

Function Point

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Reference

- http://en.wikipedia.org/wiki/Function_point
- <http://www.bfpug.com.br/Artigos/Albrecht/MeasuringApplicationDevelopmentProductivity.pdf>
- <http://www.softwaremetrics.com/fpafund.htm>
- <http://www.softwaremetrics.com/Function%20Point%20Training%20Booklet%20New.pdf>

Brief History

- 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 . In 1984 Albrecht refined the method and since 1986, when the International Function Point User Group (IFPUG) was set up, several versions of the Function Point Counting Practices Manual have been published by IFPUG. The current version of the IFPUG Manual is 4.1.

The Five Major Components

- External Inputs (EI)
- External Outputs (EO)
- External Inquiry (EQ)
- Internal Logical Files (ILF's)
- External Interface Files (EIF's)

Process

- 1. Determine type of function point count
- 2. Determine the application boundary
- 3. Identify and rate transactional function types to determine their contribution to the unadjusted function point count.
- 4. Identify and rate data function types to determine their contribution to the unadjusted function point count.
- 5. Determine the value adjustment factor (VAF)
- 6. Calculate the adjusted function point count.

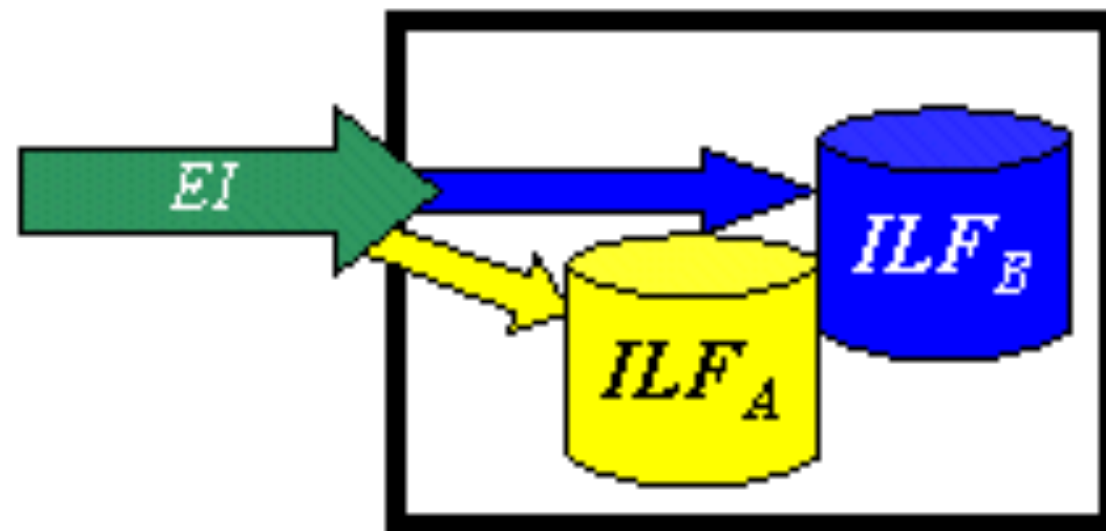
Definition

- Record Element Type (RET):
 - A RET is user recognizable sub group of data elements within an ILF or an EIF. It is best to look at logical groupings of data to help identify them. The concept of RET will be discussed in detail in the chapters that discuss internal logical file and external interface files.
- File Type Referenced (FTR):
 - A FTR is a file type referenced by a transaction. An FTR must also be an internal logical file or external interface file.
- Data Element Type (DET):
 - A DET is a unique user recognizable, non-recursive (non-repetitive) field. A DET is information that is dynamic and not static. A dynamic field is read from a file or created from DET's contained in a FTR. Additionally, a DET can invoke transactions or can be additional information regarding transactions. If a DET is recursive then only the first occurrence of the DET is considered not every occurrence.

