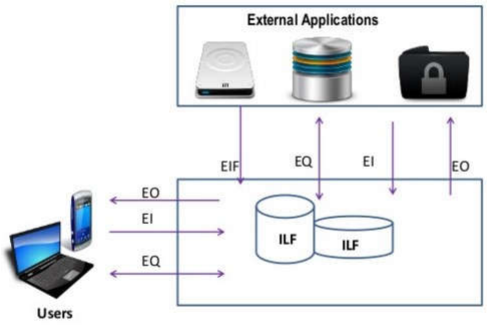
VISUAL REPRESENTATION



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FUNCTION POINT ANALYSIS

- A function point is a "*unit of measurement*" to express the amount of business *functionality* an information system (as a product) provides to a user.
- Each function point is ranked according to *complexity*; low, average, high.
- There exists *predefined weights* for each function point in each category:

Functional Units	Weighing Factor		
	Low	Average	High
EI	3	4	6
EO	4	5	7
EQ	3	4	6
ILF	7	10	15
EIF	5	7	10

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FUNCTION POINT ANALYSIS

- How to assign weights or rank to F.Ps?
  - *Depends on the organization (based on past projects).*

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CALCULATION OF UFP

- The method provides a matrix that assigns a number of *Function Points (FP)* to each of the types of functions, on different levels of complexity (traditionally three: low, average and high complexities).
- For each function, the complexity is estimated, and the correspondent value on the table is obtained.
- The sum of these values for all the functions is the *UFP*. This represents the functional size of the project.

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THE VALUE ADJUSTMENT FACTOR (VAF)

- The traditional version provides 14 General System Characteristics (GSCs), like "data communication" or "performance", that are rated, usually from 0 (low) to 5 (high) that are then added to obtain the Total Degree of Influence (TDI).
- This total degree of influence is then incorporated into this formula to obtain the VAF:

$$\text{VAF} = (\text{TDI} \times 0.01) + 0.65$$

$\text{VAF} \equiv$ Value Adjustment Factor
$\text{TDI} \equiv$ Total Degree of Influence

- The VAF is a value that can range from 0.65 to 1.35 which is multiplied with the UFP in order to obtain the Adjusted Function Points (AFP).

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14 Factors in Function Point Analysis Complexity

#	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	Did the user require response time or throughput?
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 online?
7	End-user Efficiency	Was the application designed for end-user efficiency?
8	Online Update	How many ILFs are updated by online 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?

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Degree of Influence

RATING	DEGREE OF INFLUENCE
0	Not present, or no influence
1	Incidental influence
2	Moderate influence
3	Average influence
4	Significant influence
5	Strong influence throughout

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Function Type	Functional Complexity		Complexity Totals	Function Type Totals
ILFs	____ Low	X 7 =	____	
	____ Average	X 10 =	____	
	____ High	X 15 =	____	____
EIFs	____ Low	X 5 =	____	
	____ Average	X 7 =	____	
	____ High	X 10 =	____	____
EIs	____ Low	X 3 =	____	
	____ Average	X 4 =	____	
	____ High	X 6 =	____	____
EOs	____ Low	X 4 =	____	
	____ Average	X 5 =	____	
	____ High	X 7 =	____	____
EQs	____ Low	X 3 =	____	
	____ Average	X 4 =	____	
	____ High	X 6 =	____	____
		Total Unadjusted Function Point Count		____

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

$$FP = UFP \times VAF$$

STEPS TO SOLVE FPA

- Steps:

1. Count EI, EO, EQ, ILF, & EIF from the requirements
2. Assign weights to EI, EO, EQ, ILF, & EIF according to your own judgment
3. Multiply counts of EI, EO, EQ, ILF, & EIF by weights of EI, EO, EQ, ILF, & EIF
4. Sum the products to get **UFP**
5. Assign degree of involvement (any value from 0 – 5) to 14 general system characteristics
6. Sum the values assigned to 14 general system characteristics to get **TDI**
7. Calculate VAF by the formula: **VAF** = (TDI x 0.01) + 0.65
8. Calculate FP by the formula: **FP** = **UFP** x **VAF**

