Mansoura University
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Software Cost Estimation

Grade : 4 (SWE)

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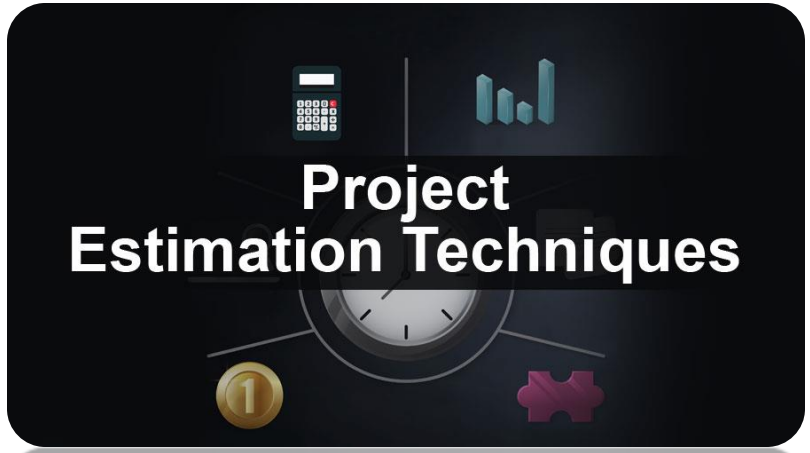
Software Cost Estimation

Agenda

- Function Points
- Examples



Function Points

- **Function Points**

It is a unit of measurement to express the amount of business functionality, an information system (as a product) provides to a user.

- **Functions: There are two types of functions:**

1. **Data Functions**
2. **Transaction Functions**

Data Functions

1. **Data Function** refers to the processes within a software application that involve the storage, retrieval, or maintenance of data. These functions are classified into two main categories:

- **Internal Logical File (ILF):**
  - A group of logically related data or control information that is maintained within the system being analyzed.
  - The application is responsible for managing and maintaining this data.
  - **Example:** A database table for storing student records.

- **External Interface File (EIF):**
  - A group of logically related data that is referenced or used by the application but maintained by an external system.
  - The application does not manage this data; it only accesses it.
  - **Example:** A table from another system that the application reads but does not modify.

Data Functions

- **Determinants of Size and Complexity:**
  - **Data Element Types (DETs):** Unique, user-recognizable fields in a logical file.
  - **Record Element Types (RETs):** Subgroups of related data elements within a logical file (ILF or EIF).These subgroups are derived based on how data is logically organized and managed.
- **Determine the Functional Complexity for Each Data Function**

RETS	Data Element Types (DETs)		
	1-19	20-50	>50
1	L	L	A
2 to 5	L	A	H
>5	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

Data Functions

- **Measure the Functional Size for Each Data Function**

Functional Complexity	FP Count for ILF	FP Count for EIF
Low	7	5
Average	10	7
High	15	10

Example 1

- **A sample data function count**

a. There is a component of a university system that tracks and stores student information, utilized in reporting on study activities. The data elements that will be stored within this system are: 1. First Name, 2. Last Name, 3.Username, 4. Password, 5. Email, 6. Student Number, 7. Level, 8. Level, 9. Status, 10. ID number Assume that all this data will be stored within the bounds of the application you are estimating, in a single database file named "Student" (ILF).

i. Count the number of DET's & RET's.

ii. Determine the level of complexity of this data function.

iii. What is the Functional Size for this Data Function?

Solution

Sol:

i. Count the number of DET's & RET's.

a) DETs:

DETs are individual, user-recognizable fields. From the data provided:

First Name,Last Name,Username,Password,Email,Student Number,Level,Status, ID number.

Number of DETs = 9.

b) RETs:

all fields belong to a single logical record (ILF), there is 1 RET.

Number of RETs = 1.

Solution

Sol:

ii. Determine the level of complexity of this data function.

RETS	Data Element Types (DETs)		
	1-19	20-50	>50
1	L	L	A
2 to 5	L	A	H
>5	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

Number of DETs = 9. & Number of RETs = 1.

Since we have ***10 DETs*** and ***1 RET*** in one data function, the complexity of this function is ***Low.***

Solution

Sol:

iii. What is the Functional Size for this Data Function?

