

Software Estimation – Function Point Ninja



A 2 Day Customized Course

Agenda [Day – 1]



Introduction [The Basics]

Stumbling Blocks In Estimation

Estimation – Common Errors And Omissions

Estimation Process

Function Point - Basics

Function Point – Kinds Of

Function Point – Detailed Discussions

Development Projects

Enhancement Projects

Shared Data

Maintenance

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Agenda [Day – 2]



Function Point Variant – Full Function Point

Function Point Templates

Function Point Case-Study

Journey From Estimation To Scheduling

When Not To Use Function Point

The WBS Method

Wide-Band Delphi Method

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Estimation Defined



The act of calculating a future outcome against a unit of measure (with some degree of probability thrown in) of an event.

Simply put trying to figure out how much something would cost when that something is completed.

Did you estimate the cost of your child's birthday or the cost of your sisters marriage?

Did you obtain an estimate of getting your car serviced before the servicing?

*Estimation is a way of life
You did it this morning*

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Software Estimation Defined



Software Estimation is the process of defining and then sizing the application to be built ***along with all the supporting activities***, that are instrumental and ancillary for the development of the application on the quality parameters as required by the client.

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Software Estimation Defined



Software cost estimation is a complex activity that requires knowledge of a number of key attributes about the project for which the estimate is being constructed.

Reliability demands understanding the relationships among scores of discrete parameters that can affect the outcomes both individually and in concert.

It is in effect an exercise to estimate an extremely flexible thing.

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Software Estimation Defined



Creating reliable estimates requires knowledge of following parameters: -

- q Sizes of major deliverables
- q Expected rate of change of requirements
- q Expected no. of bugs and defects that could be encountered
- q Presence or absence of re-usable artifacts
- q Capabilities of the development team
- q Loaded costs of all resources in development team
- q Formal methodologies that are going to be utilized
- q Tools that are going to be utilized on the project
- q Set of activities that would be carried out for development

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Introduction



- q Estimation of Software is more complex than Estimating a civil project.
- q No other stream of project gets affected so profoundly by the individual skills of the executors
- q Its even more difficult as there are innumerable building material in the market place.
- q Mid project changes are also very high in software projects adding to the complexity
- q It's a very very young science / art.
- q Estimation is the first victim of the rat race.

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Legal Side Of Estimates



More and more Companies are being sued over or pulled into litigation for failing to deliver, hence estimations are playing important roles in lawsuits involving: -

1. Breach of contract suits
2. Suits involving taxable value of software assets
3. Suits involving excess costs incurred due to expansion of scope
4. Suits involving favoritism while awarding software contracts thru bids
5. Suits involving wrongful termination of software personnel due to inefficiency.

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Estimate Formula



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Project Attributes



Attributes that can affect the Estimates outcome are: -

- q Rate of requirements change
- q Experience of development team (General and project specific)
- q Process or Method used for the project
- q Specific activities that would be performed for the dev. of the project
- q Language / Platform utilized
- q Presence / absence of reusable artifacts
- q Development tools used and supporting tools used
- q Environment and ergonomics of the office workspace
- q Geo separation of team or co-location
- q Schedule pressure put on the team

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Best Advice For The Estimators



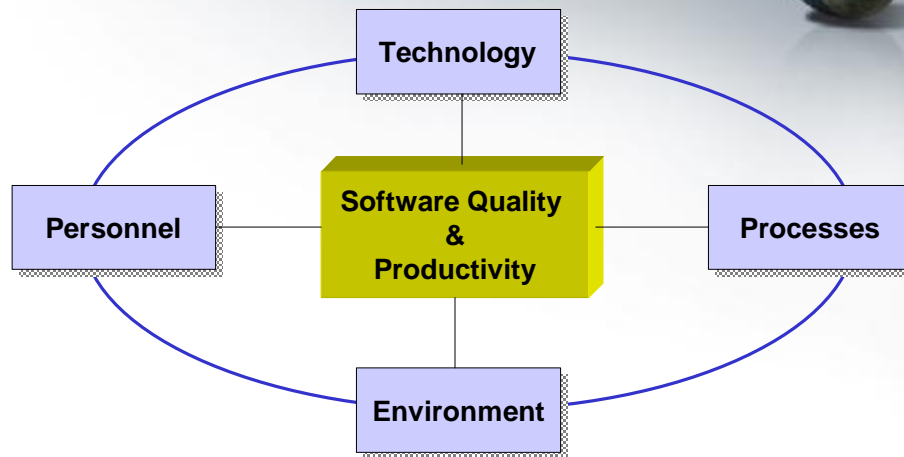
- q Be Accurate
- q Be Conservative
- q Base the estimate on solid historical data
- q Include quality activities
- q Include paper documents
- q Include project management
- q Include the effects of creeping requirements
- q Do NOT be overtly optimistic about the time reduction features of Tools
- q Get below the phase level
- q Use at least two methods of estimation
- q List down all Assumptions – (And make sure your executive / client understands)
- q Do not believe the executive

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Understand This...



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The FUNCTION POINT

From IFPUG. Based On Counting Manual 4.2



What Is FP



It is important
To twist the nut to
Repair the ladder
But its even more important
To determine
which
Nut to twist.

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Kinds Of FP Counting



**Whoever thinks a
faultless piece
to see,
Thinks what
never was,
nor is,
nor ever shall be.**

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Types Of FP Count



q Development Project FP Count

Measures the functions provided to user with first installation of software when project is complete.

q Enhancement Project FP Count

Measures modifications to the existing application - Add, Change or Delete user functions delivered.

q Application FP Count

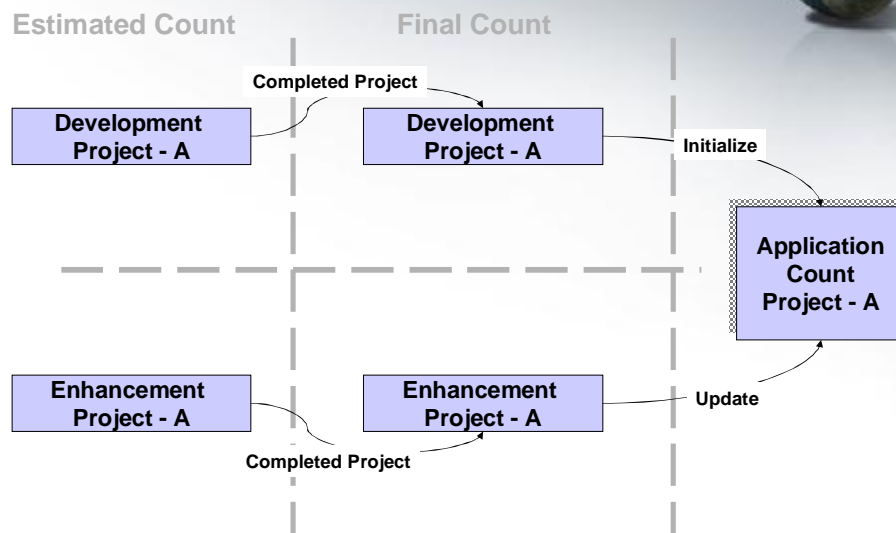
Measure of the current functions the application provides the user. It is initialized when a development project is completed and is updated every time an enhancement project alters application's functions.

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Relationship – FP Types

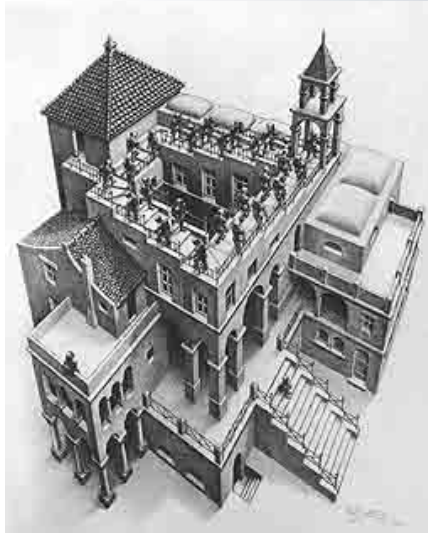


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FP Detailed Discussions



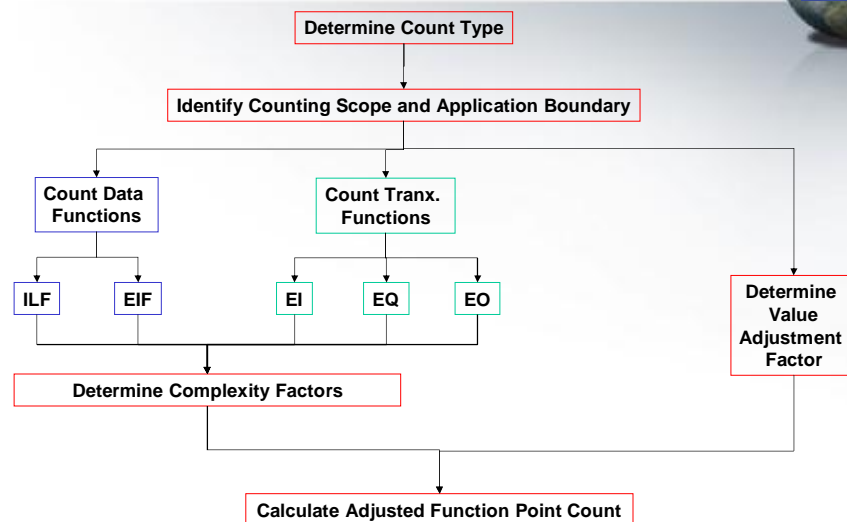
I know of no way of
Judging the future
But by the
Past

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FP Calculation Steps / Procedure



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FP Basic Structure



FPA measures the size of an application system in 2 areas:

- Ø the specific user functionality
- Ø the system characteristics.

Function Point = (User Functionality) X (System Characteristics)

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The Boundary



The position of the application boundary is important because it impacts the result of the **function point count.**

The application boundary assists in identifying the data entering the application which will be included in the scope of the count.

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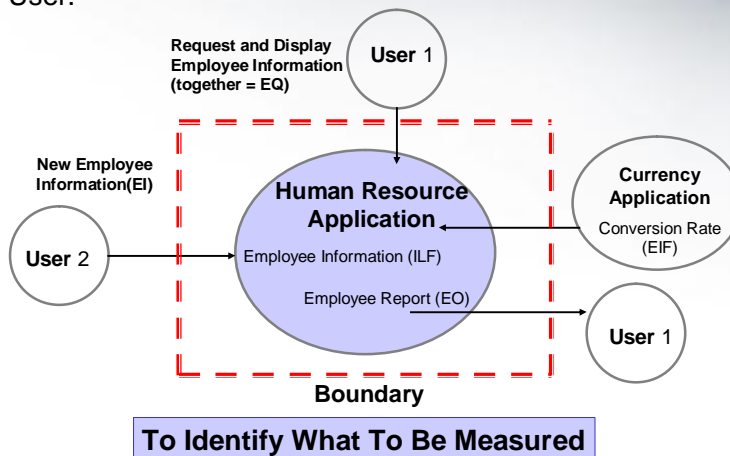
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Establishing Boundary



The Border between Software Being Measured and the User.



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The Boundary Rules



The following rules must apply for boundaries:

- q The boundary is determined based on the **user's view**. The focus is on what the user can understand and describe.
- q The boundary between related applications is based on **separate functional areas** as seen by the user, not on technical considerations.
- q The initial boundary already established for the application or applications being modified is not influenced by the counting scope.