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Function Type	Estimated Count	Weight	FP-Count
EI	24	(Average) 4	96
EO	16	(Average) 5	80
EQ	22	(Average) 4	88
ILF	4	(Average) 10	40
ELF	2	(Average) 7	14
UFP count			**318**

Functional Units	Weighing Factor		
	Low	Average	High
EI	3	4	6
EO	4	5	7
EQ	3	4	6
ILF	7	10	15
EIF	5	7	10

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
2. Distributed Data Processing	0
3. Performance	5
4. Heavily Used Configuration	5
5. Transaction Rate	2
6. Online Data Entry	4
7. End-User Efficiency	3
8. Online Update	5
9. Complex Processing	4
10. Reusability	5
11. Installation Ease	4
12. Operational Ease	3
13. Multiple Sites	4
14. Facilitate Change	5
Total Degree of Influence (TDI)	52
Value Adjustment Factor (VAF)	1.17

$VAF = 52 * 0.01 + 0.65$
$= 1.17$
$FP_{estimated} = 318 \times 1.17$
$= 372$

AN EXAMPLE

General System Characteristics (GSCs)	Degree of Influence (DI) 0 - 5
1. Data Communications	2
2. Distributed Data Processing	0
3. Performance	5
4. Heavily Used Configuration	5
5. Transaction Rate	2
6. Online Data Entry	4
7. End-User Efficiency	3
8. Online Update	5
9. Complex Processing	4
10. Reusability	5
11. Installation Ease	4
12. Operational Ease	3
13. Multiple Sites	4
14. Facilitate Change	5
Total Degree of Influence (TDI)	52
Value Adjustment Factor (VAF)	1.17

EXAMPLE 1

- (VAF = 51 * 0.01 + 0.65)

VAF = 52 * 0.01 + 0.65
= 1.17
$FP_{estimated}$ = 318 x 1.17
= 372

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EXAMPLE 2

- Given the following values, compute F.P. when all complexity adjusted factors and weighing factors are as given below:

  User I/O=50 (Low)

  User O/P=40 (Ave)

  User Inquiries=35 (High)

  User Files=6 (Low)

  External Interfaces=4 (Ave)

Functional Units	Weighing Factor		
	Low	Average	High
EI	3	4	6
EO	4	5	7
EQ	3	4	6
ILF	7	10	15
EIF	5	7	10

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EXAMPLE

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

1. Number of user inputs = 24
2. Number of user outputs = 46
3. Number of inquiries = 8
4. Number of files = 4
5. Number of external interfaces = 2
6. Effort = 36.9 p-m
7. Technical documents = 265 pages
8. User documents = 122 pages
9. Cost = $7744/ month

Various processing complexity factors are: 4, 1, 0, 3, 3, 5, 4, 4, 3, 3, 2, 2, 4, 5.

EXAMPLE

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

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

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

$= 378 * [0.65 + 0.01 * 43]$

$= 378 * [0.65 + 0.43]$

$= 378 * 1.08 = 408$

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

Functional Units	Weighing Factor		
	Low	Average	High
EI	3	4	6
EO	4	5	7
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EXAMPLE

Total pages of documentation = technical document + user document
= 265 + 122 = 387pages

