

Function Size Measurement (FSM) - Software Sizing Techniques 3 days workshop

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Faculty & Participants

An Introduction

Name, Role, Expectations, Hobby

Trainer Introduction

- **MCA, MBA (Operations), PGDFM, PMP, MCITP, PMI-ACP, Prince2 Practitioner and CSM**
 - **2 decades** of experience in IT Delivery, Training, Consulting, Agile/Scrum. **16+ years** in various IT delivery positions, **6 years** as Project Management Trainer/Coach/Mentor.
 - **Trained 3000+ leaders** in India and internationally
 - **190+ corporate** or open-house trainings on PMP®, Agile Project Management, PMI-ACP®, PRINCE2, PMI-RM®, PMI-SM®, CAPM®, Microsoft Project® 2007 & 2010, Enterprise Microsoft Project Server® 2007 & 2010, AgileEVM, Earn Value Management, Function Point Estimation (FPA)
 - Delivered many trainings at **international location** for the citizen of **Philippines, Singapore, Indonesia, Malaysia, Thailand, Japan**
 - Class room training experience of around **5500+ hours**
 - FPA counting experience of more than **30000 FP** of 15+ proposals/projects
 - **CMMI (1.1, 1.2), ISO9001:2000** initiative rollout
-
- Ex-Vice President- Volunteer Development with PMI Chennai Chapter
 - Ex-Vice President- Volunteer Development with PMI Mumbai Chapter
 - Ex-Chair of Ethics Committee of PMI Mumbai Chapter
 - Member of PMI Mumbai Chapter & PMI Chennai Chapter
 - Member of PMI (Project Management Institute) USA



My Favorite Quotes

- "Not everything that can be counted counts, and not everything that counts can be counted." - Albert Einstein
- "Work expands so as to fill the time available for its completion" - Parkinsons Law
- The same work under the same conditions will be estimated differently by ten different estimators or by one estimator at ten different times. So why to estimate!
- Any project can be estimated accurately (once it's completed).
- You say you have estimated without assumptions!

Abran and Galorath gave similar messages

Some quotes from Abran's paper: what has NOT changed much with 40 years of estimating experience?

- *"Software managers ... are still expected to meet budget targets and deadlines typically based on imprecise requirements."*
- *"Researchers continue to develop increasingly complex estimation models and techniques in pursuit of 'accurate' estimates."*
- *"Estimation tools ... are still offered for which there is little or no documented evidence on how these tools have performed on projects completed"*

He concludes:

- *"The role of the software estimator is not to promise miracles, but to provide the best and most complete technical information, context, and insights ... i.e. information to support decision making;"*
- *"The role of the manager is to look at all this information, select and allocate a project budget, and then ... to take risks and manage those risks along the way."*

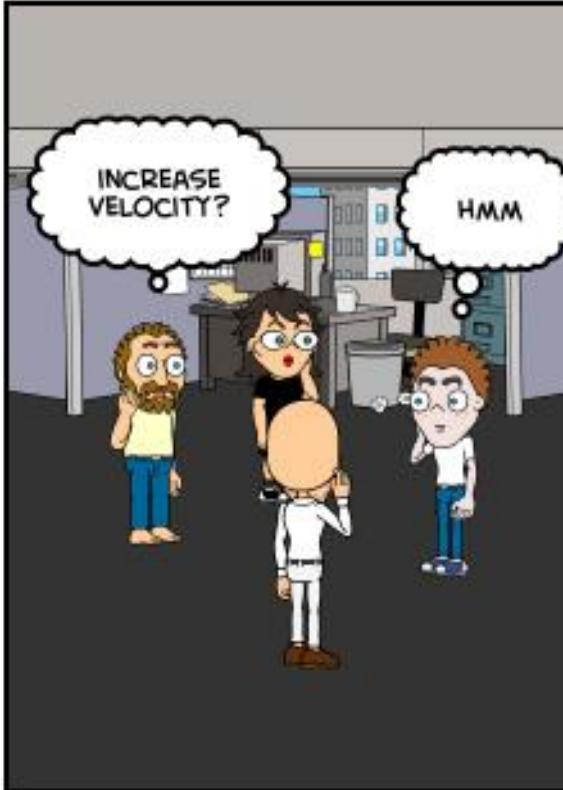
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Working Agreements

- Working Time
- Break Time
- Electronics
- Corner Talk
- Group Exercises
- Participation
- Our Values (for this project)
 - Focus
 - Communication
 - Respect
 - Openness
 - Courage
 - Share



Everybody

Workshop Objective

- Understand Project & Project Boundaries
- What to Estimate on Project?
- Ranges of Estimates
- Metrics, Benchmarking
- Familiarity to Various Function Size Measurement Methods
- **Deep Dive Estimation using Function Point Analysis**
- **Estimation using COSMIC FFP**
- Application of FSM in Development, Enhancement, Maintenance Projects. Agile and Traditional Project Management

Exclusion

In the interest of time and to learn maximum about software sizing.

- Avoid deliberation on software costing and cost components, type of costs
- Avoid deliberation on project scheduling techniques/ methodology/ tool
- Avoid deliberation on various requirements documentation/ Business Analysis work
- Avoid deliberation on various quality metrics and reporting formats.
- Avoid deliberation on various estimation techniques discussed in PMBoK.

However all these topics are related to software sizing so if absolutely required we can discuss this consciously.

Agenda

Day 1

- **Introduction to Software Estimation**
- **Understanding Elements of FPA of IFPUG**
- **Estimating Transaction Function Types**
- **Estimating Data Function Types**

Day 2

- **Final Step of Size Estimation**
- **Converting Size into Efforts**
- **Converting efforts into Cost and Schedule**
- **FP Thumb Rules & Metrics**

Day 3

- **Let us Count (A case study)- FPA**
- **COSMIC FFP**

Lets think little more about calculation, estimation....
What we calculate or estimate.

Calculation vs Estimate

- Calculations are always correct and accurate unless your calculator has problem 😊
 - Estimates are guess... based on historical data or experience
 - If you cannot calculate (because of any reason) you should estimate.
 - If you cannot estimate you cannot calculate!
-
- Quantity of bricks / cement/ steel in this building?
 - What is the distance between Delhi & Bangalore?
 - How many electron in all the carbon atom on this planet
 - How much money you earned last year?
 - How much value you delivered in last release of your product?
 - What was the average speed of your friend if he reached to you within 20 min
 - What was the size of software your department delivered in last 5 years?
 - Can you calculate the speed if you know the time but not the distance?
 - In your house renovation work.... can you calculate effort or money if you do not know the size of work?
 - In software how to know size?
 - Calculate or Estimate?

How do you estimate?

How will you know these numbers? Do you estimate this?

- Number of brother and sister you have
- Your age
- Number of uncles and aunts you have
- Total of your marks in secondary school exam

No

Some More Questions..

- Do you estimate about past?
- Do you estimate about present?
- Do you estimate about future?
- Why do we estimate?
- In what circumstances you estimate?
- What do you consider when you estimate?
- What do you estimate?
- When do you stop estimating?

Estimation...

- Known is counted with 100% confidence
- Unknown is estimated
- When time is constraint to count then you estimate

Importance of Size of Work

- To know the cost of house you need to know “How big is the house?”
- To know the cost of item you need to know “What is the weight or length of an item?”
- To know the cost of travel you need to know “What is the distance between two places?”

But to know the cost knowing “Size” is not enough.

- You also need to know Quality of material to be used, Quality of output defined, Performance, Reliability, Portability etc.
- You should also consider Inflation, Availability of Resources
- Though there are many factors (like quality, complexity, skill) that affect the cost, schedule and effort for development, **size is the primary factor that helps to estimate these.**
- Do you measure dimension of house at the time of final handover? If yes then you should also measure size of software at the time of final handover.

Work Size Estimate

- Work size is independent of Productivity, Availability, Efficiency and Work Calendars
- Knowing size of work is first step towards planning

Estimate

- How much time is required to go from your city to your favorite past time vacation place?

Duration Depends Upon - Mode



Duration Depends Upon- Roads



Duration Depends Upon- Traffic and Other People on Road



Duration Depends Upon- Driver



Duration Depends Upon- Distance



Project Duration Depends Upon

- Environmental Factors (climate, politics, regulator, policies, willingness, project working time, resource availability, technology maturity)

How Many Candies in Jar?

- What will you do to know the candies in jar without opening and physically counting them?

Factors affecting number are

- Size of unseen candies
- Distribution is equal in whole jar?
- Is there anything else in jar
- ??



Why we tend to underestimate?

- Optimistic individuals ... a desire to please
- Incomplete recall of previous experiences
- Not generally familiar with the entire job to be required.
- Murphy, of Murphy's Law fame, will not work on this project.
- Key estimating factors dramatically change estimates
-

Schedule is Influenced By

- Historical Data
- Intuition
- PERT (3 Points)
- Delphi
- Your Experience
- Productivity
- Time of the year
- Availability
- Waiting
- Team Configuration
- Vacations
- Holidays
- Work Schedule
- Elapsed Time
-

Availability is Influenced by

A calendar has 365 days in a year.

- Weekends
- Holidays
- Vacations
- Sickness
- Training
- Conferences
- Snow Days
- Strikes
- Floods
- Terrorist Activities
- Election
-

Productivity is Influenced by

Availability is 8 Hours/day.

- Bio-Breaks
- Networking
- Personal Phone Calls
- Wasted Meeting Time
- Interruptions
- E-Mail, Voice, In-Box
- Emotional and Physical Health Disturbances
- Unrelated IMs & Chats
- Travel, Elevator
- Surfing, Games
-