Note: There may be more than one application included in the counting scope. If so, multiple application boundaries would be identified.

When the application boundary is not well-defined (such as early in analysis), it should be located as accurately as possible.

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User Functionality



User Functionality == Unadjusted Function Point

Transaction Function Types

External Input (EI)
External Output (EO)
External Query (EQ)

File Type Referenced - FTR
Data Element Type DET

Data Function Types

Internal Logical files (ILF)
External Logical File (ELF)

Record Element Type - RET
Data Element Type DET

Can You Tell The Logic Behind Counting
Transaction Functions First?

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TRANSACTION FUNCTIONS



Transactional functions
represent the functionality
provided to the user to
process data.

Transactional functions
are either
**external inputs, external
outputs,**
or
external inquiries.

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Transaction Functions

Rule Alert

Recommended that Transaction Functions are counted before the Data Functions.

Tally of all FTR's should be kept.

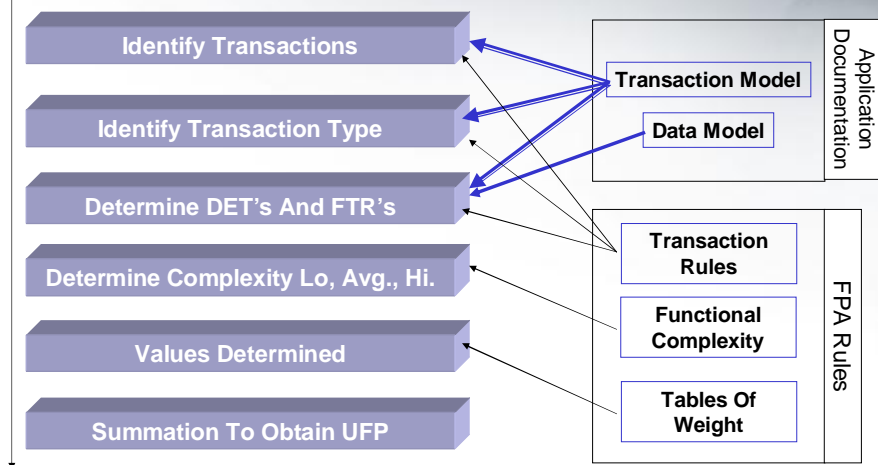
Every FTR must have at least one or more transactions.

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Transaction Functions – The Steps



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Transaction Functions



External Input [EI]

An external input (EI) is an elementary process that processes data or control information that comes from outside the application boundary.

The primary intent of an EI is to maintain one or more ILFs and/or to alter the behavior of the system.

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Transaction Functions



External Output [EO]

An external output (EO) is an elementary process that sends data or control information outside the application boundary.

The primary intent of an external output is to present information to a user through processing logic other than, or in addition to, the retrieval of data or control information.

The processing logic must contain at least one mathematical formula or calculation, create derived data, maintain one or more ILFs or alter the behavior of the system.

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Transaction Functions



External Output [EQ]

An external inquiry (EQ) is an elementary process that sends data or control information outside the application boundary.

The primary intent of an external inquiry is to present information to a user through the retrieval of data or control information from an ILF or EIF.

The processing logic contains no mathematical formulas or calculations, and creates no derived data. No ILF is maintained during the processing, nor is the behavior of the system altered.

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Transaction Functions - Summary



The main difference between the transactional function types is their **primary intent**.

Function	Transactional Function Type		
	EI	EO	EQ
Alter the behavior of the system	PI	F	N/A
Maintain one or more ILF's	PI	F	N/A
Present information to a user	F	PI	PI

Where: -

PI = Primary Intent

F = Sometimes there but NOT PI

N/A = Something not allowed to this type

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Transaction Functions – Some Terms



Before we dive into the procedures and counting rules let us consume and do away with some oft-repeated terms.

Elementary Process

An elementary process is the smallest unit of activity that is meaningful to the user(s).

The elementary process must be self-contained and leave the business of the application being counted in a consistent state.

*Eg.: - The user requirements to add an employee include setting up salary and dependent's information. If all the employee information is not added, an employee has not yet been created. **Adding some of the information alone leaves the business of adding an employee in an inconsistent state.** If both the employee salary and dependent information is added, this unit of activity is completed and the business is left in a consistent state.*

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Transaction Functions – Some Terms



Control Information

Control Information is data that influences an elementary process of the application being counted.

It specifies what, when, or how data is to be processed.

*E.g., A payment schedule for salaries. The **schedule** would be the control information.*

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Transaction Functions – Some Terms



Maintained

The term maintained is the ability to modify data through an elementary process.

E.g., include, but are not limited to, add, change, delete, populate, revise, update, assign, and create.

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Transaction Functions – Some Terms



User

A user is any person that specifies Functional User Requirements and/or any person or thing that communicates or interacts with the software at any time.

E.g., include people within the (say) HR department who interact with the application to set up employees, and the Benefits application that interacts with the HR application to receive information about employees' dependents.

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Transaction Functions – Some Terms



Processing Logic

Processing logic is defined as requirements specifically requested by the user to complete an elementary process. Those requirements may include the following actions:

- | | |
|--|--|
| 1. Validations are performed | 7. ILFs or EIFs are referenced |
| 2. Mathematical formulas and calculations are performed | 8. Data or control information is retrieved |
| 3. Equivalent values are converted | 9. Derived data is created |
| 4. Data is filtered | 10. Behavior of the system is altered |
| 5. Conditions are analyzed to determine which are applicable | 11. Prepare and present the information outside the boundary |
| 6. ILF (s) is / are updated | 12. Data is restored or re-arranged. |
13. Capability to accept data or control information that enters the application boundary.

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Transaction Functions – Some Terms



User Identifiable

The term user identifiable refers to defined requirements for processes and/or groups of data that are agreed upon, and understood by, both the user(s) and software developer(s).

E.g., users and software developers agree that a Human Resources Application will maintain and store Employee information in the application.

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Transaction Functions – Some Terms



FTR (File Type Referenced)

An internal logical file read or maintained by a transactional function or

An external interface file read by a transactional function

DET (Data Element Type)

A data element type is a unique user recognizable, non-repeated field.

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Transaction Functions



***The Complexity
And
Contributions
Of
Each EI, EO and EQ
Are
Measured Using The
FTR's And DET's***

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Basic Counting Rules – [EI/EO/EQ]



Identify The Elementary Process

Determine the primary intent of the identified elementary processes, and classify as an EI, EO, or EQ.

Validate against the transaction (EI, EO, EQ) identification rules.

Determine the transaction (EI, EO, EQ) complexity.

Determine the transaction (EI, EO, EQ) contribution to the unadjusted function point count.

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IDENTIFICATION – ELEMENTARY PROCESS



Some
pertinent
Examples...

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Example - 1



User Requirements

If a user adds a new employee, the user is required to enter

1. employee setup (basic) data and
2. dependent information if the number of dependents is greater than zero.

A transaction file is created during the update of the employee information. This transaction file is sent periodically to the Benefits System.

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Example - 1



Determine whether adding the employee information without the associated dependent information is an elementary process.

Elementary Process Counting Rules	Whether The Rule Applies?
The process is the smallest unit of activity that is meaningful to the user.	No, when an employee has dependents, the dependent's information must be included to represent the user requirement to add an employee.
The process is self-contained and leaves the business of the application in a consistent state.	No, when an employee has dependents the business is not in a consistent state after entering only the employee information.

Adding the employee information without the associated dependent information does not meet the requirements of an elementary process.

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Example - 1



Determine whether adding only the dependent information without the employee information is an elementary process.

Elementary Process Counting Rules	Whether The Rule Applies?
The process is the smallest unit of activity that is meaningful to the user.	No , this activity is apparently not meaningful to the user because it can not be executed independent of maintaining an employee.
The process is self-contained and leaves the business of the application in a consistent state.	Not Applicable.

Adding the dependent information without the associated employee information does not meet the requirements of an elementary process.

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Example - 1



For an employee who has dependents, determine whether adding the employee information with the associated dependent information is an elementary process.

Elementary Process Counting Rules	Whether The Rule Applies?
The process is the smallest unit of activity that is meaningful to the user.	Yes , together employee and dependent information are used to add an employee to the HR system.
The process is self-contained and leaves the business of the application in a consistent state.	Yes , this process is meaningful by itself and all necessary information is added to the HR application so the business is left in a consistent state (update file can be created and sent to Benefits system).

Adding the employee information with the dependent information meets the requirements of an elementary process.

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Example - 1



Determine whether sending the transactions file to the Benefits System is an additional elementary process.

Elementary Process Counting Rules	Whether The Rule Applies?
The process is the smallest unit of activity that is meaningful to the user.	Yes , this internally triggered process reflects a separate user requirement that could have been implemented as an independent process.
The process is self-contained and leaves the business of the application in a consistent state.	Yes , this process is self-contained, and after the creation of the record on the transaction file that is used to update the Benefits application, the system is in a consistent state.

Sending the transaction file to the Benefits System meets the requirements of an elementary process.

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Example - 1



Conclusions

There could be different implementations of the user requirement to add dependent(s) to an employee.

For example:

- Ø a data entry field called Number of Dependents on the employee screen which triggers the display of the dependent screen
- Ø a button which displays the dependent's screen
- Ø a menu item on the employee screen which displays the dependent's screen
- Ø the possibility to enter dependent(s) on the employee screen

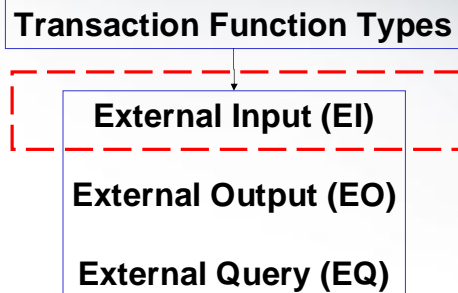
Irrespective of the implementation, there is still one elementary process, adding employee including dependents.

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Transaction Functions



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External Inputs



- q It is an elementary process in which data crosses the boundary from outside to inside.
- q This data may come from a **data input screen** or **another application**.
- q The data may be used to maintain one or more internal logical files.
- q The data can be either control information or business information.
- q If the data is control information it does not have to maintain an internal logical file.

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External Inputs - Primary Intent



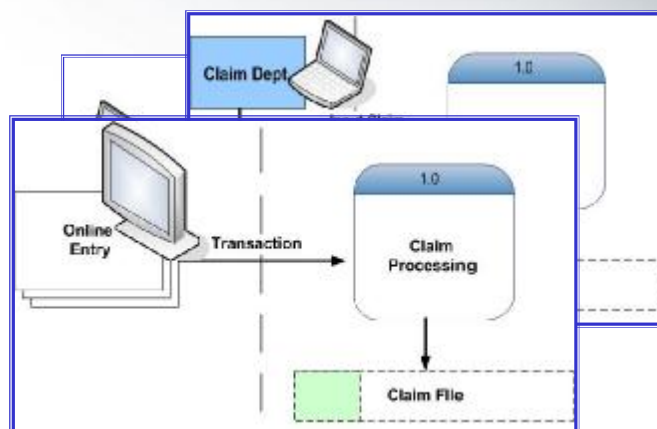
To maintain an ILF
or
alter the behavior of the system.