Definition:

External Inputs (EI) - is an elementary process in which data crosses the boundary from outside to inside. This data is coming external to the application. The 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. If the data is control information it does not have to maintain an internal logical file.

If an external input adds, changes and deletes (maintains) information on an internal logical file, then this represents three external inputs. External inputs (especially change & delete) may be preceded by an external inquiry (see the section on external inquiries). Hence a full function screen is add, change, delete and inquiry (more will be discussed about inquiries later in the book).



External Input

Rating:

Like all components, EI's are rated and scored. The rating is based upon the number of data element types (DET's) and the file types referenced (FTR's). DET's and FTR's are discussed earlier. The table below lists both the level (low, average or high) and appropriate score (3, 4 or 6).

Files Type Referenced (FTR)	Data Elements (DET's)		
	1-4	5-15	Greater than 15
Less than 2	Low (3)	Low (3)	Average (4)
2	Low (3)	Average (4)	High (6)
Greater than 2	Average (4)	High (6)	High (6)

Examples:

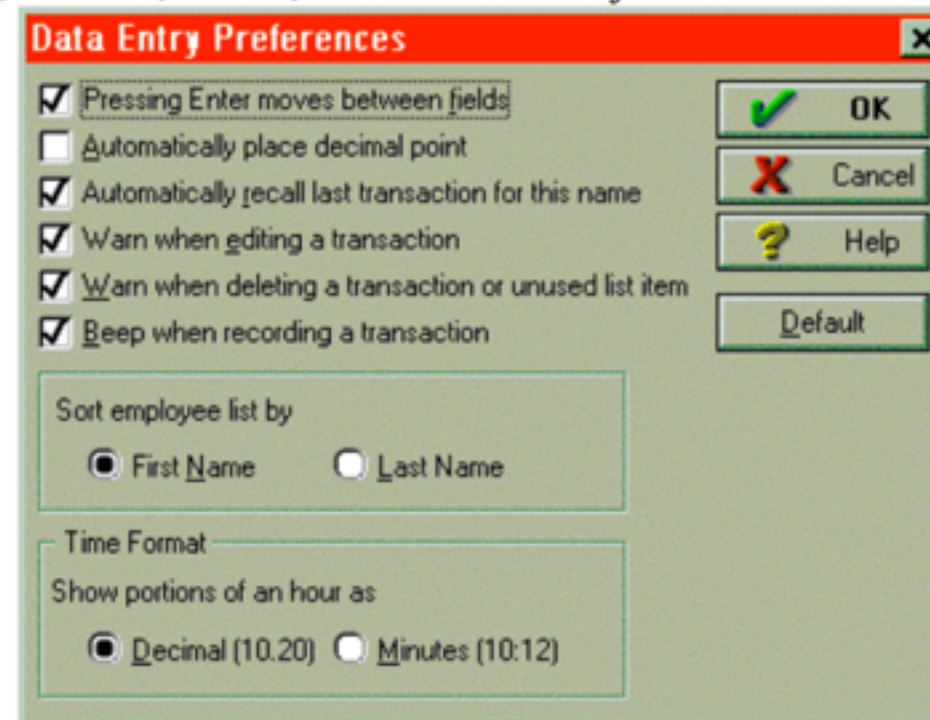
EI's can be business data, control data and rules based data.

Business Data: Customer Name, Address, Phone, and so on and so forth.

Control Data:

The data elements are those that invoke the transaction or change the behavior of the application. Each check box represents a data element. Additionally, the sort employee list radio buttons represents one data element as well as the time format radio buttons.

Control information changes or alters the state (or behavior) of the application. Control information specifies how, what, and when data will be processed.



The screenshot shows a 'Data Entry Preferences' dialog box with a red title bar. It contains several settings:

- ☒ Pressing Enter moves between fields
- ☐ Automatically place decimal point
- ☒ Automatically recall last transaction for this name
- ☒ Warn when editing a transaction
- ☒ Warn when deleting a transaction or unused list item
- ☒ Beep when recording a transaction

On the right side of the dialog are four buttons: 'OK' (with a green checkmark icon), 'Cancel' (with a red X icon), 'Help' (with a yellow question mark icon), and 'Default'.