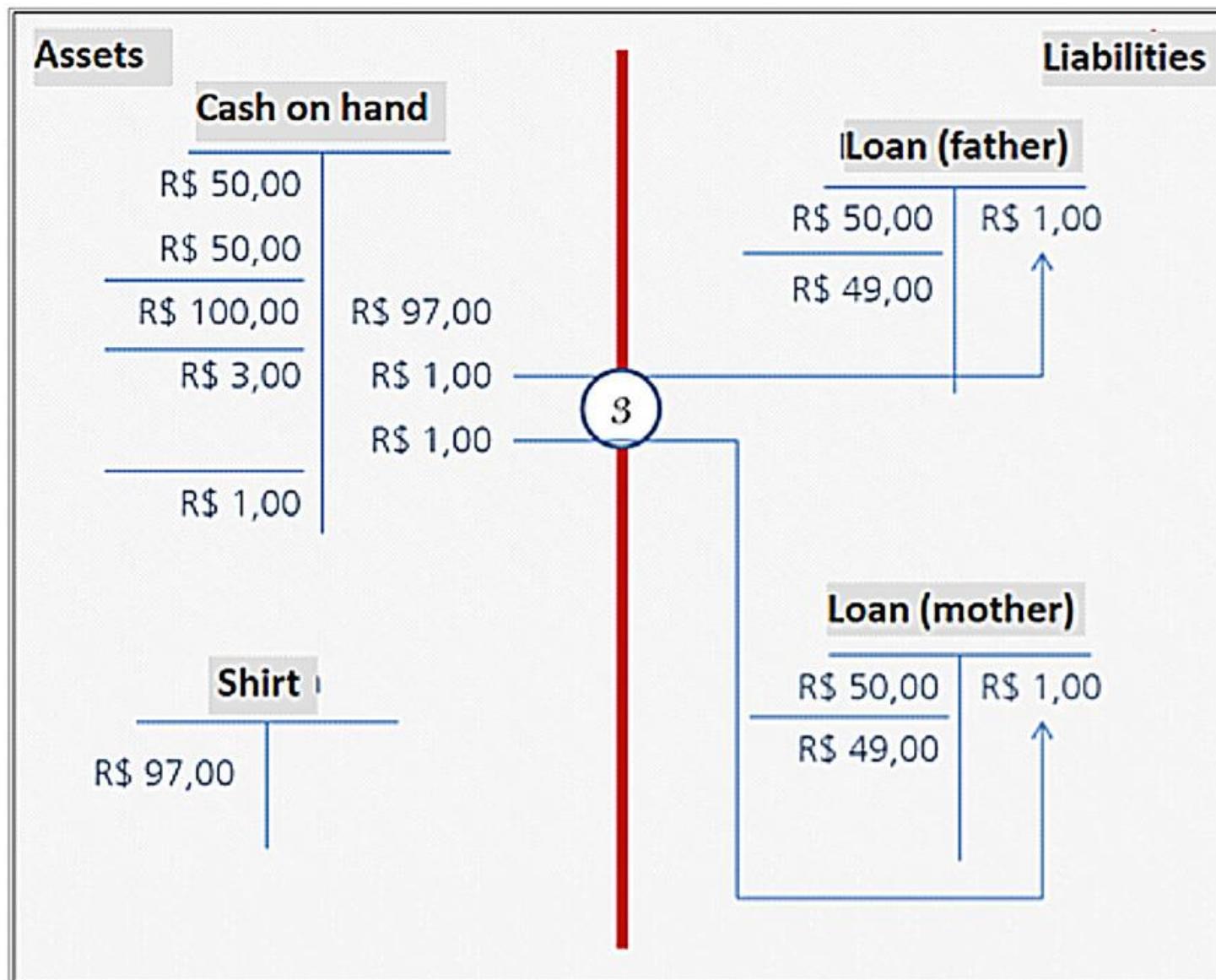
So you estimate....

- Work Size
 - Resources
 - Efforts
 - Duration
 - Elapsed Time
 - Scheduled Time
-
- Project Budget
 - Project Cost Estimates
 - Cost Baseline
-
- Contingency Reserve
 - Management Reserve

A Counting Game

- You've found a shirt for US\$ 97.00.
- But, you have no money, so you've borrowed US\$ 50.00 from your mother and US\$ 50.00 from your father. So:
- $US\$ 50.00 + US\$ 50.00 = US\$ 100.00$
- You've bought the shirt, and there is change of US\$ 3.00.
- You pay US\$ 1.00 back to your father, US\$ 1.00 to your mother and keep the other US\$ 1.00 to you.
- Now you owe US\$ 49.00 to you mother and US\$ 49.00 to your father.
- $US\$ 49.00 + US\$ 49.00 = US\$ 98.00 + \text{your } US\$ 1.00 = US\$ 99.00$
- What about the other US\$ 1.00?
- **This is not counting But accounting problem! 😊**

Solution of Game



Estimate Time



- How much time is required to produce these fruits in your farm house
- OR How much time is required to collect these fruits from your farm house

Think About This.....

- **Can a 4,000 Hour Project be of Smaller size than One of 1,000 Hours ?**
- **If yes, then what are the reasons?**

- Outsourcing Management
- Benchmarking
- Measurement and Estimating Programs
- CMMI Assessments
- Continuous Process Improvements
-

How do you Estimate?

- Take your best guess and multiply by two
- Take the best guess, multiple by two and raise it to the next higher unit of time
- Add 54%"(An algorithmically determined fudge factor)
- Ask the boss which number they want
- Take the remaining time until the deadline and multiply it by the number of people on the team
- Look Up
- **What are the advantages?**

Guidelines for Good Estimation

1. Use ranges to know a confidence factor
2. Include basis of estimation (documented)
3. Perform at the appropriate level of detail
4. Should be performed by the person doing the work (experiential estimating)
5. Identify constraints and risks
6. Do not confuse between estimates of work and duration
7. Do not confuse between duration and project schedule
8. Considers experience and availability
9. Uses lessons learned at organization level
10. Never negotiates numbers without the basis of estimation

Project Management Body of Knowledge 5th Edition

Estimation Types

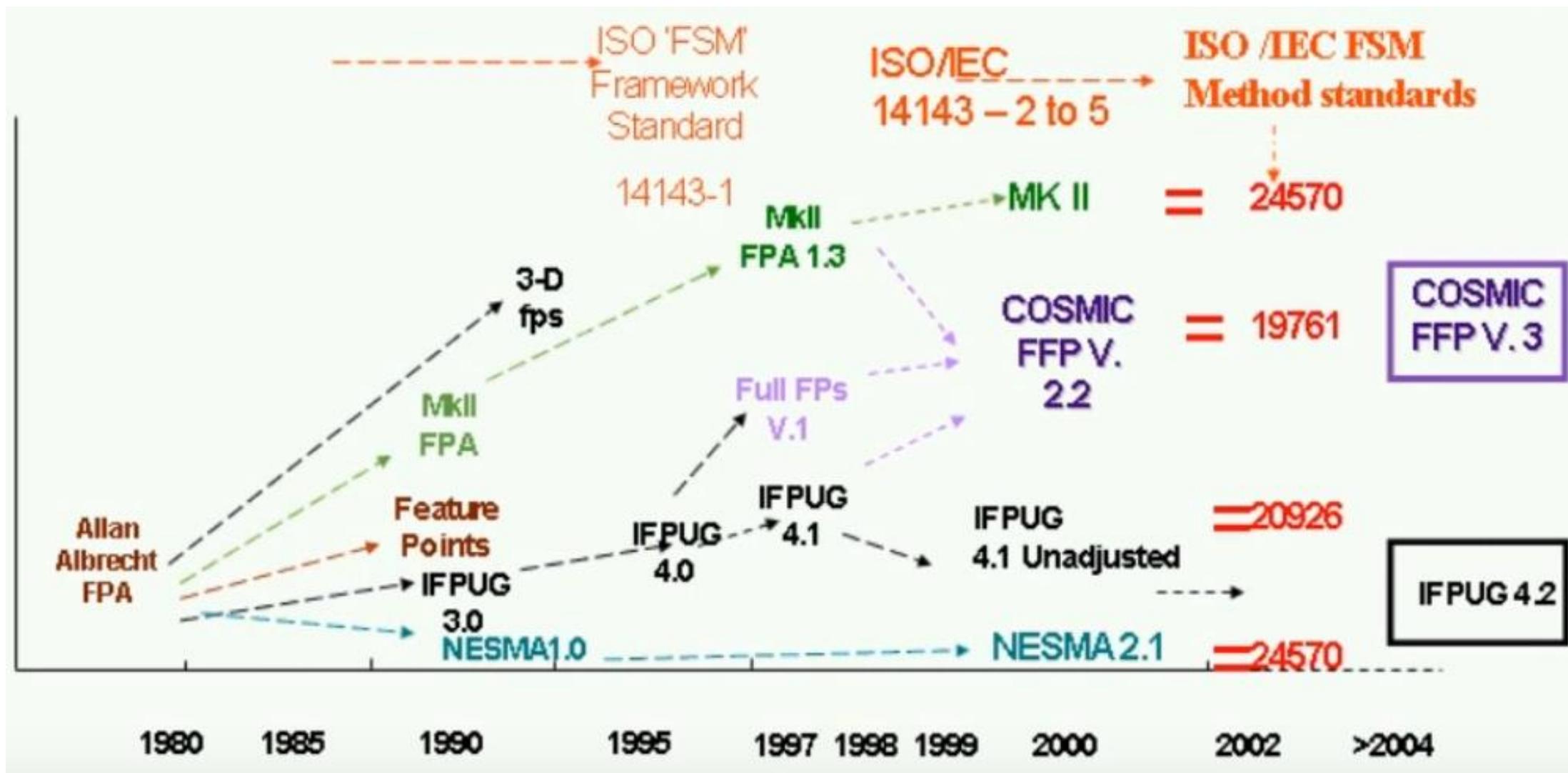
- Estimation at Initiation Stage
 - Rough order of Magnitude (ROM) – [-25% - +75%]
 - Budget Estimate [-10% - 25%]
- Estimation when Project Work or Solution Approach is known
 - Bottom up or Definitive Estimates. When WBS & details are available [-5% - +10%]

- Expert Based Techniques
 - × Analogous Estimation
 - × Parametric Estimation
 - × Bottom-up Estimation
 - × Three point Estimation
 - × Published Data Source
 - × Delphi Estimation
 - × Wideband Delphi Estimation
 - × Planning Poker

- Scientific Techniques
 - Functional Size Measurement
 - ✓ Function Points Analysis (FP) (by IFPUG)
 - ✓ Cosmic Function Points (cFP) (by COSMIC) - useful for complex real-time applications.
 - ✗ Feature Points – developed by Capers Jones and is an extension of FPA to count real-time applications.
 - ✗ FiSMA – used by Finland Software Metrics Association.
 - ✗ Mark II – used in United Kingdom.
 - ✗ Nesma – used by Nederlands Software Metrics Association.
 - ✗ Use Case Points (UCP)
 - ✗ Lines of Code (LOC)

Function Size Measurement (FSM)

History of FSM



Functional Size Measurement Variants

- ✓ FPA of IFPUG based on current Counting Practice Manual (CPM) 4.3.1.
- ✓ [IFPUG: ISO/IEC 20926:2009](#) Software and systems engineering - Software measurement - IFPUG functional size measurement method.
- ✓ COSMIC-FFP of COSMIC: [ISO/IEC 19761:2011](#) Software engineering.
- ✗ FiSMA: [ISO/IEC 29881:2008](#) Information technology - Software and systems engineering - FiSMA 1.1 functional size measurement method. Finnish function points
- ✗ Mark-II: [ISO/IEC 20968:2002](#) Software engineering - MI II Function Point Analysis - Counting Practices Manual
- ✗ NESMA: [ISO/IEC 24570:2005](#) Software engineering - NESMA function size measurement method version 2.1 - Definitions and counting guidelines for the application of Function Point Analysis. Netherlands function points

Who uses FPA in the world?