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External Inputs



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EI Counting Rules



- q The data or control information is received from outside the application boundary.
- q At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.
- q For the identified process, one of the following three statements must apply:
 - Ø Processing logic is unique from the processing logic performed by other external inputs for the application.
 - Ø The set of data elements identified is different from the sets identified for other external inputs for the application.
 - Ø The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.

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Quick Look At FTR's And DET's



- q **FTR's** : - This is a file type referenced by a transaction. Essentially speaking FTR should be a Internal Logical File (ILF) or a External Interface File (EIF).
- q **DET's** : - 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 the DET's contained in a FTR. Additionally, a DET can invoke transactions.
 - Ø In case the DET is recursive than only the **FIRST** instance is taken into consideration.

Understanding of FTR's and DET's help distinguish one transaction from another.

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FTR Counting Rules



- q Count an FTR for each ILF maintained.
- q Count an FTR for each ILF or EIF read during the processing of the external input.
- q Count only one FTR for each ILF that is both maintained and read.

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DET Counting Rules



- q Count one DET for each user recognizable, non-repeated field that enters or exits the application boundary and is required to complete the external input.
- q Do not count fields that are retrieved or derived by the system and stored on an ILF during the elementary process if the fields did not cross the application boundary.
- q Count one DET for the capability to send a system response message outside the application boundary to indicate an error occurred during processing, confirm that processing is complete or verify that processing should continue.
- q Count one DET for the ability to specify an action to be taken even if there are multiple methods for invoking the same logical process.

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External Inputs



These are rated through weights and numbers of “Data Element Types” (DET’s) and “File Type Referenced” (FTR’s)

External Inputs (EI)

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

Do you see a counting pattern

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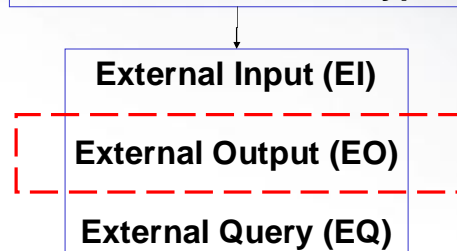
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Transaction Functions



Transaction Function Types



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External Outputs



Is 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.

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External Outputs – Primary Intent



To present information to a user.

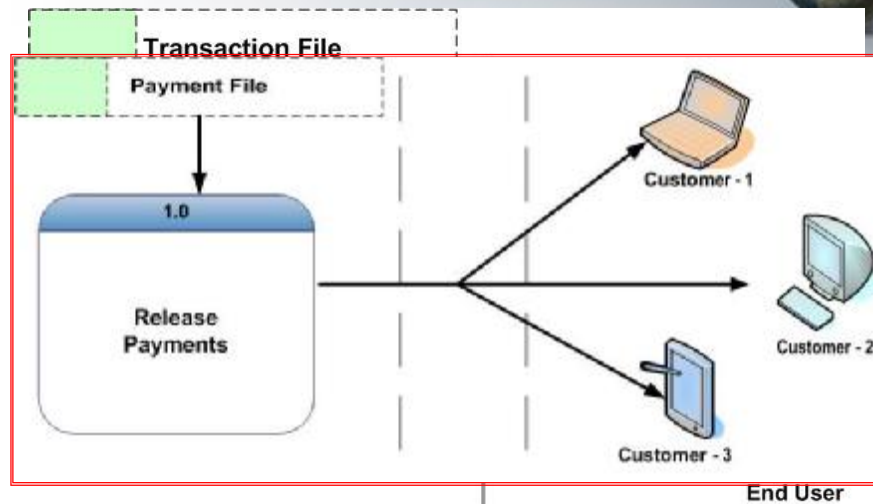
It presents data that is calculated or derived, it updates 1 or more ILFs, or it alters the behavior of the system.

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External Output



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EO – Counting Rules



All the following rules MUST apply

- q The function sends data or control information external to the application boundary.
- q For the identified process, one of the following three statements must apply:
 - Ø Processing logic is unique from the processing logic performed by other external outputs or external inquiries for the application.
 - Ø The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.
 - Ø The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.

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EO – Counting Rules



One of the following rules must apply for the elementary process to be counted as a unique external output.

- q The processing logic of the elementary process contains at least one mathematical formula or calculation.
- q The processing logic of the elementary process creates derived data.
- q The processing logic of the elementary process maintains at least one ILF.
- q The processing logic of the elementary process alters the behavior of the system.

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FTR Counting Rules - EO



- q Count one FTR for each ILF or EIF read during the processing of the elementary process.
- q Count one FTR for each ILF maintained during the processing of the elementary process.
- q Count only one FTR for each ILF that is both maintained and read during the elementary process.

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DET Counting Rules - EO



- q Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.
- q Count one DET for each user recognizable, non-repeated field that exits the boundary.
- q If a DET both enters and exits the boundary, count it only once for the elementary process.
- q Count one DET for the capability to send a system response message outside the application boundary to indicate an error occurred during processing, confirm that processing is complete or verify that processing should continue.

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DET Counting Rules - EO



- q Count one DET for the ability to specify an action to be taken even if there are multiple methods for invoking the same logical process.
- q Do not count fields that are retrieved or derived by the system and stored on an ILF during the elementary process if the fields did not cross the application boundary.
- q Do not count literals as DETs.
- q Do not count paging variables or system-generated stamps.

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External Output



These are rated through weights and numbers of “Data Element Types” (DET’s) and “File Type Referenced” (FTR’s)

External Outputs (EO)

Files Type Referenced	Data Elements		
	1 - 5	6 - 19	> 19
Less Than 2 FTR's	Low (4)	Low (4)	Average (5)
2 FTR's or 3 FTR's	Low (4)	Average (5)	High (7)
Greater Than 3 FTR's	Average (5)	High (7)	High (7)

Do you see a pattern here.

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Understanding EO



- q EO always contains business data.
- q Rules based data and control based “Outputs” are always External Query (EQ) and **NOT** External Output (EO)
- q Which means ONLY and ONLY Derived Data “Output” is treated as EO.
- q Notification Message is an EO but NOT Error Messages. Error Messages are part of an elementary process...where as notifications **ARE** and elementary process
- q Derived Data displayed in Textual Fashion as well as in a Graphical fashion == 2 EO's.

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EO – Special Issues And Concerns



The General DET and FTR rules are same with the following special concerns: -

- q Report Headers are counted as DET if and only if they are Dynamic.
- q External Output can have an INPUT side as well and included in the EO count itself.
- q Graphs DET and FTR's are counted just as in Textual Reports.

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Transaction Functions



Transaction Function Types

External Input (EI)

External Output (EO)

External Query (EQ)

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External Query



Is 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***.

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External Query – Primary Intent



To present information to a user.

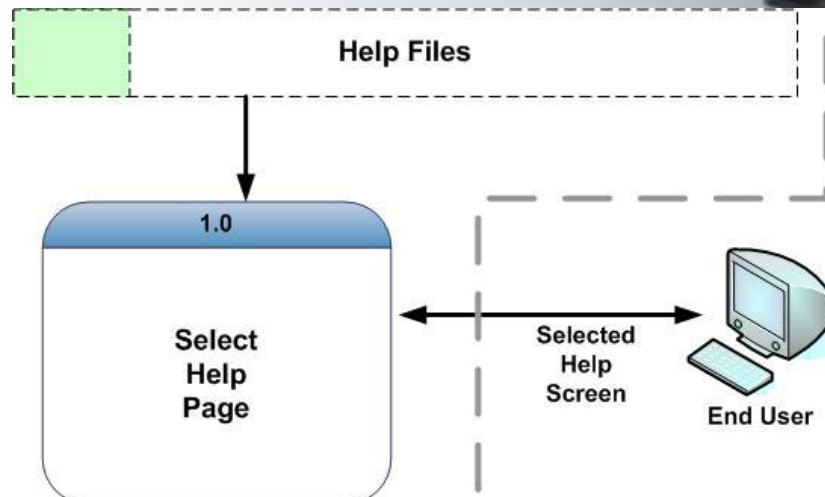
It presents only data that is retrieved from 1 or more ILFs or EIFs.

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External Query



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EQ – Counting Rules



All the following rules **MUST** apply

- q The function sends data or control information external to the application boundary.
- q For the identified process, one of the following three statements must apply:
 - Ø Processing logic is unique from the processing logic performed by other external outputs or external inquiries for the application.
 - Ø The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.
 - Ø The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.

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EQ – Counting Rules



All of the following rules must apply

- q The processing logic of the elementary process retrieves data or control information from an ILF or EIF.
- q The processing logic of the elementary process does not contain a mathematical formula or calculation.
- q The processing logic of the elementary process does not create derived data.
- q The processing logic of the elementary process does not maintain an ILF.
- q The processing logic of the elementary process does not alter the behavior of the system.

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FTR Counting Rules - EQ



- q Count one FTR for each ILF or EIF read during the processing of the elementary process.

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DET Counting Rules - EQ



- q Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.
- q Count one DET for each user recognizable, non-repeated field that exits the boundary.
- q If a DET both enters and exits the boundary, count it only once for the elementary process.
- q Count one DET for the capability to send a system response message outside the application boundary to indicate an error occurred during processing, confirm that processing is complete or verify that processing should continue.

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DET Counting Rules - EQ



- q Count one DET for the ability to specify an action to be taken even if there are multiple methods for invoking the same logical process.
- q Do not count fields that are retrieved or derived by the system and stored on an ILF during the elementary process if the fields did not cross the application boundary.
- q Do not count literals as DETs.
- q Do not count paging variables or system-generated stamps.

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External Query



These are rated through weights and numbers of “Data Element Types” (DET’s) and “File Type Referenced” (FTR’s)

External Query (EQ)

Files Type Referenced	Data Elements		
	1 - 5	5 - 19	> 19
Less Than 2 FTR's	Low (3)	Low (3)	Average (4)
2 FTR's or 3 FTR's	Low (3)	Average (4)	High (6)
Greater Than 3 FTR's	Average (4)	High (6)	High (6)

Do you see a pattern here.

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Understanding EQ



q EQ's contain business data, control data and rules based data.

Ø Business Data are:

- o Customer names
- o Addresses
- o Phone
- o Pin No.
- o Regional Preference...etc.

q EQ includes Drop Down Lists

q A screen full of customer address information would be an example of an EQ

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Understanding EQ and EO



Extremely important to note that EQ and EO may both have an input part.

This input is info that comes from Outside To Inside.

But the intent of the information coming from outside to inside in either EO or EQ

Does NOT maintain an ILF.

EO and EQ is mainly distinguished by the fact that EQ cannot have Derived / Calculated Values.

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EQ - Special Issues And Concerns



- q Can and EQ have an input side?
 - Ø Well yes and actually even if its not visible all EQ's have an input side. Input side not specifically visible are called Implied inquiry.
- q Can an EQ update an ILF?
 - Ø Yes! Just like in EO updates may happen but not maintenance of ILF. Only component that Maintains ILF is an EI.
- q Menus (Dynamic Menus)
 - Ø IFPUG counting manual states that menu items are NOT counted. But all Dynamic Menus are essentially External Queries and should be counted so.

By The way what is the difference between Update and Maintain.

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GENERAL HINTS



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General Hints – Counting EI, EO and EQ



- q Is data received from outside the application boundary?
 - Ø Look at the work flow.
 - Ø Identify where the user and other application interfaces occur in the process functional decomposition.