Below the list of checkboxes, there are two sections:

- Sort employee list by:** Two radio buttons, 'First Name' (selected) and 'Last Name'.
- Time Format:** A label 'Show portions of an hour as' followed by two radio buttons, 'Decimal (10.20)' (selected) and 'Minutes (10:12)'.

Data Elements:

- Data Input Fields
- Calculated Values or Derived Data that are stored
- Error Messages
- Confirmation Messages
- Recursive fields are only counted as one DET.
- Action keys (command buttons such as OK, Next, so on and so forth)
- Multiple Action Keys that perform the same function are counted only as one DET

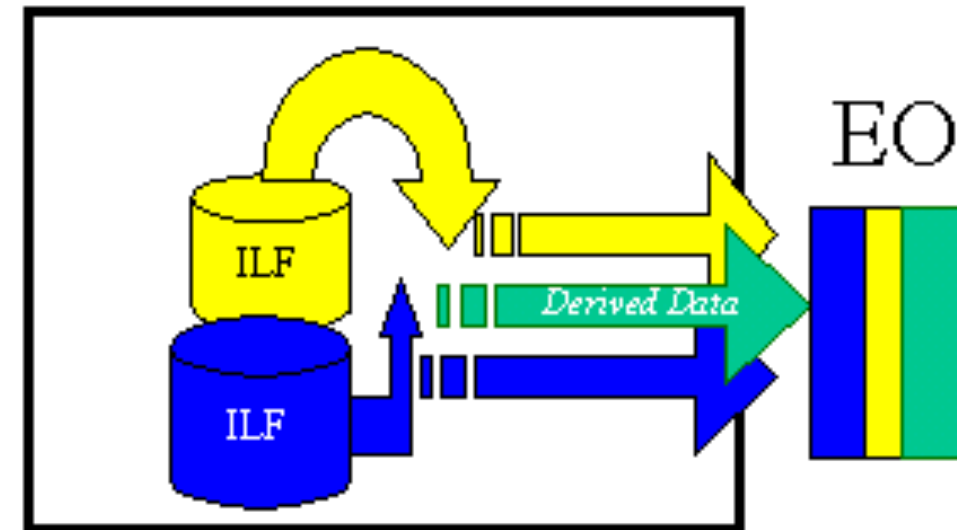
Typical Vocabulary:

The following words are associated with external input or “inputs.” While reading textual document or application description look for these type of words, they may indicate an add, change or delete aspect of an external input.

Add	Modify (change)
Activate	Override (change)
Amend (change and delete)	Post (add, change and delete)
Cancel	Remove (delete)
Change	Reactivate (change)
Convert (change)	Remit
Create (add)	Replace (change)
Delete	Revise (change and delete)
Deassign	Save (add, change or delete)
Disable	Store (add)
Disconnect (change or delete)	Suspend (change or delete)
Enable	Submit (add, change or delete)
Edit (change)	Update (add, change or delete)
Insert (add and change)	Voids (change and delete)
Maintain (add, change, or delete)	
Memorize (add)	

Definition:

External Outputs (EO) - an elementary process in which **derived data** passes across the boundary from inside to outside. Additionally, an EO may update an ILF. The data creates reports or output files sent to other applications. These reports and files are created from information contained in one or more internal logical files and external interface files.



Derived Data is data that is processed beyond direct retrieval and editing of information from internal logical files or external interface files. Derived data is usually the result of algorithms, or calculations. *Derived data occurs when one or more data elements are combined with a formula to generate or derive an additional data element(s).* This derived data does not appear in any FTR (internal logical file or external interface file).

An algorithm is defined as a mechanical procedure for performing a given calculation or solving a problem in a series of steps.