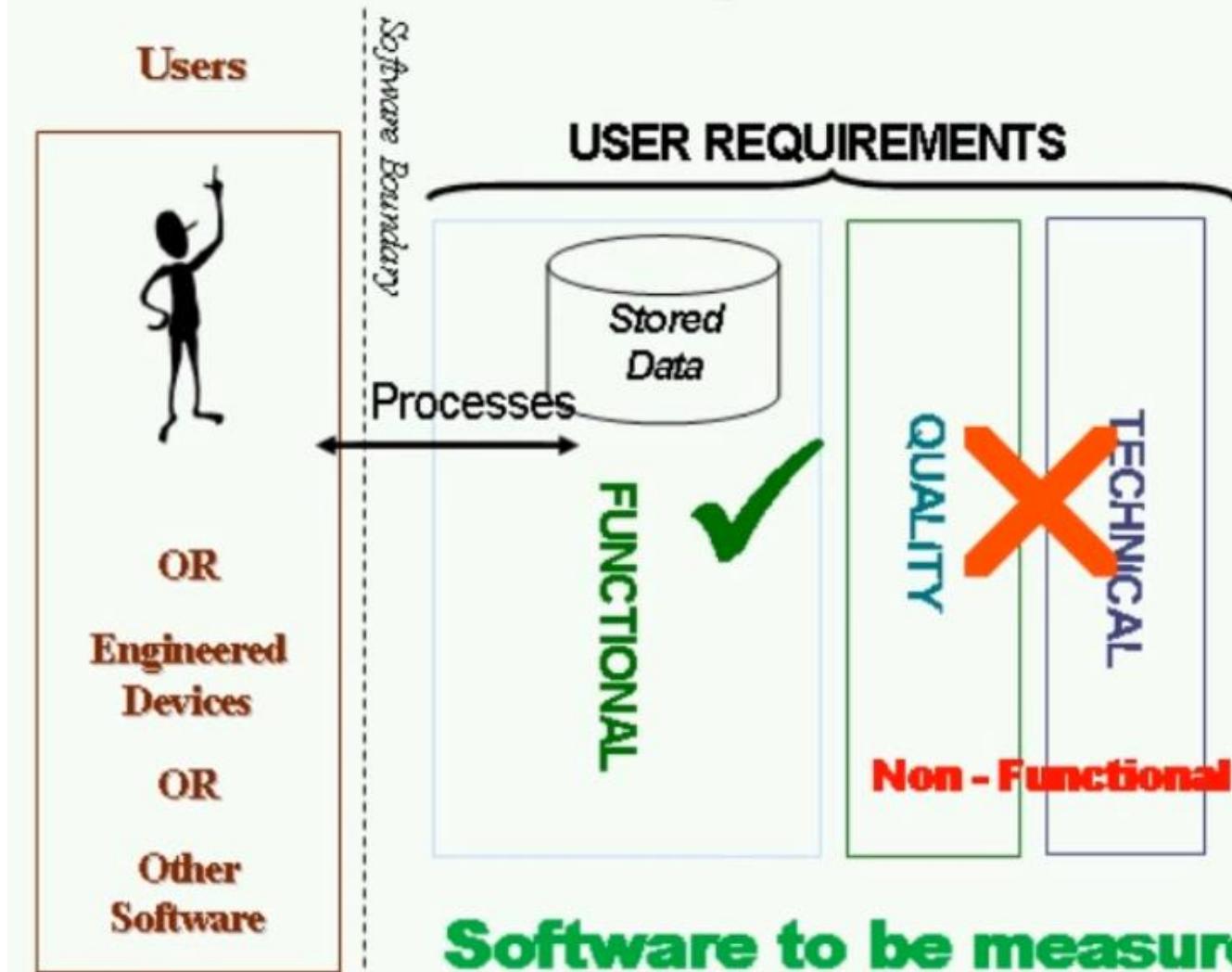
- ❖ The IFPUG has affiliates in more than 40 countries around the world, with the most presence in:
 - ❖ Germany, Australia, Brazil, Canada, South Korea, USA, India, England, Italy, Colombia, Uruguay, Mexico, Argentina and the Netherlands.
 - ❖ IBM
 - ❖ HP
 - ❖ ACCENTURE
 - ❖ ATOS ORIGIN
 - ❖ TCS
 - ❖ CAPGEMINI
 - ❖ STEFANINI
 - ❖ INDRA
 - ❖ TOTVS
 - ❖ DIEBOLD/PROCOMP
 - ❖ SCOPUS
 - ❖ EVERIS
 - ❖ UNISYS
 - ❖ CITIBANK / HSBC / BRADESCO / SANTANDER / BANCO DO BRASIL / Central Banks of (BRASIL, COLOMBIA y CHILE)
 - ❖ PETROBRAS / VALE
 - ❖ TELEFÓNICA / OI / PORTUGAL TELECOM
 - ❖ ITAIPU / CORREIOS
 - ❖ TAM (airline)
 - ❖ The entire federal Brazilian government

ISO/IEC/JTC1/SC7 Standard 14143-1(2004) Definitions:

- **Functional Size:** A size of the software derived by quantifying the functional user requirements.
- **Functional Size Measurement (FSM):** The process of measuring Functional Size.
- **FSM Method:** A specific implementation of FSM defined by a set of rules, which conforms to the mandatory features of this part of ISO/IEC 14143



Basic Concepts of FSM



Functional Size Measurement

Measures Functional User Requirements

Excludes:

- Physical or technical components
- Quality features

Derived in terms understood by users of the software

Derived without reference to

- Effort to develop or support
- Methods used

Reality of Functional Sizing Methods (FSM)

- For all current FSM methods two trained counters will achieve size figures of +/- 10 % if the user requirements are known and well specified.
- if ten project managers from different business areas try to estimate project effort without a systematic approach, including FSM methods, the ratio between the smallest and biggest estimate is 1 to 6, the worst as high as 1 to 12.

Function Point Analysis (IFPUG)

Basic Functional Components

**Transaction Function
Interaction**

**Data Function
Storage**

*External
Input (EI)*

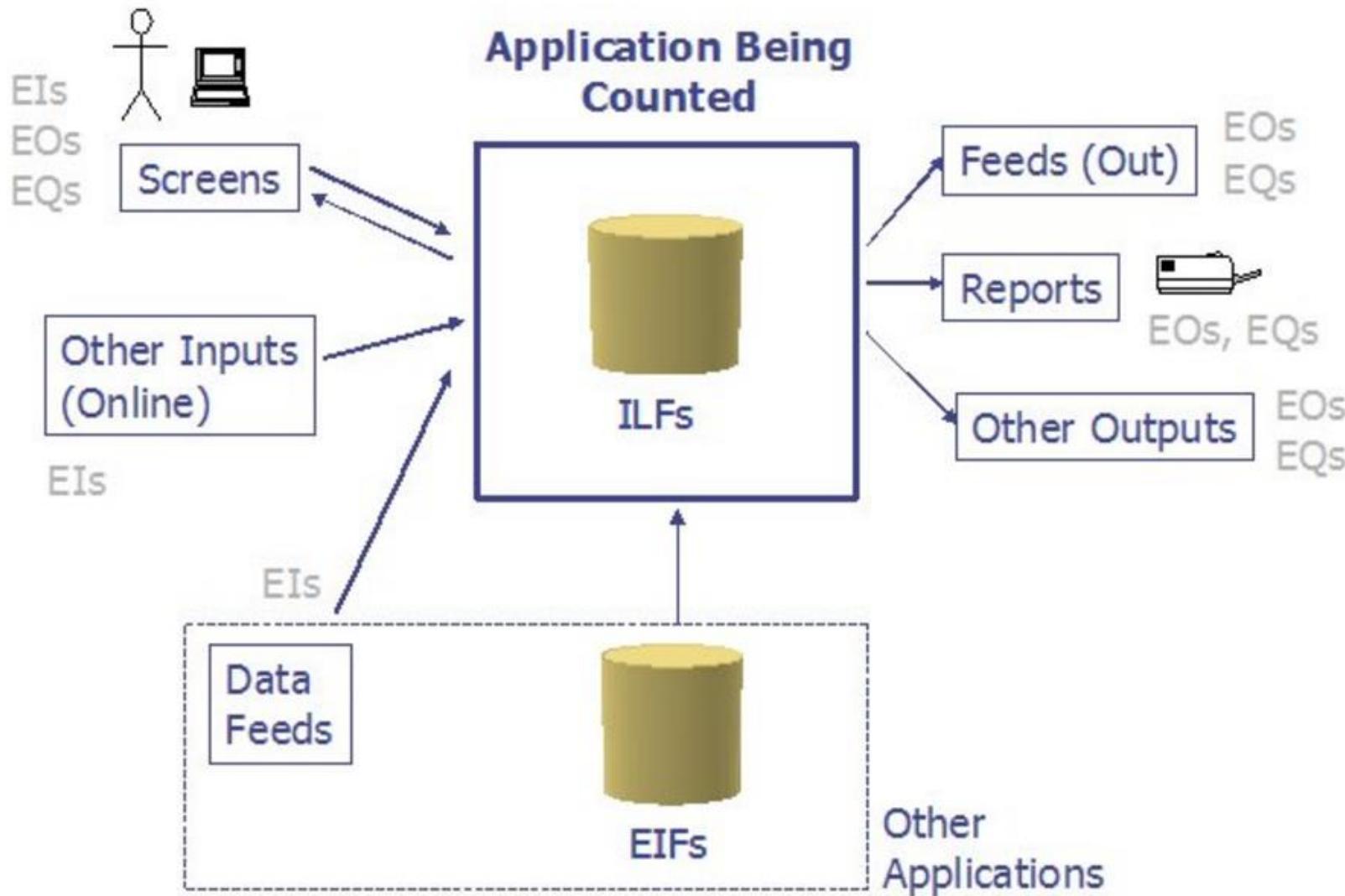
*External
Output (EO)*

*External
Query (EQ)*

*Internal
Logical File
(ILF)*

*External
Interface File
(EIF)*

Functional Point Analysis- A Glance



- Based on
 - Functional requirements as seen by the user. User functionalities
 - Screens
 - Reports
 - Data stores
 - Interfaces.
- Not based on
 - Technical aspects of the development
 - Number of programs
 - Lines of code
 - Physical architecture etc.

- FP is Repeatable and Reproducable
- Provides functional and non-functional insights
- Can be used in early development stages
- Independent of implementation technology
- Based on well defined rules so no technical skills required to count. Thus auditable.

FPA : Key Terms used

- Project Boundary
- DET: Data Element Type
- RET: Record Element Type
- FTR: File Type Reference
- Data Function Types
 - Internal Logical File (ILF)
 - External Interface File (EIF)
- Transactional Function Types
 - External Input (EI)
 - External Output (EO)
 - External Query (EQ)
- UFPC
- AFPC
- VAF
- Degree of Influence

How to calculate?

Components	Record Element Type (RET)	File Type Reference (FTR)	Data Element Type (DET)
Internal Logical Files (ILF)	✓ .		✓ .
External Interface Files (EIF)	✓ .		✓ .
External Inputs (EI)		✓ .	✓ .
External Queries (EQ)		✓ .	✓ .
External Outputs (EO)		✓ .	✓ .

Data Functions

ILF Definition

An Internal Logical File (ILF) is a user identifiable group of logically related data or control information maintained within the boundary of the application

Data Element Types of ILF/EIF

A *data element type* (DET) is a unique user recognizable, non-recursive field maintained on the Internal Logical File by the External Input

ILF/EIF DET Counting Rules

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

Record Element Types

- A *record element type* (RET) is a user recognizable subgroup of data elements within an ILF or EIF.
 - Optional
 - Mandatory
- ***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 subgroups*** are those of which the user must use at least one of the subgroups.

RET Counting Rules

- Count a RET for each optional or mandatory subgroup of the ILF or EIF. (OR)
- If there are no subgroups, count the ILF or EIF as one RET.