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General Hints – Counting EI, EO and EQ



- q Is the process the smallest unit of activity from the user perspective?
- Ø Look at the different paper or on-line forms used.
 - Ø Review the ILFs to identify how the user groups the information.
 - Ø Identify where the user and other application interfaces occur in the process functional decomposition.
 - Ø Look at what happened in the manual system.
 - Ø Note that one physical input or transaction file or screen can, when viewed logically, correspond to a number of EIs, EOs or EQs.
 - Ø Note that two or more physical input or transaction files or screens can correspond to one EI, EO or EQ if the processing logic is identical.

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General Hints – Counting EI, EO and EQ



- q Is the process self-contained and does it leave the business in a consistent state?
- Ø Review other external inputs, external outputs and external inquiries to understand how the user works with the information.
 - Ø Work through the process diagram to get hints.
 - Ø Look at what happened in the manual system.
 - Ø Check for consistency with other decisions.

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General Hints – Counting EI, EO and EQ



- q Is the processing logic unique from other EIs, EOs and EQs?
 - Ø Identify batch inputs or outputs based on the processing logic required.
 - Ø Remember that sorting or rearranging a set of data does not make processing logic unique.

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General Hints – Counting EI, EO and EQ



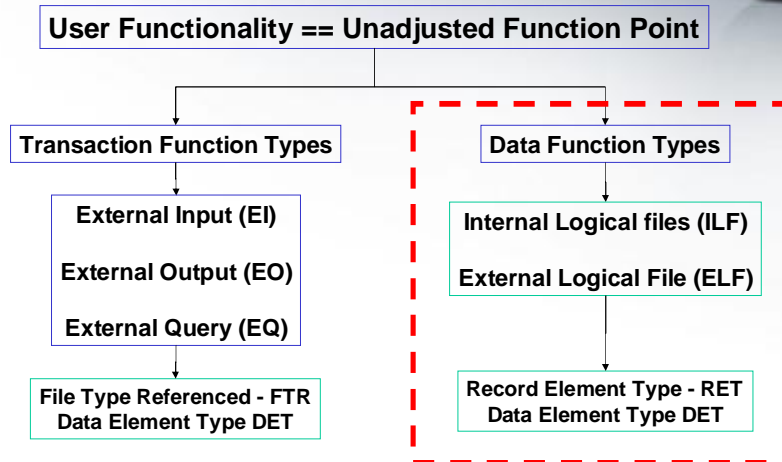
- q Are the data elements different from those for other EIs, EOs or EQs?
 - Ø If the data elements appear to be a subset of the data elements of another EI, EO, or EQ, be sure two elementary processes are required by the user—one for the main data elements and one for the subsets.
 - Ø Identify the primary intent of the elementary process before classifying it as an EI, EO, or EQ.
 - Ø Identification of the elementary process(es) is based on a joint understanding or interpretation of the requirements between the user and the developers.
 - Ø Each element in a functional decomposition may not map to a unique elementary process.
 - Ø The identification of the elementary processes requires interpretation of the user requirements.
 - Ø Count only one FTR for each ILF/EIF referenced even if the ILF/EIF has multiple RETs.

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User Functionality



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Data Functions - Defined



An **internal logical file (ILF)** is a user identifiable group of logically related data or control information maintained within the boundary of the application.

The primary intent of an ILF is to hold data maintained through one or more elementary processes of the application being counted.

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Data Functions - Defined



An **external interface file (EIF)** is a user identifiable group of logically related data or control information referenced by the application, but maintained within the boundary of another application.

The primary intent of an EIF is to hold data referenced through one or more elementary processes within the boundary of the application counted.

This means an EIF counted for an application must be in an ILF in another application.

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Primary Difference – ILF and EIF



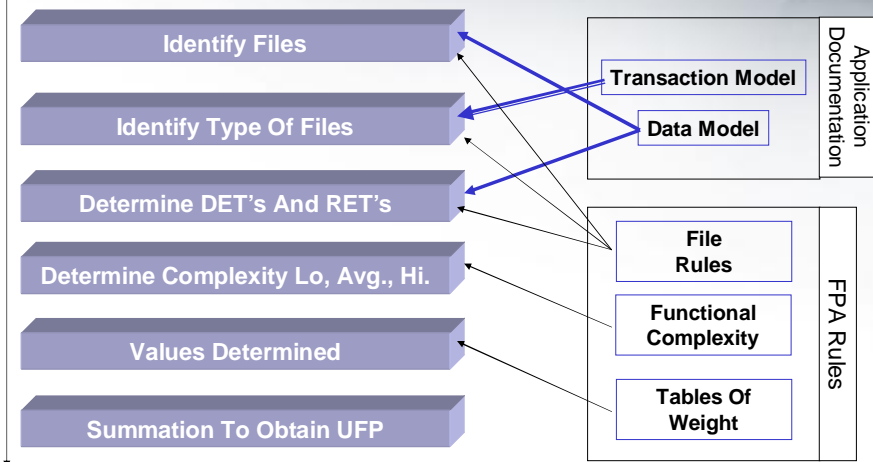
The primary difference
between an
internal logical file
and
an external interface file
is that an EIF is
not maintained by the application being
counted,
while an ILF is.

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Data Functions – The Steps



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DET and ~~FTR~~ RET



For the Data Functions complexity and contribution
RET and DET
are used and counted
for ILF and EIF

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RET – Defined



A record element type (RET) is a user recognizable subgroup of data elements within an ILF or EIF.

q There are two types of subgroups:

- Ø Optional
- Ø Mandatory

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RET – Defined



Record Element Type - RET

Optional

Optional subgroups are those that the user has the option of using one or none of the subgroups during an elementary process that adds or creates an instance of the data.

Mandatory

Mandatory subgroups are subgroups where the user must use at least one.

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RET – Defined



E.g., In a Human Resources Application, information for an employee is added by entering some general information.

In addition to the general information, the employee is a salaried or hourly employee.

The user has determined that an employee must be either salaried or hourly.

Each type of employee has unique attributes. Either type can have information about dependents.

For this example, there are three subgroups or RETs as shown below:

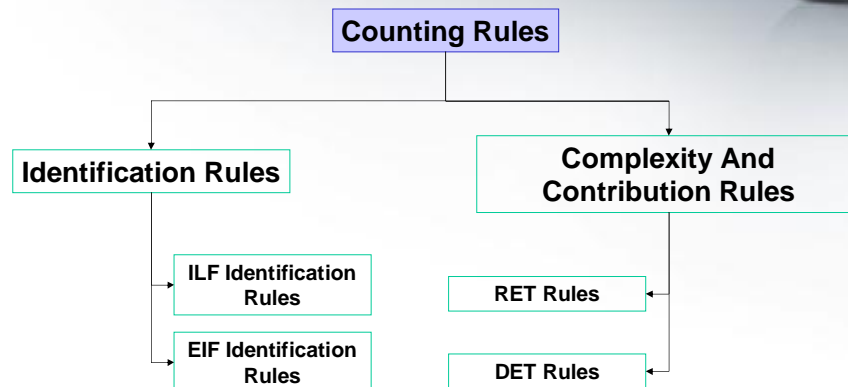
- Ø Salaried employee (mandatory); includes general information
- Ø Hourly employee (mandatory); includes general information
- Ø Dependent (optional)

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Common Rules – Data Functions

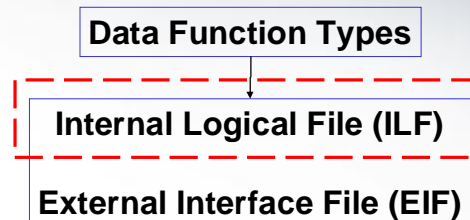


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Data Functions Types



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Internal Logical Files



A user identifiable group of logically related data that resides entirely ***within the application boundary*** and is maintained through External Inputs.

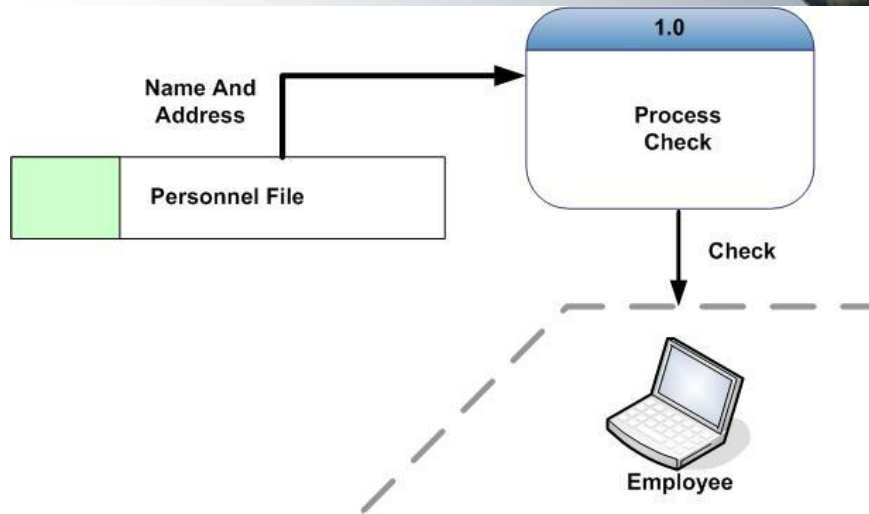
Maintained is the process of modifying data (adding, changed and deleting) via an elementary process (via an External Input).

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Internal Logical Files



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ILF Identification Rules



All of the following **MUST** apply: -

- q The group of data or control information is logical and user identifiable.
- q The group of data is maintained through an elementary process within the application boundary being counted.

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DET Counting Rules - ILF



- q Count a DET for each unique user recognizable, non-repeated field maintained in or retrieved from the ILF through the execution of an elementary process.
- q When two applications maintain and/or reference the same ILF, but each maintains/references separate DETs, count only the DETs being used by each application to size the ILF.
- q Count a DET for each piece of data required by the user to establish a relationship with another ILF.

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RET Counting Rules - ILF



One of the following rules applies when counting RETs:

- q Count a RET for each optional or mandatory subgroup of the ILF
- Or
- q If there are no subgroups, count the ILF as one RET.

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Internal Logical Files



This is how the RET's and the DET's stack up.

Internal Logical Files (ILF)

Files Type Referenced	Data Elements		
	1-19	20 - 50	> 50
One RET	Low (7)	Low (7)	Average (10)
2 to 5 RET's	Low (7)	Average (10)	High (15)
Greater Than 5 RET's	Average (10)	High (15)	High (15)

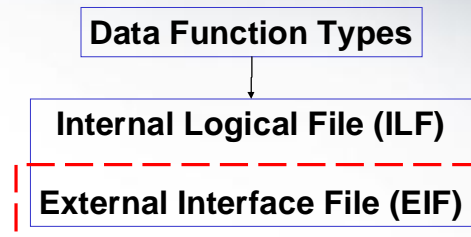
Do you see a pattern here

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Data Functions Types



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External Interface File



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.