A calculation is defined as an equation that has one or more operators. An operator is a mathematical function such as addition, subtraction, multiplication, and division (+, -, x, /).

Transactions between applications should be referred to as interfaces. You can only have an external output or external inquiry of data external to your application. If you get data from another application and add it to a file in your application, this is a combination get and add (external inquiry and external input).

External Output

Rating:

Like all components, EO's are rated and scored. The rating is based upon the number of data elements (DET's) and the file types referenced (FTR's). The rating is based upon the **total number of unique** (combined unique input and out sides) data elements (DET's) and the file types referenced (FTR's) (combined unique input and output sides). DET's and FTR's were discussed earlier in this section. The table below lists both the level (low, average or high) and appropriate score (4, 5 or 7).

File Types Referenced (FTR)	Data Elements		
	1-5	6-19	Greater than 19
less than 2	Low (4)	Low (4)	Average (5)
2 or 3	Low (4)	Average (5)	High (7)
Greater than 3	Average (5)	High (7)	High (7)

Example

- Unlike other components EO's almost always contain business data. Rule base data and control based “outputs” are almost always considered External Inquiries. This is true due to the fact that rule data and control type data is not derived (or derivable).
- Notification Messages are considered EO's. A notification message differs from an error message. A notification message is an elementary process, while an error message (or confirmation message) is part of an elementary process. A notification message is the result of some business logic processing. For example, a trading application may notify a broker that the customer trying to place an order does not have adequate funds in their account.
- Derived Data displayed in textual fashion (rows and columns) and graphical format is an example of two external outputs.

Data Elements

- Error Messages
- Confirmation Messages
- Calculated Values (derived data)
- Values on reports that are read from an internal logical file or external interface file.
- Recursive values or fields (count only once)
- Generally, do not count report headings (literals) as data elements unless they are dynamic. That is, if the report headings are read from files that are maintained they may be DET's also.
- System generated dates that are on the tops or reports or are displayed are normally not counted as DET's. If system generated dates is part of business information of the external output they should be counted as DET's. For example, the date an invoice is printed or the date a check is printed.

Typical Vocabulary:

The following words are associated with an “external outputs.” While reading textual documents or application descriptions look for these types of words. They may indicate an external output. Notice these words are very similar to those words used for an External Inquiry (discussed in the next chapter).

Browse
Display
Get
On-lines
Output
Print
Query

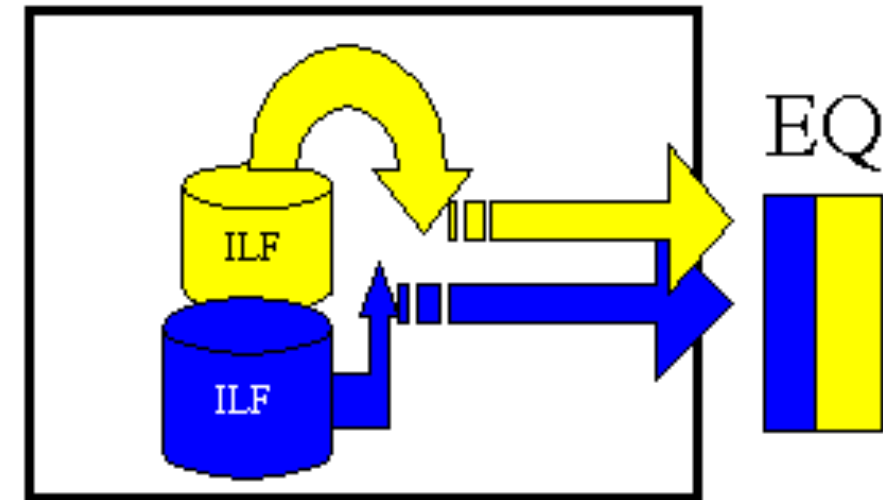
Reports
Request
Retrieve
Seek
Select
View

Definition:

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. The input process does not update or maintain any FTR's (Internal Logical Files or External Interface Files) and the output side does not contain derived data.