Record Element Types: Example

- 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). Either type can have information about dependents. For this example, there are three subgroups or RETs as shown below:
 - Salaried employee (mandatory); includes general information
 - Hourly employee (mandatory); includes general information
 - Dependent (optional)

Example: RET

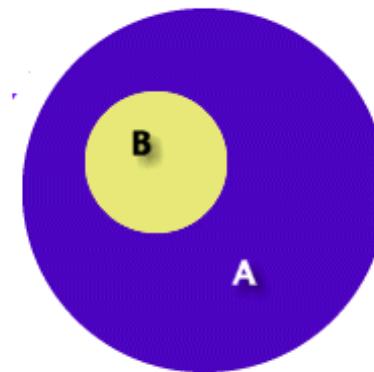
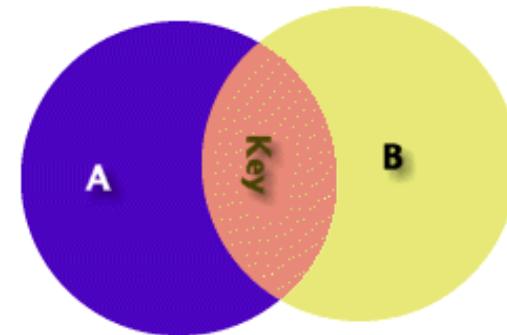
Some A are B – The first diagram represents two separate logical groups of data A and B (with key information between). This represents two internal logical files one RET each

All B are A – The second diagram represents one logical group of data A with two record types. B is a complete subset of A

Example – A singer gives voice to 50 different poems and creates a music album. Now if you have maintain records of CD and music in some system then you need one RET to manage Singer and his album. Second RET to manage music and related information.

Singer RET will have information (Singer, Producer, Label, Genre, Date)

Music RET will have information (Song Name, Length, Author)



ILF Identification Rule

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

EIF Definition

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

EIF Identification Rules

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

Elementary Processes Transaction Functions

Elementary Process Counting Rules

- The process is the smallest unit of activity that is meaningful to the user.
- The process is self-contained and leaves the business of the application in a consistent state.

Step to FP Counting for Each Elementary Process

- Step1: Identify the Elementary Process
- Step2: Determine the Primary Intent, and classify
- Step3: Validate against the EI/EQ/EO Counting Rules
- Step4: Determine Complexity (Count FTR & Count DET)
- Step5: Determine the Contribution

File Types Referenced (FTR)

Definition

A *file type referenced* is

- An internal logical file read or maintained by a function type
- An external interface file read by a function type.

FTR Counting Rules

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

DET Counting Rules for Elementary Process

- 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.
- 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.
- 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.
- 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.

DET Counting Rules: GUI

- **Radio Buttons** – One DET is counted for all the radio buttons contained in the frame.
- **Check Boxes** – Each check box, within a frame, that can be selected should be treated as a data element.
- **Command Buttons**  – According to IFPUG counting rules each command button would be counted as a data element for the action it invokes.
- **Display of Graphical Images or Icons** – A display of a graphical image or schematic is treated as a single DET.
- **Sound Bytes** - Sound byte is one DET.
- **Photographic Images** – A photographic image is one DET.
- **Messages** – Error message and Confirmation message are treated as a one DET each for the appropriate transaction.

DET Counting Rules: GUI

- **Command Buttons** – Command Buttons are one DET each. Command buttons may specify an add, change, delete or inquire action. For example, a simple application to track Distributors could have fields for Distributor Name, Address, City, State, Zip, Phone Number, and Fax Number. This would represent seven data elements (7 DET's) and the add command button would represent the 8th data element. In short, the add external input represents a one external input with eight data elements, the change external input represents another external input with eight data elements (7 fields plus the change command button), and the delete external input represents the last external input with eight data elements (7 fields plus the delete command button).
- Graphic Images are one DET
- **Sound Bytes** – This represents one data element. The number of notes played is simply recursive information. If the length of the sound byte increases, then the data element remains one. If it is played for two seconds or four seconds, then this is still one data element.

DET Counting Rules. GUI

- **Messages**

- Error Messages / Confirmation Messages – It indicates that a process will be or has been completed. A message, “Zip code is required” would be an example of an error message. A message, “Are you sure you want to delete the customer?” is an example of a confirmation message. Neither of these type of messages are treated as a unique External Output, but they are treated as data elements for the appropriate transaction. Each is one DET
- Notification Messages – It is the basis of processing and a conclusion being drawn. For example, while withdrawing from an ATM machine more money than you have in your account. You may receive the message, “You have insufficient funds to cover this transaction.” This is the result of information being read from a file and a conclusion being drawn. A notification message is treated as an EO.
- ***Notification Messages may be the result of processing and the actual processing or derived data my not be seen. If a message is created to be sent to a pager (beeper) at a given time. This is much like an alarm. The pager message has one data element the text message.***

DET Counting Rules: GUI

- In a GUI or OO environment it is common for information to move from one window to the next. The actual movement of data is not considered an external input because it has not crossed the application boundary (outside to inside) and does not maintain an ILF.

DET Counting Rules: Examples

- **Example:** An account number that is stored in multiple fields is counted as one DET.
- **Example:** A before or after image for a group of 10 fields maintained for audit purposes would count as one DET for the before image (all 10 fields) and as one DET for the after image (all 10 fields) for a total of 2 DETs.
- **Example:** The result(s) of a calculation from an elementary process, such as calculated sales tax value for a customer order is counted as one DET on the customer order ILF.
- **Example:** Accessing the price of an item which is saved to a billing file or fields such as a time stamp if required by the user(s) are counted as DETs.

DET Counting Rules: Examples

- **Example:** If an employee number appears twice in an ILF or EIF as (1) the key of the employee record and (2) a foreign key in the dependent record, count the DET only once.
- **Example:** Within an ILF or EIF, count one DET for the 12 Monthly Budget Amount fields. Count one additional field to identify the applicable month.
- **Example:** When two applications maintain and/or reference the same ILF/EIF, but each maintains/references separate DETs, count only the DETs being used by each application to size the ILF/EIF. **For example**, Application A may specifically identify and use an address as: street address, city, state and zip code. Application B may see the address as one block of data without regard to individual components. Application A would count four DETs; Application B would count one DET.

DET Counting Rules: Examples

- **Example:** Application X maintains and/or references an ILF that contains SSN, Name, Street Name, Mail Stop, City, State, and Zip. Application Z maintains and/or references the Name, City, and State. Application X would count seven DETs; Application Z would count three DETs.
- **Example:** Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF. **For example**, in an HR application, an employee's information is maintained on an ILF. The employee's job name is included as part of the employee's information. This DET is counted because it is required to relate an employee to a job that exists in the organization. This type of data element is referred to as a foreign key.
- **Example:** In an object oriented (OO) application, user requires an association between object classes, which have been identified as separate ILFs. Location name is a DET in the Location EIF. The location name is required when processing employee information; consequently, it is also counted as a DET within the Employee ILF.

When to Count Single DETs ?

- Fields that indicate an error occurred during processing or confirm that processing is complete.
- Example: Error Message Fields.
- Count a single DET for the capability to specify the action to be taken by the external input.
- Example: count as one DET command lines or function/action (PF) keys that provide the capability to specify the action to be taken by the external input. Count this as one additional DET per external input.

DET Counting Rules- Real Time System

- Real time and embedded systems – The time of diagnostics, hardware state during diagnostics, temperature, voltage etc. would all be examples of one DET each.
- Operator Controls, Volume Controls, Sensor Readings, Radio Frequencies, Standards and Limit Settings (Alarms Settings etc.) would be counted as one DET each.

Count DET

Customer Details

Untitled

Go to Save and New E-mail Save As Outlook Contact Close

General

First Name	1	E-mail	14
Last Name	2	Web Page	15
Company	3		
Job Title	4		

Phone Numbers

Business Phone	5
Home Phone	6
Mobile Phone	7
Fax Number	8

Address

Street	9
City	10
State/Province	11
Zip/Postal Code	12
Country/Region	13

Notes
17

Record: 1 of 1 No Filter Search

EI Definition

An *external input* (EI) processes data or control information that comes from outside the application's boundary. The external input itself is an elementary process. The processed *data* maintains one or more ILFs. The processed *control information* may or may not maintain an ILF.

OR

External Inputs (EI) is an elementary process in which data crosses the boundary from outside to inside. This data may come from a data input screen, electronically or another application. The data can be either control information or business information. If the data is business information it is used to maintain one or more internal logical files. If the data is control information it does not have to update an internal logical file.

Typical Vocabulary to Identify EI

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

EI Counting Rules

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

EO Counting Rules

- The function sends data or control information external to the application boundary.
- For the identified process, one of the following three statements must apply:
 - Processing logic is unique from the processing logic performed by other external outputs or external inquiries for the application.
 - The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.
 - The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.
- For the identified process, one of the following three statements must apply:
 - The processing logic of the elementary process contains at least one mathematical formula or calculation.
 - The processing logic of the elementary process maintains at least one ILF.
 - The processing logic of the elementary process creates derived data.

EO Definition

- An *external output* (EO) is an elementary process that generates data or control information sent outside the application's boundary.
- OR**
- *External Outputs (EO) is an elementary process in which derived data passes across the boundary from inside to outside. The data creates reports or output files sent to other applications. These reports and files are created from one or more internal logical files and external interface file .*
 - *Derived Data is data that is processed beyond direct retrieval and editing of information from internal logical files or external interface files. Derived data is the result of algorithms, and/or calculations. Derived data occurs when one or more data elements are combined with a formula to generate or derive an additional data element(s).*

Typical Vocabulary to Identify EO

Browse
Display
Get
On-lines
Output
Print
Query

Reports
Request
Retrieve
Seek
Select
View

DETs for Outputs

Rules

- Count a DET for each user recognizable, non-recursive field that appears on the external output.
- Do not count literal as DETs.
- Do not count paging variables or system-generated stamps.
- A logical field that is stored physically as multiple fields, but is required by the user as a single piece of information.
- Each type of label and each type of numerical equivalent in a graphical output.
- Text information that may be a single word, sentence, or phrase.
- For example, a message is included on a report to indicate why a transaction to add a job could not be completed successfully

Hints for EO Counting

- **Is data sent outside the application boundary?**
 - Look at the work flow.
 - Identify where the user and other application interfaces occur in the process functional decomposition.
- **Is the process self-contained and does it leave the business in a consistent state?**
 - Review external inputs and external inquiries to get an overall view of how the user works with the information.
 - Work through the process diagram to get hints.
 - Look at what happened in the manual system.

DET Counting Rules: GUI

- External Outputs
 - Textual, graphical or electronic information
 - Each type of report to be treated as external outputs.
- External Inquiries
 - Serial Inquiries to be counted separately
 - EQs do not contain derived data
 - for e.g.. customer is selective from customer list which in turn is used to extract other customer details

EQ Counting Rules

- The function sends data or control information external to the application boundary.
- For the identified process, one of the following three statements must apply:
 - Processing logic is unique from the processing logic performed by other external outputs or external inquiries for the application.
 - The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.
 - The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.
- The processing logic of the elementary process retrieves data or control information from an ILF or EIF.
- The processing logic of the elementary process does not maintain an ILF.
- The processing logic of the elementary process does not contain a mathematical formula or calculate
- The processing logic of the elementary process does not create derived data.ion.

EQ Definition

- An *external inquiry* (EQ) is an elementary process made up of an input-output combination that results in **data retrieval**. **The output side contains no derived data.** No internal logical file (ILF) is maintained during processing.