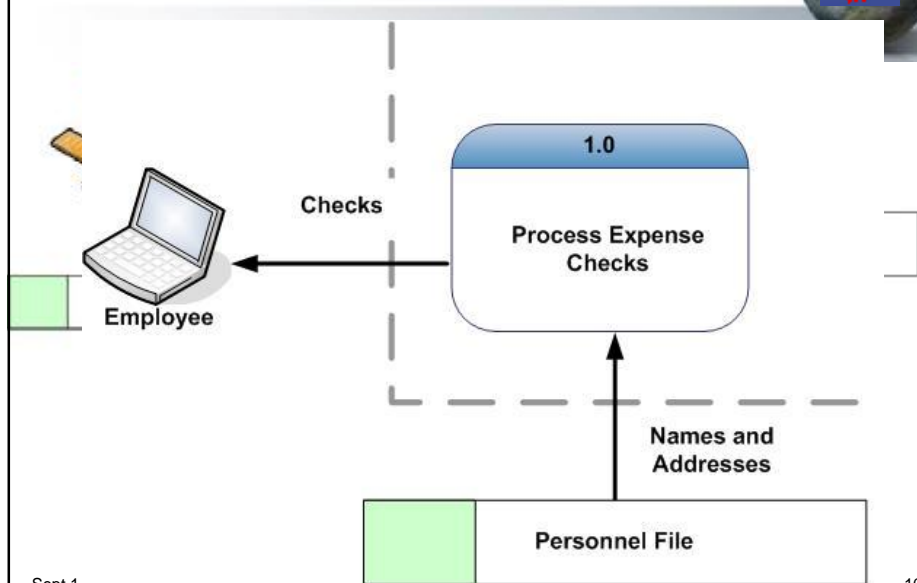
The external interface file is an internal logical file for another application.

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External Interface File



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EIF Identification Rules



All of the following **MUST** apply: -

- q The group of data or control information is logical and user identifiable.
- q The group of data is referenced by, and external to, the application being counted.
- q The group of data is not maintained by the application being counted.
- q The group of data is maintained in an ILF of another application.

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DET Counting Rules - EIF



- q Count a DET for each unique user recognizable, non-repeated field maintained in or retrieved from the EIF through the execution of an elementary process.
- q When two applications maintain and/or reference the same EIF, but each maintains/references separate DETs, count only the DETs being used by each application to size the EIF.
- q Count a DET for each piece of data required by the user to establish a relationship with another EIF.

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RET Counting Rules - EIF



One of the following rules applies when counting RETs:

q Count a RET for each optional or mandatory subgroup of the EIF

Or

q If there are no subgroups, count the EIF as one RET.

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Did You Notice????



The RET and DET Counting
Rules
For
EIF and ILF
Are
Exactly the
Same

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External Interface File



This is how the RET's and the DET's stack up.

External Interface Files (EIF)

Files Type Referenced	Data Elements		
	1-19	20 - 50	> 50
One RET	Low (5)	Low (5)	Average (7)
2 to 5 RET's	Low (5)	Average (7)	High (10)
Greater Than 5 RET's	Average (7)	High (10)	High (10)

Do you see a pattern here

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GENERAL HINTS



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General Hints – IFL and EIF



Is the data a logical group that supports specific user requirements?

- q An application can use an ILF or EIF in multiple processes, but the ILF or EIF is counted only once.
- q A logical file cannot be counted as both an ILF and EIF for the same application. If the data group satisfies both rules, count as an ILF.
- q If a group of data was not counted as an ILF or EIF itself, count its data elements as DETs for the ILF or EIF, which includes that group of data.
- q Do not assume that one physical file, table or object class equals one logical file when viewing data logically from the user perspective.
- q Although some storage technologies such as tables in a relational DBMS or sequential flat file or object classes relate closely to ILFs or EIFs, do not assume that this always equals a one-to-one physical-logical relationship.
- q Do not assume all physical files must be counted or included as part of an ILF or EIF.

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General Hints – IFL and EIF



Where is data maintained? Inside or outside the application boundary?

- q Look at the workflow.
- q In the process functional decomposition, identify where interfaces occur with the user and other applications.
- q Work through the process diagram to get hints.
- q Credit ILFs maintained by more than one application to each application at the time the application is counted. Only the DETs being used by each application being counted should be used to size the ILF/EIF.

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General Hints – IFL and EIF



Is the data in an ILF maintained through an elementary process of the application?

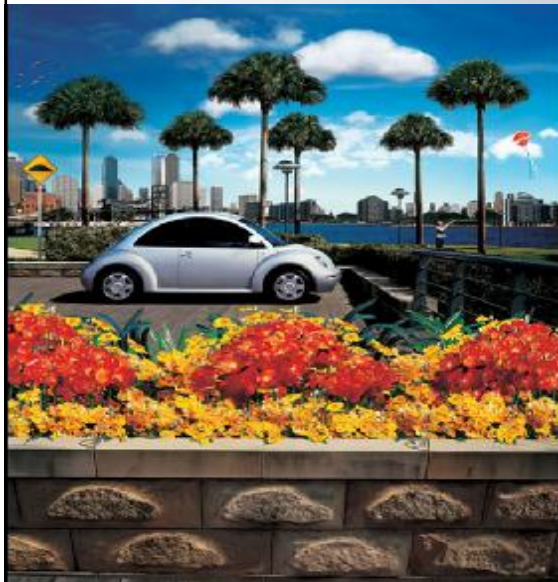
- q An application can use an ILF or EIF multiple times, but you count the ILF or EIF only once.
- q An elementary process can maintain more than one ILF.
- q Work through the process diagram to get hints.
- q Credit ILFs maintained by more than one application to each application at the time the application is counted.

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VALUE ADJUSTMENT FACTORS



These affect the entire application per se.

And
These values have a profound effect on the total size of the overall application.

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FP Basic Structure



FPA measures the size of an application system in 2 areas:

- Ø the specific user functionality
- Ø the system characteristics.

Function Point = (User Functionality) X (System Characteristics)

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The Value Adjustment Factor - Determination



- q The value adjustment factor (VAF) is based on 14 general system characteristics (GSCs).
- q These rate the general functionality of the application being counted.
- q Each characteristic has associated descriptions that help determine the degree of influence of that characteristic.
- q The degree of influence for each characteristic ranges on a scale of zero to five, from no influence to strong influence.

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General System Characteristics



- q Affects the entire application
- q Tweaks the counting of the entire application based on 14 industry tested characteristics
- q These have a profound effect on the total count of the application
- q When applied, the value adjustment factor adjusts the unadjusted function point count **+/-35 percent** to produce the adjusted function point count.
- q These are used for calculating the Value Adjustment Factor (VAF) for the application
- q Each characteristic has to be rated from 0 to 5

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Steps In Calculating VAF



- q Step – 1 : Evaluate each of the 14 general system characteristics on a scale from zero to five to determine the **degree of influence (DI)**.
- q Step – 2 : Add the degrees of influence for all 14 general system characteristics to produce the total degree of influence **(TDI)**.
- q Step – 3 : Use the formula **$VAF = (TDI * 0.01) + 0.65$**

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GSC - Overview



General System Characteristics		Brief Descriptions
1	Data Communications	Data Communications describes the degree to which the application communicates directly with the processor.
2	Distributed Data Processing	Describes the degree to which the application transfers data among components of the application.
3	Performance	Performance describes the degree to which response time and throughput performance considerations influenced the application development.
4	Heavily Used Configuration	A heavily used operational configuration, requiring special design considerations, is a characteristic of the application.
5	Transaction Rate	Describes the degree to which the rate of business transactions influenced the development of the application.
6	On-Line Data Entry	Describes the degree to which data is entered through interactive transactions.
7	End user efficiency	Describes the degree of consideration for human factors and ease of use for the user of the application measured.

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GSC – Overview [Contd..]



General System Characteristics		Brief Descriptions
8	On-line update	Describes the degree to which internal logical files are updated online.
9	Complex Processing	Describes the degree to which processing logic influenced the development of the application.
10	Reusability	Describes the degree to which the application and the code in the application have been specifically designed, developed, and supported to be usable in other applications.
11	Installation Ease	Describes the degree to which conversion from previous environments influenced the development of the application.
12	Operational Ease	Describes the degree to which the application attends to operational aspects, such as start-up, back-up, and recovery processes.
13	Multiple Site	Describes the degree to which the application has been developed for multiple locations and user organizations.
14	Facilitate Change	Describes the degree to which the application has been developed for easy modification of processing logic or data structure.

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Degree Of Influence



Based on the stated user requirements, each general system characteristic (GSC) must be evaluated in terms of its degree of influence (DI) on a scale of zero to five.

Score As	System Influence
0	Not Present or No Influence
1	Indidental Influence
2	Moderate Influence
3	Significant Influence
4	Significant Influence
5	Strong Influence Throughout

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GSC – Details



Data Communications

Data Communications describes the degree to which the application communicates directly with the processor.

Data Communications	
Score As	Description To Dtermine Degree Of Influence
0	Application is pure batch processing or a stand-alone application
1	Application is batch but has remote data entry or remote printing
2	Application is batch but has remote data entry and remote printing
3	Application includes on-line data collection or TP (teleprocessing) front end to a batch process or query system
4	Application is more than a front-end, but supports only one type of TP communications
5	Application is more than a front-end, and supports more than one type of TP communications protocol

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GSC – Details

Data Communications



Hints to rules 1 and 2: -

- q The entry of data does not involve reading or writing directly to an ILF. Updated to ILF using batch updates at a later time.
- q The entry of data does not involve reading or writing directly to an ILF.

Hints to rule 3: -

- q Simple business rules and minimal edits (e.g., alpha/numeric, range check, required data, etc.) may be performed. When this data is eventually processed by the application, additional edits are performed.
- q The entry of data does not involve reading or writing directly to an ILF. Data are entered on-line, but the transactions are stored in a temporary file for batch update of ILF(s) at a later time.

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GSC – Details

Data Communications



Hints to rule 4: -

- q Data for the application is collected and may directly update ILF(s) or be stored for future processing using an input device, which performs edits based on business rules.
- q Only one communication protocol is used. Typically, when this data is processed by the application, no further edits are required.
- q The entry of data involves reading or writing to an ILF.
- q For example, client-server data entry or Internet data entry, but not both.

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GSC – Details

Data Communications



Hints to rule 5: -

- q Same as 4, however, data collection is performed using multiple telecommunication protocols.
- q For example, client-server data entry and Internet data entry of the same transaction.

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GSC – Details

Distributed Data Processing



Distributed Data Processing describes the degree to which the application transfers data among components of the application.

Distributed Data Processing	
Score As	Description To Dtermine Degree Of Influence
0	Data is not transferred or processed on another component of the system.
1	Data is prepared for transfer, then is transferred and processed on another component of the system, for user processing.
2	Data is prepared for transfer, then is transferred and processed on another component of the system ,not for user processing.
3	Distributed processing and data transfer are on-line and in one direction only.
4	Distributed processing and data transfer are on-line and in both directions
5	Distributed processing and data transfer are on-line and are dynamically performed on the most appropriate component of the system.

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GSC – Details



Distributed Data Processing

In a distributed environment, the application is viewed as requiring multiple components (hardware) on which certain processing or data resides.

Hints to rule 0: -

- q Presentation, processing, and I/O components are all in the same place (i.e., stand-alone applications).

Hints to rule 1: -

- q Application downloads data to a user's client machine, so the user can use Excel or other reporting tools to prepare graphs and perform other analysis.
- q Process that transfers data from mainframe to an external component for user processing. This transfer is performed using a simple protocol such as FTP.
- q Transferred to a user for processing.