Functional Complexity	FP Count for ILF	FP Count for EIF
Low	7	5
Average	10	7
High	15	10

Since we have ***one low complex ILF*** , its size will be equivalent to ***7 function points.***

Example 1

- **A sample data function count**

b. Students may be moved from another university, have different certificates, have different nationalities and such. An additional requirement is to be able to track the history of the students ID number, First Name and Last Name. Given this additional requirement:

i. Count the number of DET's & RET's.

ii. Determine the level of complexity of this data function.

iii. What is the Functional Size for this Data Function?

Solution

Sol:

i. Count the number of DET's & RET's.

- **The new requirement introduces the ability to track historical data for the following fields:**
  ID Number,First Name,Last Name
- **To store this historical data, a secondary table (or logical structure) is added to the existing Student file.**
  This table:
  Contains the history of ID Number, First Name, and Last Name.
- **Uses Student Number as a foreign key to maintain the relationship with the main student record.**

a) DETs:

First Name, Last Name, Username, Password, Email, Student Number, Level, Status, ID Number

- **Number of DETs = 9.**

Since only unique, non-repetitive DETs are counted, the total remains 9 DETs

Solution

Sol:

i. Count the number of DET's & RET's.

b) RETs:

The main record (original Student table) is the first RET.

The history record (tracking ID Number, First Name, Last Name) is the second RET.

Number of RETs = 2.

Solution

Sol:

ii. Determine the level of complexity of this data function.

RETS	Data Element Types (DETs)		
	1-19	20-50	>50
1	L	L	A
2 to 5	L	A	H
>5	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

Number of DETs = 9. & Number of RETs = 2.

Since we have ***9 DETs*** and ***2 RET*** in one data function, the complexity of this function is ***Low.***

Solution

Sol:

iii. What is the Functional Size for this Data Function?

Functional Complexity	FP Count for ILF	FP Count for EIF
Low	7	5
Average	10	7
High	15	10

Since we have ***low complex ILF*** , its size will be equivalent to ***7 function points.***

Transaction Functions

2. **Transaction Function represent processes or actions performed by a software system to manage or retrieve data. These functions involve interactions between the system and its users, external systems, or other processes.**

- **Transaction functions are divided into three categories:**
  - **External Input (EI):**
    - Captures data from the user or an external system.
    - Stores or updates information in one or more internal logical files (ILFs).
    - **Example: A form used to add a new student to the database.**
  - **External Output (EO):**
    - Provides data to the user or an external system.
    - May involve data retrieved from one or more ILFs or EIFs.
    - Includes calculations or derived data.
    - **Example: A report showing a student's grades and GPA.**

Transaction Functions

➢ **External Inquiry (EQ):**

- Provides data to the user or an external system.
- Involves data retrieved from one or more ILFs or EIFs, without significant calculations.
- **Example: A query to display a student's basic profile details**

❑ **Identify FTRs (File Type Referenced)**

- **A FTR is a file referenced or maintained by a transaction function (External Input, External Output, or External Inquiry).**
- **Count the number of ILFs (Internal Logical Files) and/or EIFs (External Interface Files) referenced during the transaction:**
  A referenced file is one from which data is read or into which data is written.

Transaction Functions

❑ Determine Complexity

- **Use the complexity matrix for the respective transaction type to determine its complexity (Low, Average, High) based on:**

    - **Number of DETs: Unique data fields involved in the transaction.**
    - **Number of FTRs: Logical files referenced during the transaction.**

Transaction Functions

- **Determine the Functional Complexity for Each EI Transaction Function**

FTRs	Data Element Types (DETs)		
	1-4	5-15	>=16
0-1	L	L	A
2	L	A	H
>=3	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

Transaction Functions

- **Determine the Functional Complexity for Each EO , EQ Transaction Function**

EQ must have a minimum of 1 FTR FTRs	Data Element Types (DETs)		
	1-4	5-15	>=16
0-1	L	L	A
2	L	A	H
>=3	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

Transaction Functions

- **Measure the Functional Size for Each EI Transaction Function**

Complexity	FP Count
Low	3
Average	4
High	6

Transaction Functions

- **Measure the Functional Size for Each EO,EQ Transaction Function**

Complexity	FP Count for EO	FP Count for EQ
Low	4	3
Average	5	4
High	6	6

Example 2

- **A sample data function count**

The interface screen of the application shows the data fields mentioned in previous problem (Q 1). It also provides a function that enables a user of the application to create a New Student within the application. There is a Save button, (which means this screen is identified as an Input).

i.Count the number of DET's and FTR's for the transaction function.

ii. Determine the level of complexity of this data function.

iii. What is the Functional Size for this Data Function?