OR

- *External Inquiry (EQ) 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. This information is sent outside the application boundary. The input process does not update any Internal Logical Files and the output side does not contain derived data.*

Typical Vocabulary to Identify EQ

Browse
Display
Extract
Fetch
Find
Gather
Get
Drop Down
Lists
Look Ups

On-lines
Output
Pick Lists
Print
Query
Scan
Seek
Select
Show
View
Reports

Summary of Processing Logic

	EI	EO	EQ
Validations are performed	c	c	c
Mathematical formula or calculations are performed	c	M*	X
Equivalent values are converted	c	c	c
Data is filtered and selected using specified criteria to	c	c	c
Conditions are analyzed to determine which are applicable	c	c	c
At least one ILF is updated	M*	M*	X
At least one ILF or EIF is referenced (read)	c	c	m
Data or control information is retrieved	c	c	m
Derived data is created	c	M*	X
Behaviour of the system is altered	M*	M*	X
Prepare and present information outside the boundary	c	m	m
Capability to accept data or control information that enters the application boundary	m	c	c
Resorting or rearranging a set of data	c	c	c

m it is mandatory that the function type perform the form of processing logic

M* It is mandatory that the function type perform at least one of these (m*) forms of processing logic

c the function can perform the form of processing logic, but it is not mandatory

X function cannot perform the form of processing logic

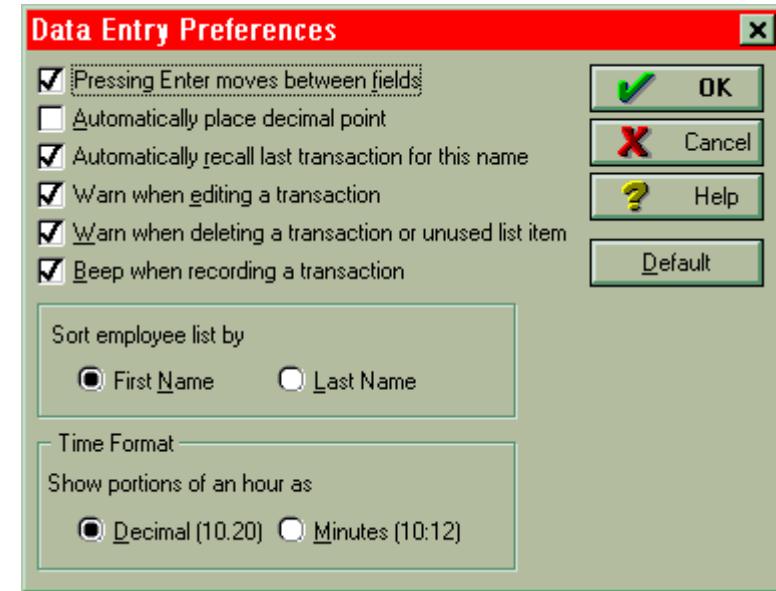
Abbreviations

AFP : Adjusted Function Point	RET : Record Element Type
UFP : Unadjusted Function Point	DET : Data Element Type
GSC : General System Characteristics	FTR : File Type Reference
FTR : File Types Referenced	GSC : General System Characteristic
FP : Function Point	VAF : Value Adjustment Factor
ILF : Internal Logical File.	LOC : Line of code
EIF : External Interface file	EAF : Effort Adjustment Factor
EI : External Inputs	SLOC : Source Lines of Code
EO : External Outputs	CPLX : Development/Technical Complexity Factor
EQ : External Enquiries	TOOL : Development/Technical Tool Complexity Factor
	TDEV : Development Time

Estimation of GUI Elements

GUI Estimation: Example

- **Check Boxes** – This may represent one data element or multiple data elements. The screen listed as Data Entry Preferences has numerous check boxes. In this case, each check box is considered a data element type (DET). Each check box is independent from other check boxes and provides different business functionality. The sort employee name and Time format are two additional data element types (DET's) also.



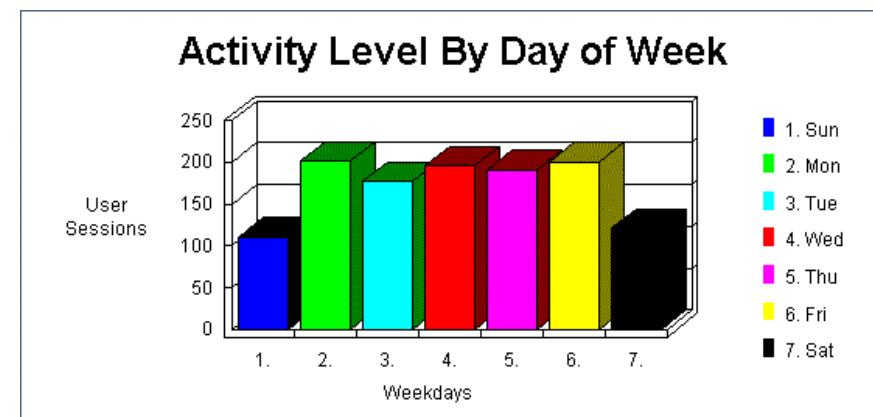
- **How many DET's..?**
- **This particular screen has X data elements (Y DET's and action key).**

GUI Estimation: Example

There are 10 data elements in the following table

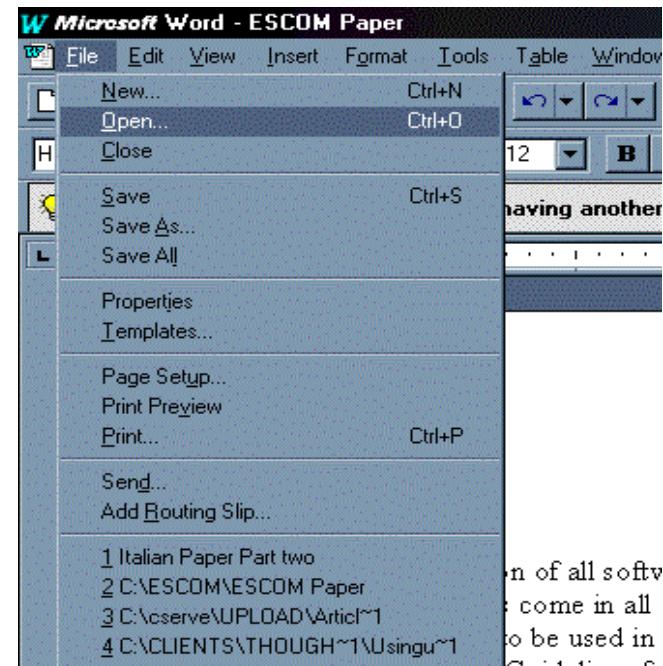
- Days
- Hits
- % of Total Hits
- User Sessions
- Total Hits (weekday)
- Total % (weekday)
- Total User Sessions (weekday)
- Total Hits (weekend)
- Total % (weekend)
- Total User Sessions (weekend)

Activity Level by Day of the Week				
	Day	Hits	% of Total Hits	User Sessions
1	Sun	1004	8.73%	111
2	Mon	1887	16.41%	201
3	Tue	1547	13.45%	177
4	Wed	1975	17.17%	195
5	Thu	1591	13.83%	191
6	Fri	2209	19.21%	200
7	Sat	1286	11.18%	121
Total Weekdays		9209	80.08%	964
Total Weekend		2290	19.91%	232



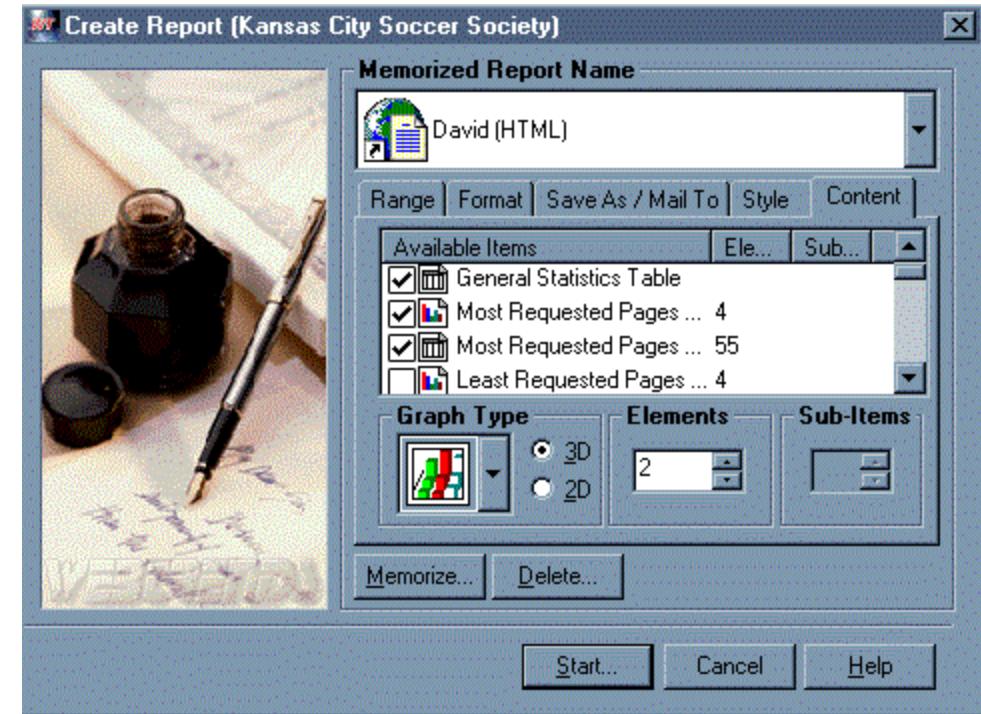
GUI Estimation: Example

- Pick List – A dynamic pick list (drop down box) is an EQ if the country names are contained in an internal logical file or external interface file.
- Menu – The menu displayed to the right is a dynamic menu. Word displays the last several files that have been opened. We can easily conclude that this information is being read from some type of internal file. Hence, the information is dynamic. The menu would be counted as an EQ. The real distinction is if a menu is dynamic or static. That is, are the contents of the screen or report dynamic (read from some file) or are they static.



GUI Estimation: Example

- It is common for GUI applications to have External Inputs preceded by serial inquiries. That is, a user may be able to select a customer name from a pick list (first EQ), the customer name is used as input for the second EQ which provides address, phone, zip and other contact information. From this point forward a user can add, change or delete the customer information (3 EI's). In this case, this one screen would represent 2 EQ's and 3 EI's.
- In the “Create Report” control screen, the user has the ability to select reports. This particular screen has several data elements types such as check box, graph type, dimensions, elements, sub-items and actions keys.
- User can choice each report individually. In fact each report is as an object. The generated report is a combination of several reports (or objects). Each object has several attributes.



Value Adjustment Factor

General System Characteristics

F01	Reliable back-up and recovery	Does the system require reliable backup and recovery?
F02	Data communications	Are data communications required?
F03	Distributed functions	Are there distributed processing functions?
F04	Performance	Is performance critical?
F05	Heavily used configuration	Will the system run in an existing, heavily utilized operational environment?
F06	Online data entry	Does the system require on-line data entry?
F07	Operational ease	Does the on-line data entry require the input transaction to be build over multiple screens or operations?
F08	Online update	Are the master files updated online?
F09	Complex interface	Are the input, outputs, files or inquiries complex?
F10	Complex processing	Is the internal processing complex?
F11	Reusability	Is the code designed to be reusable?
F12	Installation ease	Are conversions and installation included in the design?
F13	Multiple sites	Is the system designed for multiple installations in different organizations?
F14	Facilitate change	Is the applications designed to facilitate change and ease of use?