Transactions between applications should be referred to as interfaces. You can only have an external output or external inquiry of data external to your application. If you get data from another application and add it to a file in your application, this is a combination get and add (external inquiry and external input).



External Inquiry

Rating:

Like all components, EQ's are rated and scored. Basically, an EQ is rated (Low, Average or High) like an EO, but assigned a value like and EI. The rating is based upon the **total number of unique** (combined unique input and out sides) data elements (DET's) and the file types referenced (FTR's) (combined unique input and output sides). DET's and FTR's were discussed in an earlier chapter. If the same FTR is used on both the input and output side, then it is counted only one time. If the same DET is used on both the input and output side, then it is only counted one time.

Functional Complexity Matrix (shared table between EO and EQ)

File Types Referenced (FTR)	Data Elements		
	1-5	6-19	Greater than 19
less than 2	Low (3)	Low (3)	Average (4)
2 or 3	Low (3)	Average (4)	High (6)
Greater than 3	Average (4)	High (6)	High (6)

Example

- EQ's can contain business data, control data and rules based data.
-
- Business Applications: An example of Business data is customer names, addresses, phone number, so on and so forth. An example of Rules Data is a table entry that tells how many days a customer can be late before they are turned over for collection.
-
- Drop Down List (a listing of customers by name) would be an example of an EQ.
-
- A screen full of customer address information would be an example of an EQ.
-
- Reset (or restore) functionality where all the modified fields are reset to their saved values. The key to understanding this an external query is the “reset to their saved values.” Clearly a table is being read.

Data Elements

- Input Side
 - Click of a the mouse
 - Search values
 - Action keys (command buttons)
 - Error Messages
 - Confirmation Messages (searching)
 - Clicking on the an action key
 - Scrolling
 - Recursive fields are counted only once.
- Outside
 - Values read from an internal logical file or external interface file
 - Color or Font changes on the screen
 - Error Messages
 - Confirmation Messages
 - Recursive fields are counted only once.
- The combined (unique) total input and outside DET's are used when rating EQ's.

-
- Like an EI, action keys that perform the same function but appear multiple times are counted as only one DET.
 -
 - Error Messages and confirmation messages can and do occur on either the input side and/or output side. If a user initiates a search and a message is displayed, “please wait searching” is an example of a confirmation message on the input side. The message “all fields must be populated” is another example of an error message on the input side. On the other hand, if the message is “customer not found” is an example of an error message on the output side. That is, the input side contained no problems. The database was searched and the “error” has occurred on the output side of the transaction.

Example of Graphical Data

Imagine the following map. There are two different ways to get the same exact data. One you can click on the specific state or you can use the drop down list. Once you choose a state data is generated and presented to the screen. These two EQ are repetitive and do the same exact thing. We would not consider this as two EQ's **but** only one. You can view this map by visiting <http://quickfacts.census.gov/qfd/index.html>

State & County QuickFacts

Quick, easy access to facts about people, business, and geography

To begin, select a state from this list or use the map to the right.

Alabama

The population of the U.S. is 281,421,906 people (April 1, 2000). The population has grown 13.1% since 1990.

View more [USA QuickFacts](#).

See our [thematic maps](#)

Source: U.S. Census Bureau



Example

Typical Vocabulary:

The following words are associated with an “external inquiry.” While reading textual document or application description look for these type of words. They may indicate an external inquiry. Notice the words are very similar to those related to external outputs.

Browse	Query
Display	Scan
Extract	Seek
Fetch	Select
Find	Show
Gather	View
Get	Reports
Drop Down	
Lists	
Look Ups	
On-lines	
Output	
Pick Lists	
Print	

Radjenovic2006.pdf

Definition:

Internal Logical Files (ILF) - a user identifiable group of logically related data that resides entirely within the application boundary and is maintained through External Inputs. An internal logical file has the inherent meaning it is internally maintained, it has some logical structure and it is stored in a file.