Solution

Sol:

i. Count the number of DET's & FTR's.

a) DETs:

DETs are unique, user-recognizable fields in the transaction. From the data provided:

First Name,Last Name,Username,Password,Email,Student Number,Level,Status,ID number.

The 10 fields include data for the student record. The Save button also counts as a DET because it is a recognizable user interaction element.

Number of DETs = 10.

b) FTRs:

The student information is stored in a single Internal Logical File (ILF) (the Student File).

Number of FTRs = 1.

Solution

Sol:

ii. Determine the level of complexity will be obtained from the following table since it is recognized as an external input (EI):

FTRs	Data Element Types (DETs)		
	1-4	5-15	>=16
0-1	L	L	A
2	L	A	H
>=3	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

Number of DETs = 10. & Number of FTRs = 1.

The complexity is LOW for either scenario described above (1 FTR) and (DETs ≤ 15).

Solution

Sol:

iii. The Functional Size for this Transaction Function is determined from the table of external input (EI) size:

Complexity	FP Count
Low	3
Average	4
High	6

Since we have ***one low complex transaction function(EI)*** , its size will be equivalent to ***3 function points.***

Example 3

➢ **Multiple data functions and transaction functions**

Assume you have an application in which 4 RETs containing 15, 25, 45, and 60 DETs respectively and stored in 4 ILF. The application has 3 transaction files, RET 1, 2 represent EI, RET 3 represents EO, RET 4 represent External query.

- **Calculate the size of this application in function points.**

Solution

Sol:

Data Functions:

There are 4 Internal Logical Files (ILFs), each containing a Record Element Type (RET) and different numbers of Data Element Types (DETs):

- **RET 1: 15 DETs.**
- **RET 2: 25 DETs.**
- **RET 3: 45 DETs.**
- **RET 4: 60 DETs.**

Solution

Sol:

Calculate the Size of Data Functions

RETS	Data Element Types (DETs)		
	1-19	20-50	>50
1	L	L	A
2 to 5	L	A	H
>5	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

- **RET 1: 15 DETs.**
- **RET 2: 25 DETs.**
- **RET 3: 45 DETs.**
- **RET 4: 60 DETs.**

RET 1:
1 RET and 15 DETs → Low complexity.
RET 2:
1 RET and 25 DETs → Low complexity.

RET 3:
1 RET and 45 DETs → Low complexity.
RET 4:
1 RET and 60 DETs → Average complexity.

Solution

Sol:

Function Points for Data Functions

- **Using the Data Function Size Table:**

Functional Complexity	FP Count for ILF	FP Count for EIF
Low	7	5
Average	10	7
High	15	10

RET 1, RET 2, RET 3: Each is Low complexity → 3 × 7 = 21 FP.
RET 4: Average complexity → 10 FP.
Total FP for Data Functions = 21 + 10 = 31 FP.

Solution

Sol:

Transaction Functions:

The application has 3 transaction types:

- **RET 1 and RET 2: Represent External Input (EI).**
- **RET 3: Represents an External Output (EO).**
- **RET 4: Represents an External Query (EQ).**

Solution

Sol:

Calculate the Size of Transaction Functions

External Input (EI):

RET 1 and RET 2:

Combined DETs = 15 + 25 = 40 DETs.

Number of FTRs = 2.

Using the EI Complexity Table:

FTRs	Data Element Types (DETs)		
	1-4	5-15	>=16
0-1	L	L	A
2	L	A	H
>=3	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

Since we have ***one external input (2 FTRs, and 15+25=40 DETs),***
so it is ***high complex EI.***

.