Degrees of Influence

0 - Not present, or no influence

1 - Incidental influence

2 - Moderate influence

3 - Average influence

4 - Significant influence

5 - Strong influence throughout

Value Adjustment Factor (VAF)

$VAF = \text{SUM}(\text{GSC Weightage})$

$AFP = UAFP * VAF$

Summary Table: FP Counting

Input Complexity Matrix (EI)						
FTRs	1-4 DETs	5-15 DETs	16+DETs		EI/EQ	
0-1	Low	Low	Average	Low		3
2	Low	Average	High	Average		4
3+	Average	High	High	High		6
Output Complexity Matrix (EO/EQ)						
FTRs	1-4 DETs	5-15 DETs	16+DETs		EO	
0-1	Low	Low	Average	Low		4
2-3	Low	Average	High	Average		5
4+	Average	High	High	High		7
File Complexity Matrix (ILF, EIF)						
RETs	1-19 DETs	20-50 DETs	51+ DETs		ILF	EIF
1	Low	Low	Average	Low		7
2-4	Low	Average	High	Average		10
5+	Average	High	High	High		15
						10

Thumb Rule of FP Elements Identification

Data Functions

- **ILF** : Validate any CRUD operation performed on a database, table, file or component including in memory caching within the boundary of the application.
- **EIF**: Any operation invoked through a web services interface, or remote application interface through some middle-ware technology or remote access through various protocols. The data is stored outside the boundary in another system typically in another application server, content management system or file server but referenced and used by the application concerned.

Thumb Rule of FP Elements Identification

Transaction Functions

- **EI** : User providing data in an online application form, selecting options, choices, inputs text, uploads files or feeds data into the system. An external application sends data to be stored/processed or both. Receive data from external sources as stream feeds at intervals. Receive a device event such as alarms or triggers with relevant data to be processed.
- **EQ**
 - Data that is fetched from the database displayed as a result of some user action.
 - Data which may sent to external devices such as printers or other devices.
 - Data which is sent to other external applications outside the application boundary.
- **EO**
 - Data that is fetched from the database displayed as a result of some user action.
 - Data which may sent to external devices such as printers or other devices.
 - Data which is sent to other external applications outside the application boundary.
- The main difference of an EO from an EQ is that it may contain some mathematical equation, calculation of sum, average, count or other manipulation of data, or may create additional derived fields such as totals, subtotals, calculation of final cost and may also update the ILF to reflect the computed sum.

Summary - Function Point Calculation Steps

- Identify and count ILF, EIF, EI , EO and EQ
- For each ILF and EIF, identify the number of RETs and the number of DETs
- For each EI, EO and EQ, identify the number of FTRs and DETs
- Using the complexity matrices, count the number of low, average and high EI, EO, EQ, ILF and EIF items.
- Compute the total unadjusted function points
- Determine the values of the fourteen general system characteristics
- Sum the total characteristics
- Determine the total function points with the Total Function Point Formula
- $[0.65 + (.01 \times \text{total of General System Characteristics})] \times [\text{Unadjusted Function Point Count}] = \text{Total function points}$

DAY 2

- New Development = $(UFP + CFP) * VAF$
 - Application Count = $ADD * VAF$
 - Enhancement = $[(ADD + CHGA + CFP) * VAFA] + (DEL * VAFB)$
 - Revised Application = $[(UFPB + ADD + CHGA) - (CHGB + Del)] * VAFA$
 - $VAF = (S(DI) * .01) + .65$
-
- **Where:**
 - ADD = Added functionality
 - CFP = Conversion functionality
 - CHGA = UFP of changed functionality after enhancement
 - CHGB = UFP of changed functionality before enhancement
 - DEL = deleted functionality
 - DI = degree of influence of GSCs
 - UFP = unadjusted function point count
 - **UFPB** = application UFP before project
 - VAF = Value Adjustment Factor
 - **VAFA** = VAF after enhancement
 - VAFB = VAF before enhancement

How to Organize Elements

Function	Type	DET	RET/FTR	Complexity	FP
Files					
Time Recording	ILF	4	1	Low	7
Standard Working Time	ILF	3	1	Low	7
Justification	ILF	3	1	Low	7
Interfaces					
Employee (from HR)	EIF	3	1	Low	5
Transactions					
Login	EQ	4	1	Low	3
Time Recording					
Import Time Recording data	EI	4	1	Low	3
Register Entry/Exit	EI	4	2	Low	3
Timesheet	EO	10	4	High	7
Justification					
Import Justification data	EI	3	1	Low	3
List justifications	EQ	6	2	Med	4
Add justification	EI	5	2	Med	4
Modify justification	EI	5	2	Med	4
Remove justification	EI	3	1	Low	3
Check justification	EQ	5	2	Low	3
Report justifications	EO	8	4	High	7
Standard Working Time					
Import standard working time data	EI	3	1	Low	3
Add standard working time	EI	4	2	Low	3
Modify standard working time	EI	4	2	Low	3
Check standard working time	EQ	4	2	Low	3

Categories of Maintenance

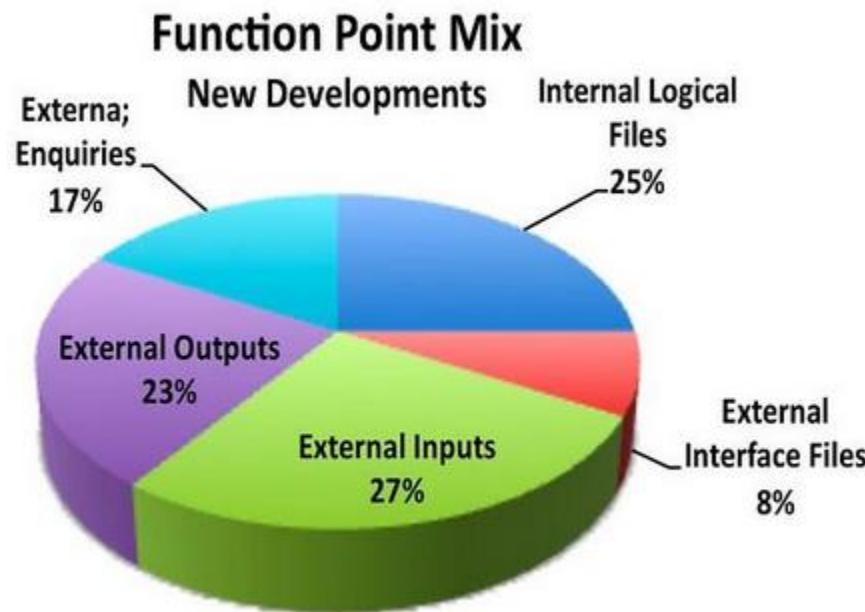
The Institute of Electrical and Electronics Engineers Inc. (IEEE) defined three categories of maintenance

- Adaptive Maintenance: Software Maintenance performed to make a computer program usable in a changed environment. Enhancement.
 - May also include modification which is required to meet changing technical requirement
- Corrective Maintenance: Software maintenance performed to correct faults in hardware or software
 - No change in functionality but fix the old problem. – No FPA
- Perfective Maintenance: Software maintenance performed to improve the performance, maintainability or other attributes of a computer program
 - Non change in functionality, - No FPA

FP Calculation : Thumb Rule

Thumb Rule for Early Prediction

- Early Prediction of Functional Size from a Logical Data Model



- If an application has 40 ILF
- ISBSG Repository shows that most ILF are low to medium. Thus complexity attributed is 9 FP
- Total ILF = $40 \times 9 = 360$ FP
- Total App size = 360×4 (25%) = 1440 FP
- Many organization has come up 1 ILF = 30 Something. It varies between 31-35 FP.

Thumb Rule for Early Prediction

Functional Size and Duration Relationships

Project Class	Equation (Duration=)	Example (Duration)	Project Duration
3GL projects:	$0.971 * FP^{0.351}$	$Duration = 0.971 * 1440^{0.351}$	12.47 months
4GL projects:	$0.622 * FP^{0.405}$	$Duration = 0.622 * 1440^{0.405}$	11.83 months
Application Generator	$1.472 * FP^{0.280}$	$Duration = 1.472 * 1440^{0.280}$	11.28 months

Work Effort and Duration Relationship

- Efforts (Man-hours) = (**Duration** / .38)^(1/.37)

*Duration in Calendar Months

- Efforts = (11.83 / .38) ^ (1/.37) = 10850 Man-hours

- **Project Duration** = 2.5 * (Cube Root of Work Months)

- If project efforts is 67 MM then

Project Duration = 2.5 * (4.1) or 10.25 months.

Optimum Staffing Size

- The origin of this formula is currently unknown, but it goes like this:
- Optimum Staffing Size = Square Root of Work Months
- If project effort is 67 work months then
- Optimum Staffing Size = $\text{SQRT}(67) = 8.1$.

Capers Jones - Thumb Rule Approximation

- Rule 1: Sizing Source Code Volumes
 - One function point = 125 statements for the C programming language
- Rule 2: Sizing Software Plans, Specifications, and Manuals
 - Paper Documents (Page Count) = $FP^{1.15}$ (approx.)
- Rule 3: Sizing Creeping User Requirements
 - Creeping user requirements will grow at an average rate of 2% per month from the design through coding phases.
- Rule 4: Sizing Test Case Volumes
 - # of Testcases = $FP^{1.2}$ (approx.)
- Rule 5: Sizing Software Defect Potentials in New Software Projects
 - Defect Potential = $FP^{1.25}$ (approx.)
- Rule 6: Sizing Defect Removal Efficiency
 - Each software review, inspection, or test step will find and remove 30% of the bugs that are present.
- Rule 7: Estimating Software Schedules
 - Development Schedule (in Calendar Months) = $FP^{.4}$
- Rule 8: Estimating Software Development Staffing Levels
 - Personal Required for Development = $FP / 150$
- Rule 9: Estimating Software Maintenance Staffing Levels
 - Personal Required for Maintenance = $FP / 750$
- Rule 10: Estimating Software Development Effort
 - Development Efforts (in staff months) = Duration X Number of Personal

Finally....

- Assume a project of 1000 function points in size:
- **Schedule Calendar Months** = $1000^{.4} = 16$
- **Staff time personnel** = $1000 / 150 = 6.6$
- **Efforts (staff months to build)** = $16 * 6.6 = 106$

Thumb Rule for Early Prediction

- 1 Usecase = 35 FP. Obviously this is a very rough approximation as Use Case sizes can vary significantly.