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GSC – Details



Distributed Data Processing

Hints to rule 2: -

- q Application sends data to client or server. This data is then processed or used to produce reports, etc. No data or confirmation is sent back to the client or server.
- q Transferred to a component for processing.

Hints to rule 3: -

- q Data is sent between client and server in **one** direction only. This data is then processed or used to produce reports, etc. by the receiving application. This data typically includes transactions that update an ILF on the client or server.
- q For example – client-server or web-enabled applications.

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GSC – Details

Distributed Data Processing



Hints to rule 4: -

- q Data is sent between client and server in **either** direction. This data is then processed or used to produce reports, etc. by the receiving application. This data typically includes transactions that update an ILF on the client or server.
- q For example - client-server or web-enabled applications.
- q The application runs under an operating system that automatically handles the allocation between components, **however**, the use of the operating system did not influence the design and implementation of the application.

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GSC – Details

Distributed Data Processing



Hints to rule 5: -

- q The developer must consider special application software that looks at multiple processors and runs the application on a specific type of processor. This is invisible to the user.
- q The application runs under an operating system that automatically handles the dynamic allocation between components, **and** the use of the operating system specifically influenced the design and implementation of the application.

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GSC – Details

Distributed Data Processing



Typically

- q Many applications, including legacy applications, receive a score of 0
- q Primitive distributed applications that include batch applications in which data is not transferred online on-line receive a score of 1 to 2
- q Client-server or web-based applications receive a score of 3 to 4
- q It is uncommon to score 5
- q There must be multiple servers or processors, each of which would be selected dynamically on the basis of its real-time availability to score 5

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GSC – Details

Performance



Performance describes the degree to which response time and throughput performance considerations influenced the application development.

Performance	
Score As	Description To Dtermine Degree Of Influence
0	No special performance requirements were stated by the user..
1	Performance and design requirements were stated and reviewed but no special actions were required.
2	Response time or throughput is critical during peak hours. No special design for CPU utilization was required. Processing deadline is for the next business cycle.
3	Response time or throughput is critical during all business hours. No special design for CPU utilization was required. Processing deadline requirements with interfacing systems are constraining.
4	In addition, stated user performance requirements are stringent enough to require performance analysis tasks in the design phase.
5	In addition, performance analysis tools were used in the design, development, and/or implementation phases to meet the stated user performance requirements.

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GSC – Details



Performance

"How fast can we make the application go and how much did/does that impact the design, development, and/or implementation?"

The users may require real time access to their data, stating or implying standards for response time and throughput capacity.

Response time typically relates to interactive processing; throughput relates to batch processing

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GSC – Details



Typically

Performance

Batch applications receive a score of 0 to 4

On-line (including interactive client-server or web-enabled) applications receive a score of 0 to 4

Web-based applications receive a score of 4 or 5

Most MIS on-line systems receive a score of 2

Real-time, telecommunication, or process control systems receive a score of 0 to 5

A score of 5 requires the use of performance analysis tools

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GSC – Details



Heavily Used Configuration

Heavily Used Configuration describes the degree to which computer resource restrictions influenced the development of the application.

Heavily Used Configuration	
Score As	Description To Dtermine Degree Of Influence
0	No explicit or implicit operational restrictions are included.
1	Operational restrictions do exist, but are less restrictive than a typical application. No special effort is needed to meet the restrictions.
2	Operational restrictions do exist, but are typical for an application. Special effort through controllers or control programs is needed to meet the restrictions.
3	Stated operational restrictions require special constraints on one piece of the application in the central processor or a dedicated processor.
4	Stated operational restrictions require special constraints on the entire application in the central processor or a dedicated processor.
5	In addition, there are special constraints on the application in the distributed components of the system.

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GSC – Details



Heavily Used Configuration

For this GSC think in terms of "How much does the infrastructure influence the design?"

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GSC – Details



Heavily Used Configuration

Examples

- q This question indicates that the application must run on a computer that is under- powered and can not adequately handle the new or changed functionality and that somehow the developers can overcome this by developing the application differently.
- q More than one application accessing the same data can create operational restrictions.
- q Application competing for the same resource and technologies with the potential deadlocks must be tuned and constrained to avoid performance degradation.

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GSC – Details



Transaction Rate

Transaction Rate describes the degree to which the rate of business transactions influenced the development of the application.

Transaction Rate	
Score As	Description To Dtermine Degree Of Influence
0	No peak transaction period is anticipated.
1	Low transaction rates have minimal effect on the design, development, and installation phases
2	Average transaction rates have some effect on the design, development, and installation phases.
3	High transaction rates affect the design, development, and/or installation phases.
4	High transaction rate(s) stated by the user in the application requirements or service level agreements are high enough to require performance analysis tasks in the design, development, and/or installation phases.
5	High transaction rate(s) stated by the user in the application requirements or service level agreements are high enough to require performance analysis tasks and, in addition, require the use of performance analysis tools in the design, development, and/or installation phases.

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GSC – Details



Transaction Rate

"How many transactions can be processed by the application in a given period of time?"

Often this score is the same as the score for GSC 3 because transaction rates often influence performance requirements.

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GSC – Details



Online Data Entry

Online Data Entry describes the degree to which data is entered through interactive transactions.

Online Data Entry	
Score As	Description To Dtermine Degree Of Influence
0	All transactions are processed in batch mode.
1	1% to 7% of transactions are interactive.
2	8% to 15% of transactions are interactive.
3	16% to 23% of transactions are interactive.
4	24% to 30% of transactions are interactive.
5	More than 30% of transactions are interactive.

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GSC – Details

Online Data Entry



Hints

- q This refers to types of transactions not volumes.
- q For example, if an application has 45 EIs, EOs, and EQs, what percent of the EIs, EOs, and EQs are accomplished via on-line transactions.

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GSC – Details

End User Efficiency



End-User Efficiency describes the degree of consideration for human factors and ease of use for the user of the application measured.

The design includes:

- q Navigational aids (for example, function keys, jumps, dynamically generated menus)
- q Menus
- q Online help and documents
- q Automated cursor movement
- q Scrolling
- q Remote printing via online transactions
- q Pre-assigned function keys
- q Batch jobs submitted from online transactions

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GSC – Details



End User Efficiency

- q Cursor selection of screen data
- q Heavy use of reverse video, highlighting, colors underlining, and other indicators
- q Hard copy user documentation of online transactions
- q Mouse interface
- q Pop-up windows
- q As few screens as possible to accomplish a business function
- q Bilingual support (supports two languages; count as four items)
- q Multilingual support (supports more than two languages; count as six items)

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GSC – Details



End User Efficiency

End User Efficiency	
Score As	Description To Determine Degree Of Influence
0	None of the above.
1	One to three of the above.
2	Four to five of the above.
3	Six or more of the above, but there are no specific user requirements related to efficiency.
4	Six or more of the above, and stated requirements for user efficiency are strong enough to require design tasks for human factors to be included
5	Six or more of the above, and stated requirements for user efficiency are strong enough to require use of special tools and processes in order to demonstrate that the objectives have been achieved.

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GSC – Details



End User Efficiency

- q Use a convention of a score of 4 whenever the application is deployed in a GUI environment (unless it scores 5).
- q Usually only software environments that prepare applications for mass-market or non-technical users score 5, and only if they have ergonomics specialists and/or usability studies as part of their process

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GSC – Details



Online Update

Online Update describes the degree to which internal logical files are updated online.

Online Update	
Score As	Description To Dtermine Degree Of Influence
0	None
1	On-line update of one to three control files is included. Volume of updating is low and recovery is easy.
2	On-line update of four or more control files is included. Volume of updating is low and recovery is easy.
3	On-line update of major internal logical files is included.
4	In addition, protection against data loss is essential and has been specially designed and programmed in the system.
5	In addition, high volumes bring cost considerations into the recovery process. Highly automated recovery procedures with minimum human intervention are included.

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GSC – Details

Online Update



- q On-line update usually requires a keyed file or database.
- q Automatic recovery provided by the operating system counts if it impacts the application.

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GSC – Details

Online Update

Typically



- q Pure batch applications receive a score of 0.
- q On-line updates of files that modify the way an application processes or validates data receive a score of 1 or 2.
- q On-line updates of user persistent data receive a score of 3.
- q MIS applications receive a score of 3 or less.
- q Most GUI type applications receive a score of 3 or above.
- q Applications which use programmed recovery such as SQL roll back and commit receive a score of 4. Operational/routine backup is not considered protection against data loss.
- q Applications required to recover data, reboot, or perform other self-contained functions in the event of a system error receive a score of 5. Recovery may require a human to press enter or perform some other minimal function to initiate this process.

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GSC – Details



Complex Processing

Online Update describes the degree to which internal logical files are updated online.

The following components are present:

- q Sensitive control (for example, special audit processing) and/or application specific security processing
- q Extensive logical processing
- q Extensive mathematical processing
- q Much exception processing resulting in incomplete transactions that must be processed again
- q Complex processing to handle multiple input/output possibilities.

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GSC – Details



Complex Processing

Online Update	
Score As	Description To Dtermine Degree Of Influence
0	None of the above.
1	Any one of the above.
2	Any two of the above.
3	Any three of the above.
4	Any four of the above.
5	All five of the above.

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GSC – Details



Complex Processing

- q **Extensive logical** processing is Boolean logic (use of 'AND', 'OR') of greater than average difficulty or a minimum of 4 nested conditional (IF, CASE) statements. Extensive logical processing does not occur in most MIS applications.
- q **Extensive mathematical** processing is arithmetic that is beyond the capability of a 4-function calculator (add, subtract, multiply, divide). This is usually not present in most MIS applications. However, an engineering application may qualify.

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GSC – Details



Reusability

Reusability describes the degree to which the application and the code in the application have been specifically designed, developed, and supported to be usable in *other* applications.

Reusability	
Score As	Description To Determine Degree Of Influence
0	No reusable code.
1	Reusable code is used within the application.
2	Less than 10% of the application code developed is intended for use in more than one application.
3	Ten percent (10%) or more of the application code developed is intended for use in more than one application.
4	The application was specifically packaged and/or documented to ease reuse, and the application is customized at the source code level.
5	The application was specifically packaged and/or documented to ease reuse, and the application is customized for use by means of user parameter maintenance.

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GSC – Details

Reusability



Hint To Rule 1: -

- q A score of 1 is awarded for reusing code regardless of where it was developed.
- q Code developed specifically for reuse within the application and used more than once within the application counts as well as code retrieved from a central library and available for general use

Hint To Rule 2: -

- q To score 2 or more, the code must be developed for use in more than one application, stored and managed in a central library and be available for general use. Code from one application that is cut and pasted into another application is not considered reuse.
- q The reusable code would be supported by documentation that enables and eases the reuse.

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GSC – Details

Reusability



Hint To Rule 5: -

- q Examples of applications customized through use of parameters include PeopleSoft and SAP and would generally receive a score of 5.
- q Reused code may be slightly modified in the receiving application.
- q Examples of reuse include objects or other static code maintained in an object/code library.

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GSC – Details



Installation Ease

Installation Ease describes the degree to which conversion from previous environments influenced the development of the application.

Installation Ease	
Score As	Description To Dtermine Degree Of Influence
0	No special considerations were stated by the user, and no special setup is required for installation.
1	No special considerations were stated by the user, but special setup is required for installation.
2	Conversion and installation requirements were stated by the user, and conversion and installation guides were provided and tested. The impact of conversion on the project is not considered to be important.
3	Conversion and installation requirements were stated by the user, and conversion and installation guides were provided and tested. The impact of conversion on the project is considered to be important.
4	In addition to 2 above, automated conversion and installation tools were provided and tested.
5	In addition to 3 above, automated conversion and installation tools were provided and tested.