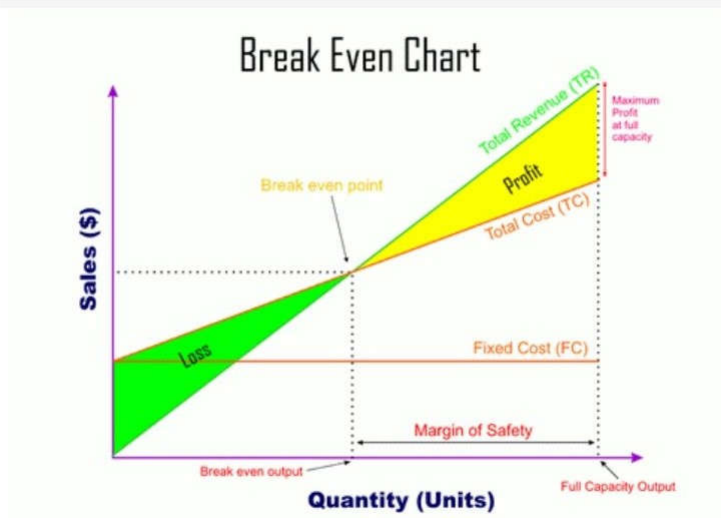
Documentation = Pages of documentation/FP
= 387/408 = 0.94

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

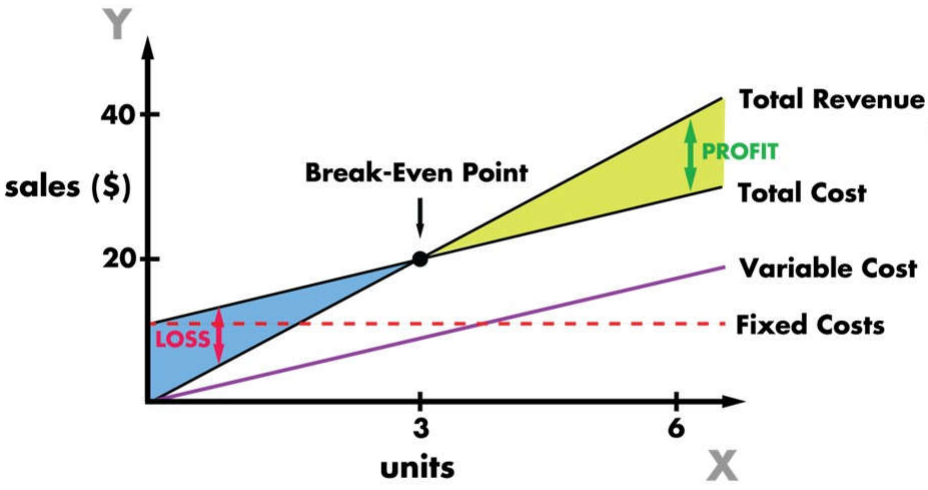
THE ECONOMICS OF RE-ENGINEERING

1. Earned Value Analysis
2. Function Point Analysis (FPA)
3. Break-Even Analysis
4. Return On Investment

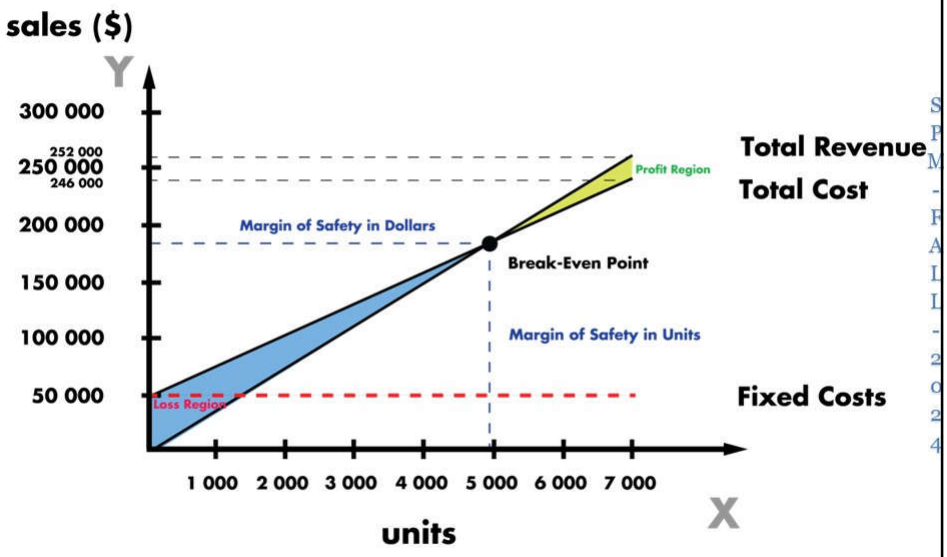
BREAK-EVEN ANALYSIS (GRAPHICALLY)