Metrics

Average Software Defect Potentials circa 2015 for the United States

- Requirements 0.75 defects per function point
- Architecture 0.15 defects per function point
- Design 1.05 defects per function point
- Code 1.25 defects per function point
- Security code flaws 0.25 security flaws per function point
- Documents 0.45 defects per function point
- Bad fixes 0.60 defects per function point
- Totals 4.50 defects per function point

Use of function points

- you can know productivity
- you can baseline to monitor the progress
- you can use it to estimate the cost of new project

Metrics

- Productivity
 - Cost per FP
 - Number of FPs per month/week/day/hours. (productivity rate)
 - Number of total hours per FP. (delivery rate)
 - Number of developer hours per FP.
 - Productivity increases (or decreases) due to technology changes
 - Capacity = FP/ Man-month
 - Efforts = Size * Delivery Rate
- Quality
 - Number of bugs/defects per FP. (Project defect rate)
 - Number of bug/defect fixing hours per FP.
 - Defect Density = Defects /FP
- Scope
 - Requirement Stability = FP (Actual) / FP (Initial)
 - Backlog Size = \sum FP (at organization level)

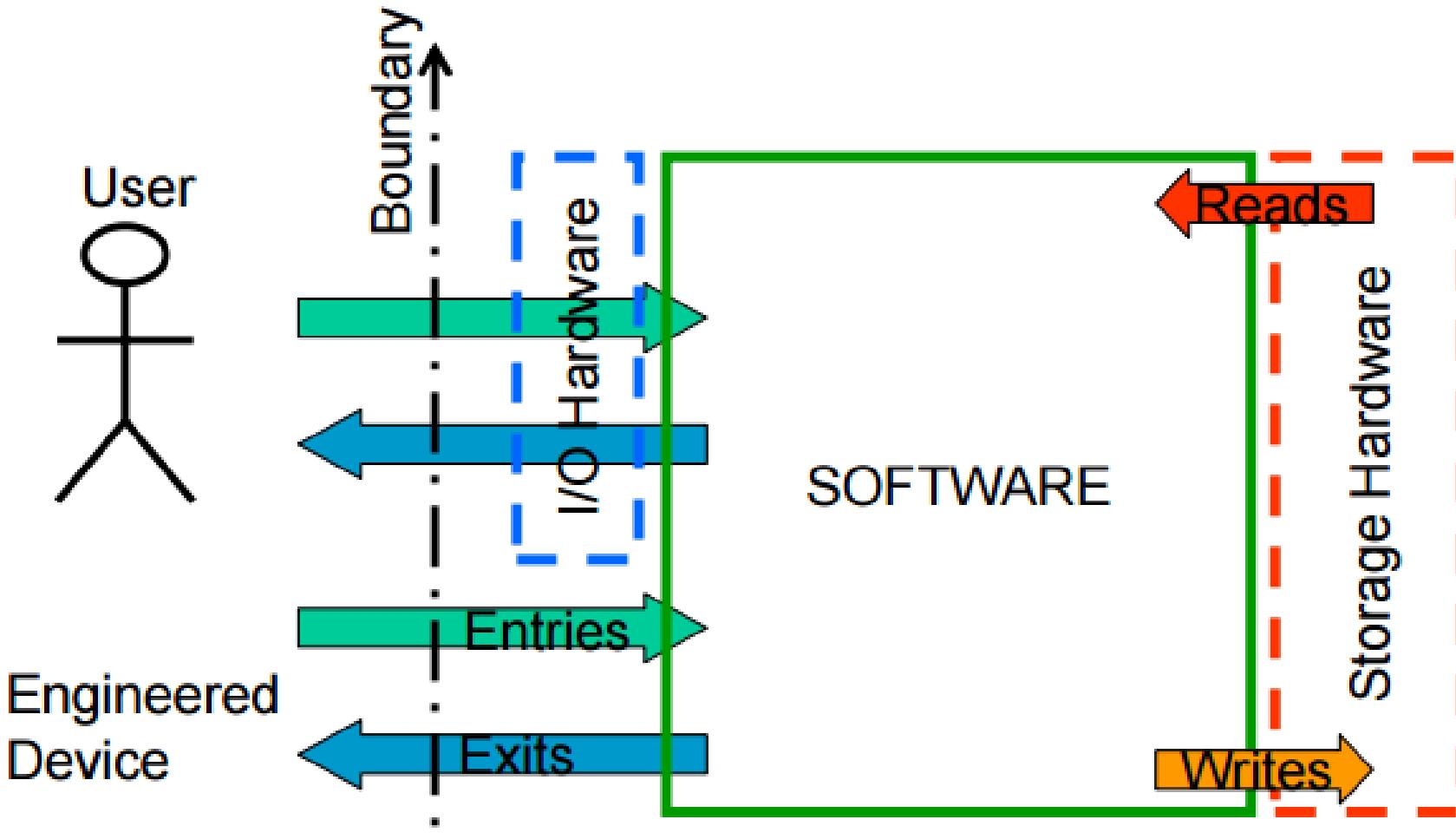
DAY 3

COSMIC-FFP

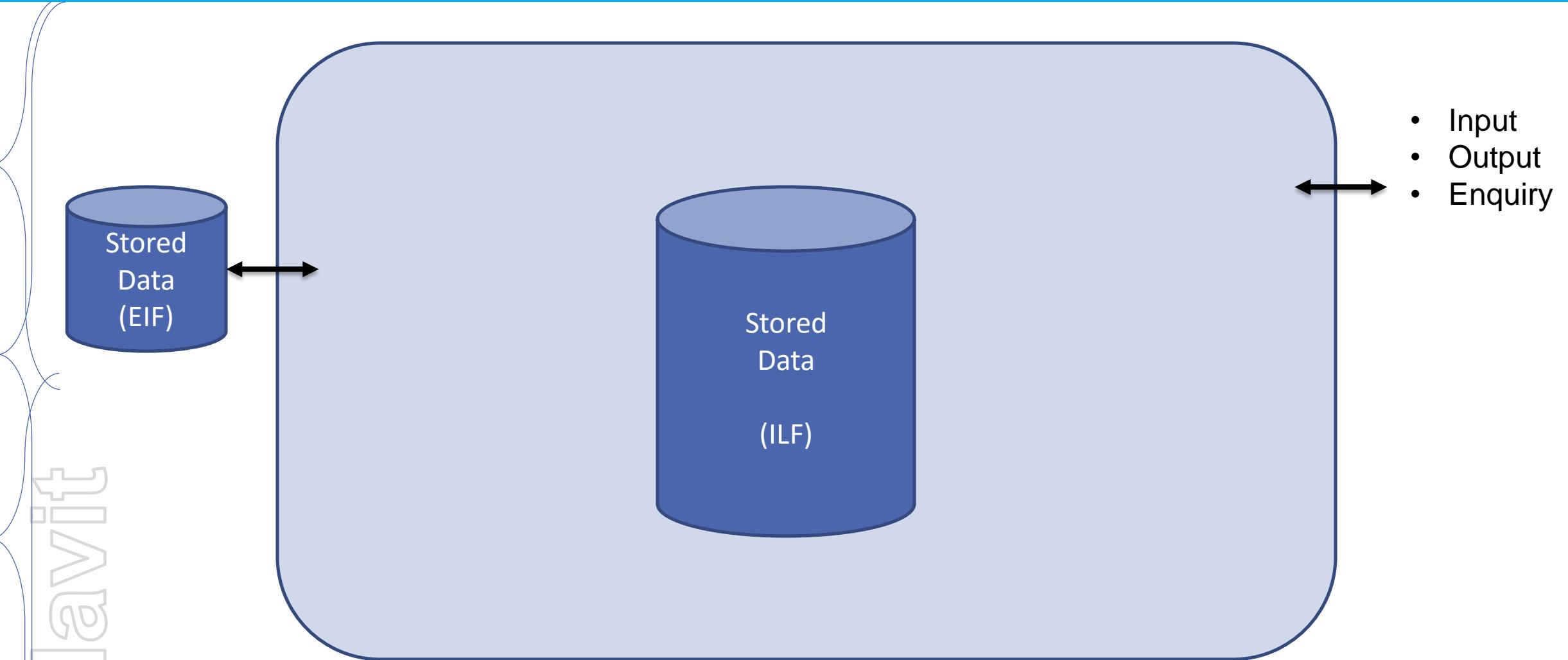
(Common Software Measurement International Consortium
Full Function Points)

- FFP (Full Function Points) methods and its newest development COSMIC-FFP have been developed in order to improve the measurement of functional size for wide range of software MIS, Real-Time, Embedded and Technical.

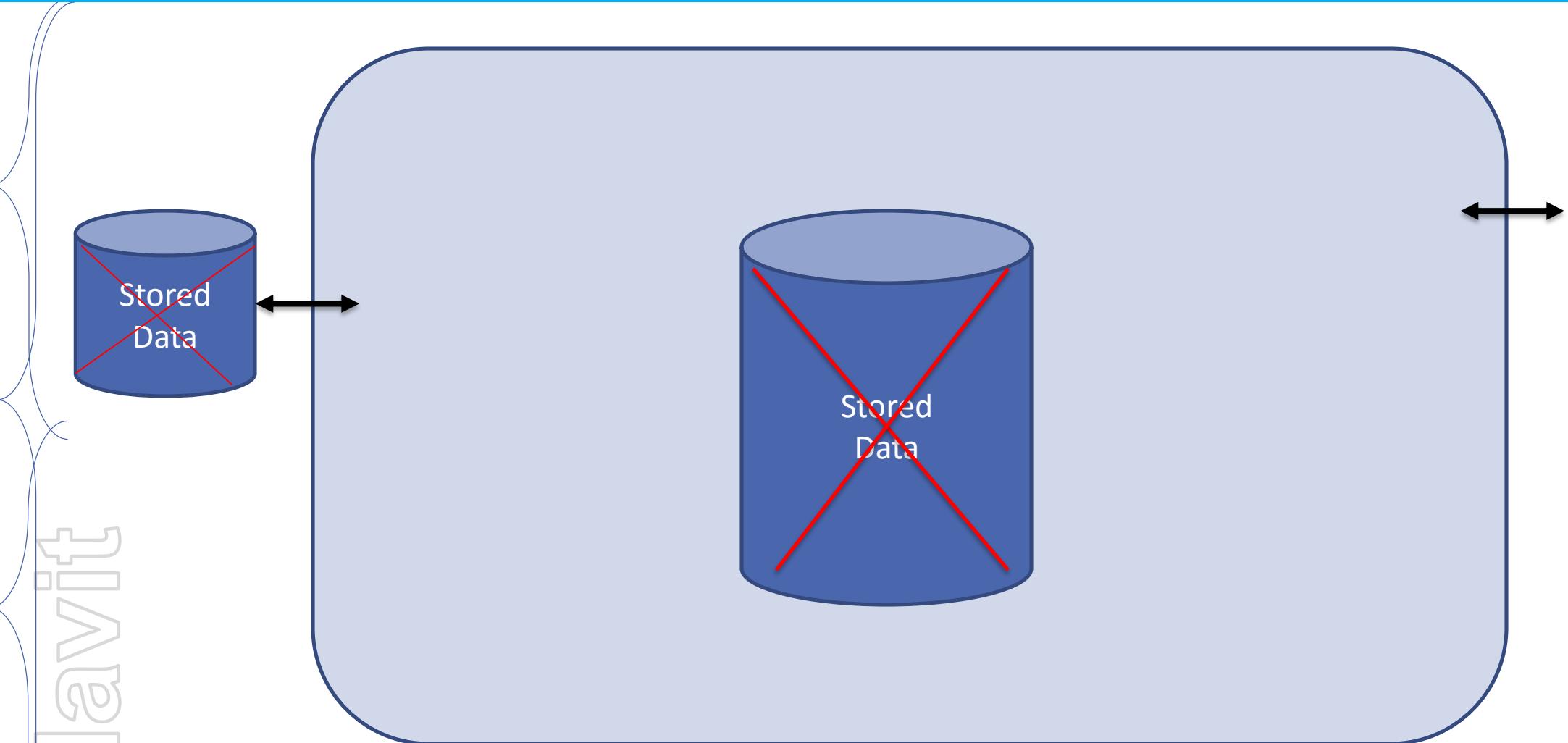
COSMIC-FFP



$$\text{Size_Cfsu} = \sum \text{size}(E) + \sum \text{size}(X) + \sum \text{size}(R) + \sum \text{size}(W)$$