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GSC – Details



Installation Ease

Conversion and installation includes converting pre-existing data into new data files, loading files with actual data, or developing special installation software, such as porting.

Purchased or developed software must be used in order to take credit for installation and conversion.

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GSC – Details

Installation Ease



Hint To Rule 1: -

- q Most business applications require some special setup to install the application and receive a score of 1.

Hint To Rule 2: -

- q If the application has conversion and installation requirements and installation guides were provided, and providing these functions and guides were not on the critical path of the project, score a 2.

Hint To Rule 3: -

- q If the application has conversion and installation requirements and installation guides were provided, and providing these functions and guides were on the critical path of the project, score a 3.

Hint To Rule 4 and 5: -

- q If the application has conversion and installation requirements and can be installed with no external intervention, score a 4 or 5, depending on the other requirements for the scoring of 2 and 3

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GSC – Details

Operational Ease



Operational Ease describes the degree to which the application attends to operational aspects, such as start-up, back-up, and recovery processes.

Operational Ease	
Score As	Description To Dtermine Degree Of Influence
0	No special operational considerations other than the normal back-up procedures were stated by the user.
1 - 4	Start-up, back-up, and recovery processes were provided, but human intervention is required.
	Start-up, back-up, and recovery processes were provided, but no human intervention is required (count as two items)
	The application minimizes the need for tape mounts and/or remote data access requiring human intervention.
	The application minimizes the need for paper handling.
5	The application is designed for unattended operation. Unattended operation means no human intervention is required to operate the system other than to start up or shut down the application. Automatic error recovery is a feature of the application.

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GSC – Details

Operational Ease



Hint To Rule 1-4a: -

- q Application has the ability to perform start-up, back-up, and recovery; however, human response is required to initiate the function.

Hint To Rule 1-4b: -

- q Application has the ability to perform start-up, back-up, and recovery; and no human response is required to initiate the function.

Hint To Rule 1-4c: -

- q The application minimizes the need to access data that is not immediately available.
- q This may include importing data from a distributed processor to the local processor prior to execution to eliminate access delays.

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GSC – Details

Operational Ease



Hint To Rule 1-4d: -

- q The application has been designed to provide the user with data in a condensed format or via a media other than paper.
- q This could include elimination of detailed printed information or access to on-line reports, inquiries, microfiche, CD, or other such media.

Hint To Rule 5: -

- q A score of 5 is assigned to an application that runs and recovers automatically from errors, on its own – an unattended operation.
- q Unattended operation may include unmanned satellite, nuclear reactor, or air traffic control.

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GSC – Details



Multiple Sites

Multiple Sites describes the degree to which the application has been developed for multiple locations and user organizations.

Multiple Sites	
Score As	Description To Determine Degree Of Influence
0	The needs of only one installation site were considered in the design.
1	The needs of more than one installation site were considered in the design, and the application is designed to operate only under identical hardware and software environments.
2	The needs of more than one installation site were considered in the design, and the application is designed to operate only under similar hardware and/or software environments.
3	The needs of more than one installation site were considered in the design, and the application is designed to operate under different hardware and/or software environments.
4	Documentation and support plan are provided and tested to support the application at multiple installation sites and the application is as described by 2.
5	Documentation and support plan are provided and tested to support the application at multiple installation sites and the application is as described by 3.

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GSC – Details



Multiple Sites

Some Hints

- q The term multiple sites is a logical term and is not necessarily physical.
- q There can be multiple sites within the same physical location.
- q The determining factor is based upon the needs of the various installations.

Scoring is dependent on the no. of different platforms

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GSC – Details

Facilitate Change



Facilitate Change describes the degree to which the application has been developed for easy modification of processing logic or data structure.

S. No.	Description	Count
Flexible Query		
1	Flexible query and report facility is provided that can handle simple requests.	
2	Flexible query and report facility is provided that can handle requests of average complexity.	
3	Flexible query and report facility is provided that can handle complex requests.	
Business Control Data		
1	Business control data is kept in tables that are maintained by the user with on-line interactive processes, but changes take effect only on the next business cycle.	
2	Business control data is kept in tables that are maintained by the user with on-line interactive processes, and the changes take effect immediately.	

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GSC – Details

Facilitate Change



Facilitate Change describes the degree to which the application has been developed for easy modification of processing logic or data structure.

Facilitate Change	
Score As	Description To Determine Degree Of Influence
0	None of the above.
1	A total of one item from above.
2	A total of two items from above.
3	A total of three items from above.
4	A total of four items from above.
5	A total of five items from above.

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GSC – Details

Facilitate Change



Hints On Flexible Query and Reporting:

- q A flexible query and reporting facility means more than a list of choices in a 'canned' query or report.
- q It is the ability of the user to control the data, data source, sequence and format of their query or report request.
- q It means freedom to design screen layout, horizontal and vertical sorting, data item display formats, selection criteria for both files and data items.
- q It includes true user programming for inquiries and is sometimes referred to as ad hoc query or reporting
- q Using filters which control the amount of data viewed or printed in a fixed format is not considered to be a flexible query and report facility.
- q Query and/or report writer capability is often provided by languages such as SQL or Focus or by some of the more dynamic ad hoc reporting tools (e.g., Crystal Reports).

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Total FP – Adjusted Function Points



$$FP = UAF * VAF$$

Type of Component	Complexity of Components			
	Low	Average	High	Total
External Inputs	___ x 3 = ___	___ x 4 = ___	___ x 6 = ___	
External Outputs	___ x 4 = ___	___ x 5 = ___	___ x 7 = ___	
External Inquiries	___ x 3 = ___	___ x 4 = ___	___ x 6 = ___	
Internal Logical Files	___ x 7 = ___	___ x 10 = ___	___ x 15 = ___	
External Interface Files	___ x 5 = ___	___ x 7 = ___	___ x 10 = ___	

Total Number of Unadjusted

Function Points

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Function Point - Enhancement



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What Is Enhancement?



Existing
Installed
User
Functions

Adding Functions

Deleting Functions

Altering Functions

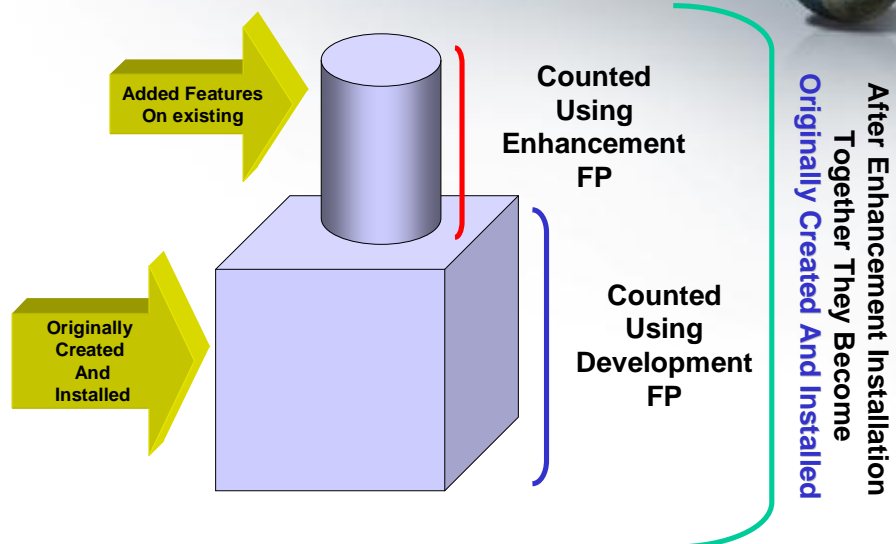
Whether
Function is reduced
Or Not
Effort is always
more

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What Is Enhancement?



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Enhancement Function Count



- q Enhancement Function Point Counts – All features added, deleted or changed.
- q However the boundary of the application remains the same
- q The scope of the overall application remains the same

Hence simply put...counting the Enhancement is measuring the difference between the

“Functionality Of Application Before Enhancement”

and

“Functionality of the Application After the Enhancement”.

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Counting Data Functions In Enhancement



Additional ILF And EIF are counted as per the rules with these additional considerations: -

1. If the change involves only the addition of new records to a logical file or new values in an existing field within that logical file, there is no justification to count the data function as being changed.
2. If a data function is changed because a field is added and that field is not used by the application being counted, then there is no change to that application.
3. In order for a data function to be counted as a changed function, the general guideline is that it must be structurally altered (e.g., adding or removing a field or changing the characteristics of the field).

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Counting Data Functions In Enhancement



Additional ILF And EIF are counted as per the rules with these additional considerations: -

4. If an application is required to use (reference or maintain) an existing field that it did not previously use, then the related data function is considered changed for that application. This can occur without any physical changes to the file.
5. If new fields are added to an ILF, look for new or modified transactional functions that maintain the field in that ILF to confirm that a change has occurred.
6. If an application neither maintains nor references a new or changed field, then it cannot take credit for a changed data function.

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Counting Data Functions In Enhancement



Additional ILF And EIF are counted as per the rules with these additional considerations: -

7. If a physical file is added by an enhancement project, it does not necessarily result in a new logical file. We first need to determine whether the new physical file is a change to an existing logical file with additional DETs and possibly an additional RET, or a new logical file..

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Counting Transactional Functions



- q The identification of Transactional Functions that have been changed by adding or removing Data Element Types is obvious.
- q It is not as obvious when the user requirements are for changes in processing logic. When processing logic has been altered within an application to meet business requirements, the elementary process that embodies that logic should be identified and counted as being changed.

For example, when an edit or validation change is made to input processing logic and Add, Delete, Update and implied Inquiry transactions exist, then only the Add and Update transactions are counted for the enhancement.

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Counting Transactional Functions



So

If the DET of a transaction function changes
Than simply count the changed DET as per the
counting rules..

***But what about the Processing Logic Change...
When do we consider that a processing logic change has
occurred and that it alters the functionality of the
Transaction Function?***

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Counting Transactional Functions



Processing logic is defined as requirements specifically requested by the user to complete an elementary process. And they would be considered changed if:-

1. Validations -

If a requirement exists to perform a different validation or change the validation in an existing transactional function, the transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



2. Mathematical Formula And Calculations

- Ø If a business requirement exists to modify an existing calculation (e.g., before, the formula was $A + B = C$ and now $C = A * B$), the transaction that includes that calculation would be counted as changed in the enhancement count.
- Ø Currently there is a list of employees that is counted as an EQ. The enhancement project requirements state to display summary counts of those employees. The transaction would be identified as changed and the function type would be changed from an EQ to an EO in the enhancement count.