BREAK-EVEN ANALYSIS (GRAPHICALLY)



BREAK-EVEN ANALYSIS (GRAPHICALLY)



BREAK-EVEN ANALYSIS (FORMULA)

$$\text{Break-even point} = \frac{F}{1 - \frac{V}{P}}$$

Where,

F = Fixed cost

V = Variable cost per unit

P = Selling price of each unit

EXAMPLE

- Fixed Costs:
  - Course development and platform maintenance: $100,000 per year
  - Marketing and administrative expenses: $50,000 per year
  - Total fixed costs: $150,000 per year
- Variable Costs per Student:
  - Instructional materials and online platform usage fees: $50 per student
  - Faculty compensation: $100 per student
  - Total variable costs per student: $150
- Course Fee per Student: $300

EXAMPLE

- Now, let's calculate the break-even point, which is the point at which total revenue equals total costs.
- Break-even Point (in terms of number of students):

Break-even Point (in terms of number of students):

$$\text{Break-even Point} = \frac{\text{Fixed Costs}}{\text{Revenue per Student} - \text{Variable Costs per Student}}$$

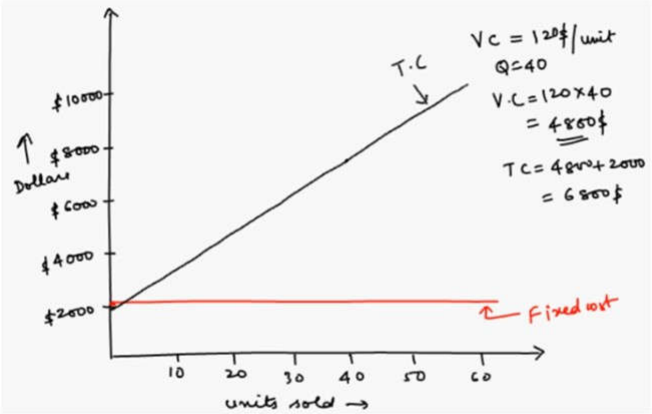
$$\text{Break-even Point} = \frac{\$150{,}000}{(\$300 - \$150)}$$

$$\text{Break-even Point} = \frac{\$150{,}000}{\$150}$$

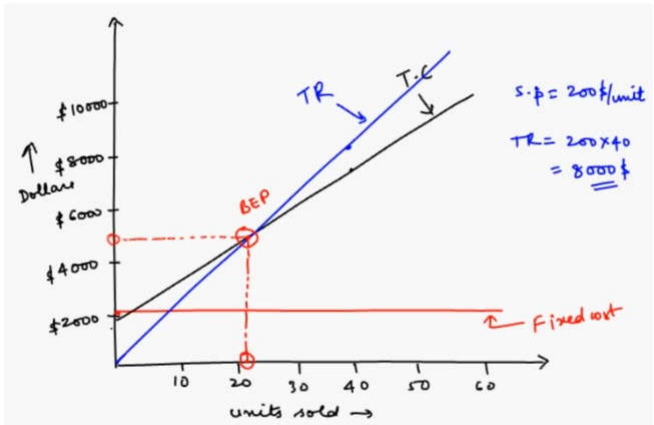
$$\text{Break-even Point} = 1{,}000$$

- Therefore, the university needs to enroll at least 1,000 students to reach the break-even point. At this point, the total revenue generated from the course fees would cover both the fixed and variable costs, resulting in neither profit nor loss.

BREAK-EVEN ANALYSIS



BREAK-EVEN ANALYSIS



COST MANAGEMENT

- https://www.investopedia.com/articles/basics/10/guide-to-calculating-roi.asp

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To be continued...

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