Even though it is not a rule, an ILF should have at least one external output and/or external inquiry. That is, at least one external output and/or external inquiry should include the ILF as an FTR. Simply put, information is stored in an ILF, so it can be used later. The EO or EQ could be from another application. It is worth noting that it is possible that a specific ILF is not referenced by EO or EQ, but it is used by an EI (other than the EI that maintains it).

Again, even though it is not a rule, an ILF should have at least one external input.

Internal Logical Files

Rating:

Like all components, ILF's are rated and scored. The rating is based upon the number of data elements (DET's) and the record types (RET's). DET's and RET's were discussed earlier. The table below lists both the level (low, average or high) and appropriate score (7, 10 or 15).

Record Element Types (RET)	Data Elements		
	1 to 19	20 - 50	51 or More
1 RET	Low (7)	Low(7)	Average (10)
2 to 5 RET	Low (7)	Average (10)	High (15)
6 or More RET	Average (10)	High (15)	High (15)

Examples:

ILF's can contain business data, control data and rules based data. The type of data contained in an ILF is the same type of data an EI contains and maintains.

It is common for control data to have only one occurrence within an ILF. For example control data file may only contain parameter settings, or a status setting. For example, part of the on board automobile system only contains current information, oil pressure, engine temperature, so on and so forth. This particular process of the on board system does not care about historical data – only the current instance. When the status changes the file is updated with current information and there is no historical information. The on board system may keep track of historical changes in diagnostics files, but this would be a totally separate process. This process is not used to keep the car running, but to help a mechanic understand what has been going on with the engine.

Real Time and Embedded Systems: For example, Telephone Switching is made of all three types, Business Data, Rule Data and Control Data. Business Data is the actual call, Rule Data is how the call should be routed through the network, and Control Data is how the switches communicate with each other. Like control files it is common real time systems will have only one occurrence in an internal logical file.

Business Applications: An example of Business data is customer names, addresses, phone number, so on and so forth. An example of Rules Data is a table entry that tells how many days a customer can be late before they are turned over for collection.

Definition:

External Interface Files (EIF) - a user identifiable group of logically related data that is used for reference purposes only. The data resides entirely outside the application boundary and is maintained by another applications external inputs. The external interface file is an internal logical file for another application. An application may count a file as either a EIF or ILF not both. An external interface file has the inherent meaning it is externally maintained (probably by some other application), an interface has to be developed to get the data and it is stored in a file.

Each EIF included in a function point count must have at least one external output or external interface file against it. At least one transaction, external input, external output or external inquiry should include the EIF as a FTR.

Every application, which references the EIF, needs to include it in their FP Count. Some organizations have a pull theory and others have a push theory of data. The pull theory is an external application “reaching into” another applications and retrieving data. Those organizations which have push theory require applications to create interfaces (EO or EQ) which other applications read.

External Interface Files

Record Element Types (RET)	Data Elements		
	1 to 19	20 - 50	51 or More
1 RET	Low (5)	Low(5)	Average (7)
2 to 5 RET	Low (5)	Average (7)	High (10)
6 or More RET	Average (7)	High (10)	High (10)

Rate

Tabulating:

Once all the 14 GSC's have been answered, they should be tabulated using the IFPUG Value Adjustment Equation (VAF) --

$$VAF = 0.65 + \left[\left(\sum_{i=1}^{14} C_i \right) / 100 \right]$$

where: C_i = degree of influence for each General System Characteristic
 i = is from 1 to 14 representing each GSC.
 \sum = is summation of all 14 GSC's.

Another way to understand the formula is $VAF = (65 + TDI)/100$, where TDI is the sum of the results from each question. A Microsoft Excel formula would be: $=0.65 + \text{SUM}(A1:A14)/100$; assuming that the values for the characteristics were in cells A1 – A14.

GSC's at a Glance:

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 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?