Solution

Sol:

Calculate the Size of Transaction Functions

The size of EI in function points is obtained from this table:

Complexity	FP Count
Low	3
Average	4
High	6

One high complex EI is equivalent to ***6 function points***.

Solution

Sol:

Calculate the Size of Transaction Functions

External Output (EO):

RET 3:

DETs = 45.

Number of FTRs = 1.

External Query (EQ):

RET 4:

DETs = 60.

Number of FTRs = 1.

Using the EI Complexity Table:

EQ must have a minimum of 1 FTR FTRs	Data Element Types (DETs)		
	1-4	5-15	>=16
0-1	L	L	A
2	L	A	H
>=3	A	H	H

Functional Complexity: **L** = Low; **A** = Average; **H** = High

We ***one external output (1 FTR, and 45 DETs)*** so it is ***average complex,***
and ***one external query (1 FTR, and 60 DETs)*** so it is ***average complex.***

Solution

Sol:

Calculate the Size of Transaction Functions

The size of EO,EQ in function points is obtained from this table:

Complexity	FP Count for EO	FP Count for EQ
Low	4	3
Average	5	4
High	6	6

One ***average complex EO*** is equivalent to ***5 function points***, and one ***average complex EQ*** is equivalent to ***4 function points.***

Solution

Sol:

Total Size of the Project

Total FP = Data Functions + EI + EO + EQ

= 31 + 6 + 5 + 4 = 46 Function Points.

Function Points

- **The Value Adjustment Factor (VAF) is based on 14 GSCs (General System Characteristics), that rate the general functionality of the application being counted.**
- **GSCs are user business constraints independent of technology.**
- **Each characteristic has associated descriptions to determine the degree of influence. (See the following table)**

Function Points

- **14 GSCs (General System Characteristics)**

General System Characteristic	Brief Description
Data Communications	How many communication facilities are there to aid in the transfer or exchange of information with the application or system?
Distributed Data Processing	How are distributed data and processing functions handled?
Performance	Did the user require response time or throughput?

Function Points

- **14 GSCs (General System Characteristics)**

Heavily Used Configuration	How heavily used is the current hardware platform where the application will be executed?
Transaction Rate	How frequently are transactions executed daily, weekly, monthly, etc.?
On-Line Data Entry	What percentage of the information is entered online?
End-user Efficiency	Was the application designed for end-user efficiency?
Online Update	How many ILFs are updated by online transaction?
Complex Processing	Does the application have extensive logical or mathematical processing?

Function Points

- **14 GSCs (General System Characteristics)**

Reusability	Was the application developed to meet one or many user's needs?
Installation Ease	How difficult is conversion and installation?
Operational Ease	How effective and/or automated are start-up, back-up, and recovery procedures?
Multiple Sites	Was the application specifically designed, developed, and supported to be installed at multiple sites for multiple organizations?
Facilitate Change	Was the application specifically designed, developed, and supported to facilitate change?

Function Points

- **The degree of influence range is on a scale of zero to five, from no influence to strong 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

Example 1

If the Total Degree of Influence (TDI) on function point adjustment is given by the equation TDI = Σ14 factor's Degrees of Influence and the degree of influence of each factor is measured on a scale of zero to five, calculate the range of TDI.

Solution

Sol:

The minimum value of TDI = 14 * 0 = 0
The maximum value of TDI = 14 * 5 = 70
the range of TDI: $0 \leq TDI \leq 70$

Example 2

If the value adjustment factor of function points counting is given by the equation: VAF = (TDI × 0.01) + 0.65 and TDI = Σ14 factor's Degrees of Influence and the degree of influence of each factor is measured on a scale of zero to five, calculate the range of VAF.

Solution

Sol :

The minimum value of VAF = (0 * 0.01) + 0.65 = 0.65
The maximum value of VAF = (70 * 0.01) + 0.65 = 0.7 + 0.65 = 1.35
the range of VAF: 0.65 ≤ VAF ≤ 1.35

Example 3

If you have 345 unadjusted function points, and the value adjustment factor = 1.2

Calculate the adjusted function points.

Solution

Sol :

The adjusted function points = unadjusted function points * influence factor
The adjusted function points = 345 * 1.2 = 414 function points

Any Question ?

Next ….