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Counting Transactional Functions



3. Equivalent values are converted

- Ø For example, an elementary process references currency conversion rates from US dollars to other currencies. The conversion is accomplished by retrieving values from tables, so calculations need not be performed.
- Ø If a business requirement exists to change the functionality to include the ability to convert other currencies to Euro, the transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



4. Data is filtered and selected by using specified criteria to compare multiple sets of data

- Ø For example, to generate a list of employees by assignment, an elementary process compares the job number of a job assignment to select and lists the appropriate employees with that assignment.
 - If a requirement exists to modify the selection criteria or add additional selection criteria to an existing transaction (a list of employees now needs to display a list of employees by assignment and location), the transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



5. Conditions are analyzed to determine which are applicable

- Ø For example, processing logic exercised by the elementary process when an employee is added and will depend on whether an employee is paid based on salary or hours worked.
- Ø If a requirement exists to modify the condition or add additional conditions to an existing transaction, the transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



6. One or more ILFs are updated

- Ø For example, when adding an employee, the elementary process updates the employee ILF to maintain the employee data.
- Ø If a business requirement results in updating an additional ILF or different DETs by an existing transaction, the transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



7. One or more ILFs or EIFs are referenced

- Ø For example, when adding an employee, the currency EIF is referenced to use the correct US dollar conversion rate to determine an employee's hourly rate.
- Ø If a business requirement results in referencing additional ILFs, EIFs or DETs in an existing transaction, the affected transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



8. Data or control information is retrieved

- Ø For example, to view a list of possible pay grades, pay grade information is retrieved.
- Ø If the business requirement results in retrieving additional information in an existing transaction, the affected transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



9. Derived data is created by transforming existing data to create additional data

- Ø For example, to determine (derive) a patient's registration number (e.g., SMIJO01), the following data is concatenated:
 - § the first three letters of the patient's last name (e.g., SMI for Smith)
 - § the first two letter of the patient's first name (e.g., JO for John)
 - § a unique two-digit sequence number (starting with 01)
- Ø If the business requirement results in changing how the transaction derives the data, the affected transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



10. Behavior of the system is altered

- Ø For example, the behavior of the elementary process of paying employees is altered when a change is made to pay them every other Friday versus on the 15th and the last day of the month.
- Ø If the business requirement results in altering the behavior of the system (e.g., in the example above, the transaction is changed so that the pay date parameter affects only hourly employees not all employees), the affected transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



11. Prepare and present information outside the boundary

- Ø For example, a list of employees displayed for the user.
- Ø When the business requirement results in presenting additional data outside the boundary, the affected transaction would be counted as changed in the enhancement count.
 - § Changes to literals, format, color or other elements of the physical presentation are not considered changes to the processing logic, and therefore not part of an enhancement count.

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Counting Transactional Functions



12. Capability exists to accept data or control information that enters the application boundary

- Ø For example, a user enters several pieces of information to add a customer order to the system.
- Ø When the business requirement results in different pieces of information that enter the boundary (e.g., DETs), the affected transaction would be counted as changed in the enhancement count.

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Counting Transactional Functions



13 Data is resorted or rearranged

q For example, a user requests the list of employees in alphabetical order.

q **Note:** Resorting or rearranging a set of data does not impact the identification of the type or uniqueness of a transactional function.

- Ø When the business requirement results in changing the existing sort sequence (e.g., user now requests the above referenced list of employees in location order instead of alphabetical order), the affected transaction would be counted as changed in the enhancement count.
- Ø The user requests an additional report of the same data (list of employees) sorted by location. A new transaction would not be counted, but a change to the existing transaction would be included in the enhancement count. Resorting or rearranging a set of data does not impact the identification of the type or uniqueness of a transactional function, but it does constitute changes in processing logic.

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Questions To Consider - *Enhancements*



q The following questions can be used during the interview with the developer or Subject Matter Expert (SME) during function point counting sessions.

q Positive responses to the questions listed below indicate possible changes to user functionality.

q Additional investigation is required to determine whether and how they should affect the function point count.

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Questions To Consider - *Enhancements*



Let us view each of the questions.....

Questions To Consider – For Enhancements

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General System Characteristics



The 14 General System Characteristics (GSCs) should be reviewed for change. Small enhancements do not normally require such a review. Examples of changes that may indicate a need to review the GSCs include:

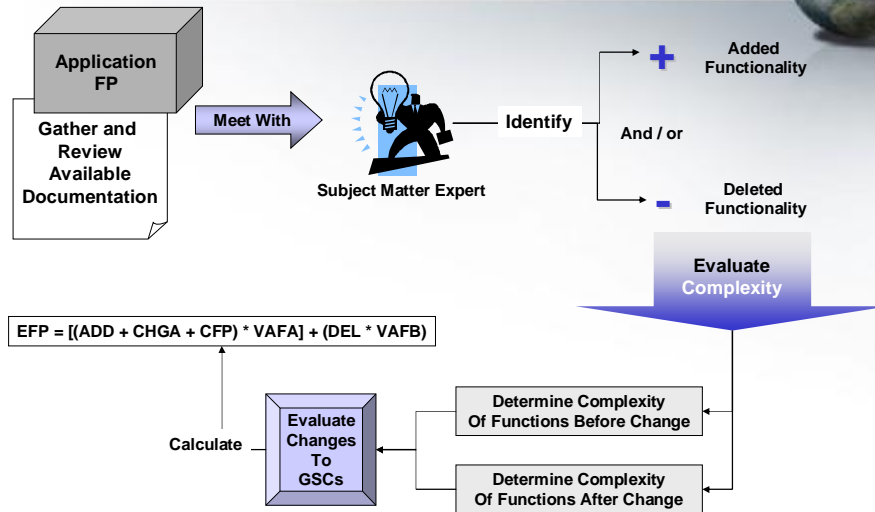
- q Addition of on-line functions to a batch application
- q Increased transaction volumes and/or degraded response times now requiring performance design and testing activities
- q Additional usability features requested
- q Addition of a Web interface to an existing on-line application
- q Addition of a new communication protocol to an existing application

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Enhancement Counting Procedure



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Function Point - Maintenance



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What is Maintenance?



Once an application has been developed and installed, it must then be maintained (modified) in order for it to continue to meet the needs of an ever-changing business and technical environment.

This maintenance includes a wide range of activities that are performed during this phase of the application life cycle, some of which involve functional changes that are applicable to FPA.

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Maintenance Vs Enhancement



Let us observe the differences between them....

If there is one...

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Categories Of Maintenance



The Institute of Electrical and Electronics Engineers, Inc. (IEEE) defines three categories of maintenance:

- q **Adaptive Maintenance:** Software maintenance performed to make a computer program usable in a changed environment.
- q **Corrective Maintenance:** Software maintenance performed to correct faults in hardware or software.
- q **Perfective Maintenance:** Software maintenance performed to improve the performance, maintainability or other attributes of a computer program.

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Adaptive Maintenance



Adaptive Maintenance includes modifications to either meet new or changing business requirements or to add functionality not accommodated in a previous release.

It also may include modifications required to meet changing technical requirements.

Adaptive maintenance is initiated by business requests to add, change and/or delete business functionality. It is synonymous with the concept of an “enhancement”.

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Corrective Maintenance



Corrective Maintenance includes modifications to repair defects.

It does not involve changes to business functionality but ensures that previously delivered functionality performs as required.

The effort related to these activities should be attributed to the original development or enhancement project that introduced the defect.

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Perfective Maintenance



Perfective (or Preventive) Maintenance may include modifications to support platform or system software upgrades, performance optimization and other activities related to maintaining agreed service levels.

There are no changes to business functionality associated with this work.

Although Function Point Analysis is not useful for estimating these activities, the GSCs may be affected and should be reviewed for changes.

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Maintenance Requests



- q Regardless of duration or level of work effort required, it is the type of activity that determines how the work is classified. Function Point Analysis should not be used to size perfective or corrective maintenance work.
- q If a release contains a mix of adaptive, corrective and/or perfective maintenance requirements, care must be exercised in separation of work effort, since the latter two categories contribute zero function points to the business.

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Maintenance Requests



A project involving only upgrades from one platform, language or technical environment to another, with no change in user functionality, should not be subject to an enhancement function point count.

Activity	Within Enhancement Counting Scope
Correction of Production Errors ("break/fix")	No
Perfective or Preventative Maintenance	No
Platform Upgrades, New System Software Releases	No
Project with both fixes and enhancements	Partially

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Ad-Hoc Requests



Activity	Within Enhancement Counting Scope
One-time Reports	Local Convention
Table Updates	No
Special Job Setup	No
Data Correction	No
Mass Data Changes	Yes – as conversion if associated with a project.

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End User Support



Activity	Within Enhancement Counting Scope
Preliminary Estimation or Feasibility Analysis	At best, ROM
Answering “What If” questions	No
General Non-Project Client Support	No
Help Desk Support	Partially

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Maintenance And *Inventory Measurement*



***Periodic FP measurements should be done
for the application under maintenance
to constantly gauge the
differences in its size
over a period of time.***

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Total FP – Adjusted Function Points



$$FP = UAF * VAF$$

Type of Component	Complexity of Components			
	Low	Average	High	Total
External Inputs	___ x 3 = ___	___ x 4 = ___	___ x 6 = ___	
External Outputs	___ x 4 = ___	___ x 5 = ___	___ x 7 = ___	
External Inquiries	___ x 3 = ___	___ x 4 = ___	___ x 6 = ___	
Internal Logical Files	___ x 7 = ___	___ x 10 = ___	___ x 15 = ___	
External Interface Files	___ x 5 = ___	___ x 7 = ___	___ x 10 = ___	

Total Number of Unadjusted

Function Points

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Some Formulae



Development Project Function Point Calculation:

$$\text{DFP} = (\text{UFP}) * \text{VAF}$$

Where: -

- q DFP is the development project function point count
- q UFP is the unadjusted function point count
- q VAF is the value adjustment factor

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Some Formulae



Application Function Point Count (Baseline):

$$\text{AFP} = \text{ADD} * \text{VAF}$$

Where: -

- q AFP is the initial application function point count.
- q ADD is the unadjusted function point count of those functions that were installed by the development project. *Since many enhancement projects (that were not counted) have been installed in the application, the ADD in this case represents all functionality that exists within the application boundary at a particular point in time.*
- q VAF is the value adjustment factor of the application.

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Some Formulae



Enhancement Project Function Point Calculation:

$$\text{EFP} = [(\text{ADD} + \text{CHGA}) * \text{VAFA}] + (\text{DEL} * \text{VAFB})$$

Where: -

- q EFP is the enhancement project function point count.
- q ADD is the unadjusted function point count of those functions that were added by the enhancement project.
- q CHGA is the unadjusted function point count of those functions that were modified by the enhancement project. This number reflects the functions *after* the modifications.

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Some Formulae



Enhancement Project Function Point Calculation:

$$\text{EFP} = [(\text{ADD} + \text{CHGA} + \text{CFP}) * \text{VAFA}] + (\text{DEL} * \text{VAFB})$$

- q VAFA is the value adjustment factor of the application *after* the enhancement project.
- q DEL is the unadjusted function point count of those functions that were deleted by the enhancement project. *It is important to consider the absolute value of the DEL not the negative value.*
- q VAFB is the value adjustment factor of the application *before* the enhancement project.

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Some Formulae



Enhancement Project Function Point Calculation:

In practice: -

$$\text{EFP} = [(\text{ADD} + \text{CHGA}) * \text{VAFA}] + (\text{DEL} * \text{VAFB})$$

In practice VAFA = VAFB = VAF, so the equation becomes

$$\text{EFP} = (\text{ADD} + \text{CHGA} + \text{DEL} * \text{VAF})$$

Also normally CFP = 0, so the equation simplifies further

$$\text{EFP} = (\text{ADD} + \text{CHGA} + \text{DEL}) * \text{VAF}$$