5 Base Functional Component Types (BFC Types)



4 Base Functional Component Types (BFC Types)

COSMIC Example

IFPUG – Logical Files

- **ILF**

- Order File (2 RET)
 - Order
 - Order Line Item
- Product File
- Order Template File

- **1 Avg, 2 Low**
- **24 FP**

- **EIF**

- General Ledger Codes File
- **1 Low**
- **5FP**
- **Data Functions: 29 FP**

Order Header Screen

Computer Components Automated Supply System

Order Header Details

Order /Reservation Details

Order Number: Reservation Sales Tax Exemption # Urgent
 Description: Order Date: Routine

Contact Name: Date Required:

Vendor:

Send Invoice To:

Deliver Goods To:

Additional Instructions:

OK Items Print Save Cancel

Order Items Details Screen

Computer Components Automated Supply System

Order ItemDetails

Order /Reservation Details

Order Number: 10711943 Reservation Order Date: Order Item Value: \$ 1.387.00
 Description: Update RRS Computers Sales Tax \$ 138.70 Order Total \$ 1.525.70

Product Items:

Product #	Description	Brand Name	Size	Unit Measure	Qty	Price
DD1235	Hard Disk Drive	Osborne	240 mb	one drive	2	\$ 589.00
DD1205	Hard Disk Drive	Osborne	120 mb	one drive	1	\$ 209.00
DD1235	Hard Disk Drive	Connor	240 mb	one drive	1	\$ 500.00
DD1200	Hard Disk Drive	Seagate	40 mb	one drive	1	\$ 89.00

Add Modify Delete Comments GL Codes OK

IPFUG - Transaction Functions

DET (24)

1. Order Type
2. Division Invoice Address
3. Reservation Number
4. Date Required
5. Additional Instructions
6. Order Description
7. Contact Name
8. Priority Flag
9. Delivery Address
10. Reservation Number
11. Order Number
12. Sales Tax Exception#
13. Order Date
14. Order Total
15. Sales Tax
16. GL Ref Code
17. Quantity
18. Product Code
19. Product Description
20. Item Size
21. Item Price
22. Item Order Value
23. Error/ Confirmation Message
24. Action/Control

FTR (4)

- Order
- Order Template
- Product
- General Ledger

- **1 EI (High)**
- **6 FP**

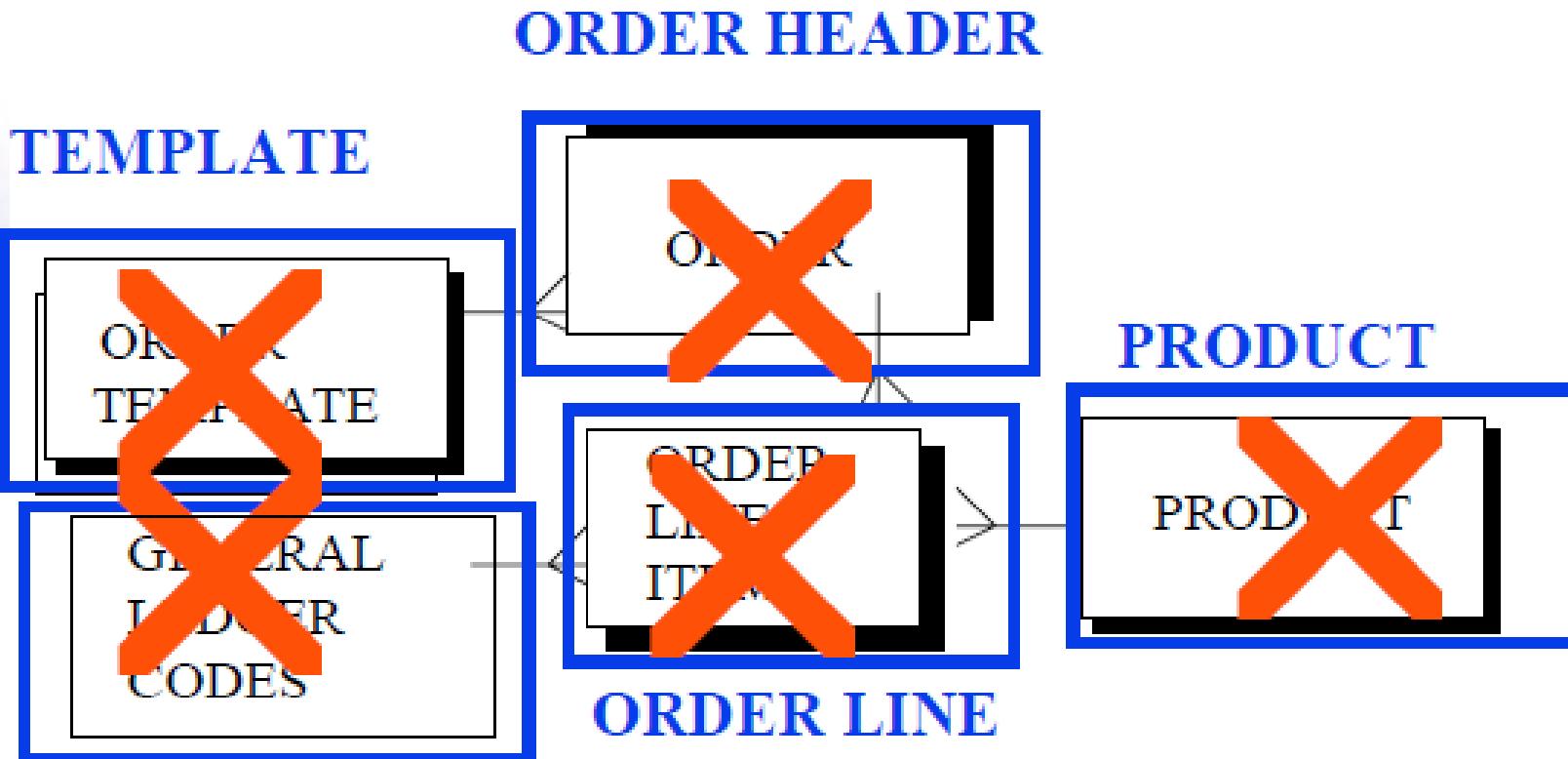
Order Header Screen

The screenshot shows the 'Order Header Details' window of the 'Computer Components Automated Supply System'. It includes fields for Order Number, Reservation Number, Sales Tax Exemption (with a checked checkbox), Urgent (radio button), Routine (radio button), Contact Name, Vendor, Order Date, Date Required, Send Invoice To, Deliver Goods To, and Additional Instructions. There are also buttons for OK, Items, Print, Save, and Cancel.

Order Items Details Screen

Product #	Description	Brand Name	Size	Unit Measure	Qty	Price
DD1235	Hard Disk Drive	Osborne	240 mb	one drive	2	\$ 589.00
DD1205	Hard Disk Drive	Osborne	120 mb	one drive	1	\$ 209.00
DD1235	Hard Disk Drive	Connor	240 mb	one drive	1	\$ 500.00
DD1200	Hard Disk Drive	Seagate	40 mb	one drive	1	\$ 89.00

COSMIC (Persistent Data)



Group Persistent data into 3rd Normal form

= 5 Persistent Data Groups

Total = 0 CFSU



Not BFC
Type

Identify READs from Persistent Data

- **READ** General Ledger Reference Code from General Ledger
 - **READ** Product Details from Product
 - **READ** Sales Tax information from Order Template
-
- Map data being retrieved (READ) from Persistent data to determine unique READS
 - 3 unique READS = Total =3 CFSU

Identify WRITES to Persistent Data

- **WRITE** Order Header details to Order Header
 - **WRITE** Order Item Details to Order Line
-
- Map data being written (WRITE) to Persistent data to determine unique WRITES
 - 2 unique WRITE = **Total =2 CFSU**

Group Transient Data ENTERing Process

- Order Header Detail Related
 - Order Type
 - Data Required
 - Order Description
 - Contact Name
 - Additional Instruction
 - Delivery Address
 - Priority Flag
 - Order Item Related
 - Product Code
 - Quantity
-
- **Map data entering to Entities**
 - **Group Data entered into get unique data movement ENTRIES**
 - **2 unique ENTRIES = Total =2 CFSU**

Group Transient Data EXITing Process

- Order Header Detail Related
 - Order Number.
 - Division Invoice Address
 - Sales Tax
 - Order Description
 - Order Total
 - Order Date
 - Sales Tax Exemption Number
- Order Item Related
 - Product Description
 - GL Ref Code
 - Item Size
 - Unit of Measure
 - Price
 - Item Order Value
- Error / Confirmation Message
- Map data exiting to Entities
- **Group Data exiting into 3rd Normal form to get 3 unique data movement EXITS**
- **3 unique EXITS = Total =3 CFSU**

IFPUG & COSMIC Comparision

IFPUG	BFC Type	FP	COSMIC	BFC Type	CFSU
Process			Sub-Process		
Create Order	EI	6	Enter Order Header Details	Entry	1
			Enter Order Item Details	Entry	1
			Read Product Details	Read	1
			Read Template	Read	1
			Read General Ledger	Read	1
Order	ILF	10	Display Order Header Details	Exit	1
Order Template	ILF	7	Display Order Item Details	Exit	1
Product	ILF	7	Display Message	Exit	1
General Leder	EIF	5	Write Order Header File	Write	1
			Write Order Item Details	Write	1
Data is shared over all processes		35	Influence of data is incorporated into each process		10

Measurement results of 5 applications

No.	Applications	IFPUG			COSMIC-FFP		
		Data	Process	Total	Data	Process	Total
1	W	21	56	77	N/A	74	74
2	M	14	26	40		34	34
3	C	14	35	49		47	47
4	LC	19	37	56		48	48
5	LS	12	19	31		26	26

IFPUG vs COSMIC

Measurement results of sixteen transactions

No.	Name	IFPUG	COSMIC-FFP
1	Add Customer	3	4
2	Change Customer	3	6
3	Delete Customer	3	5
4	Receive Payment	3	4
5	Deposit Item	6	5
6	Retrieve Item	4	6
7	Add Place	3	4
8	Change Place Data	3	6
9	Delete Place	3	4
10	Print Customer Item List	5	4
11	Print Bill	4	5
12	Print Stored Items List	4	3
13	Query Customers	3	4
14	Query Customer's Items	3	5
15	Query Places	3	4
16	Query Stored Items	3	5
Total		56	74

IFPUG vs COSMIC

Measurement details of the Query customers transaction

Process Objects	IFPUG				COSMIC-FFP	
	Type	#DET	#FTR	Point	Type	Point
Process	EQ	5	2	3	N/A	4
Sub-process	N/A				E R X X	1 1 1 1

IFPUG vs COSMIC

Measurement details of the Print Bill transaction

Process Objects	IFPUG				COSMIC-FFP	
	Type	#DET	#FTR	Point	Type	Point
Process	EO	4	2	4	N/A	5
Sub-process	N/A				E R R X X	1 1 1 1 1

IFPUG vs COSMIC

Measurement details of the Add Customer transaction

Process Objects	IFPUG				COSMIC-FFP	
	Type	#DET	#FTR	Point	Type	Point
Process	EI	4	1	3	N/A	4
Sub-process	N/A				E R X W	1 1 1 1

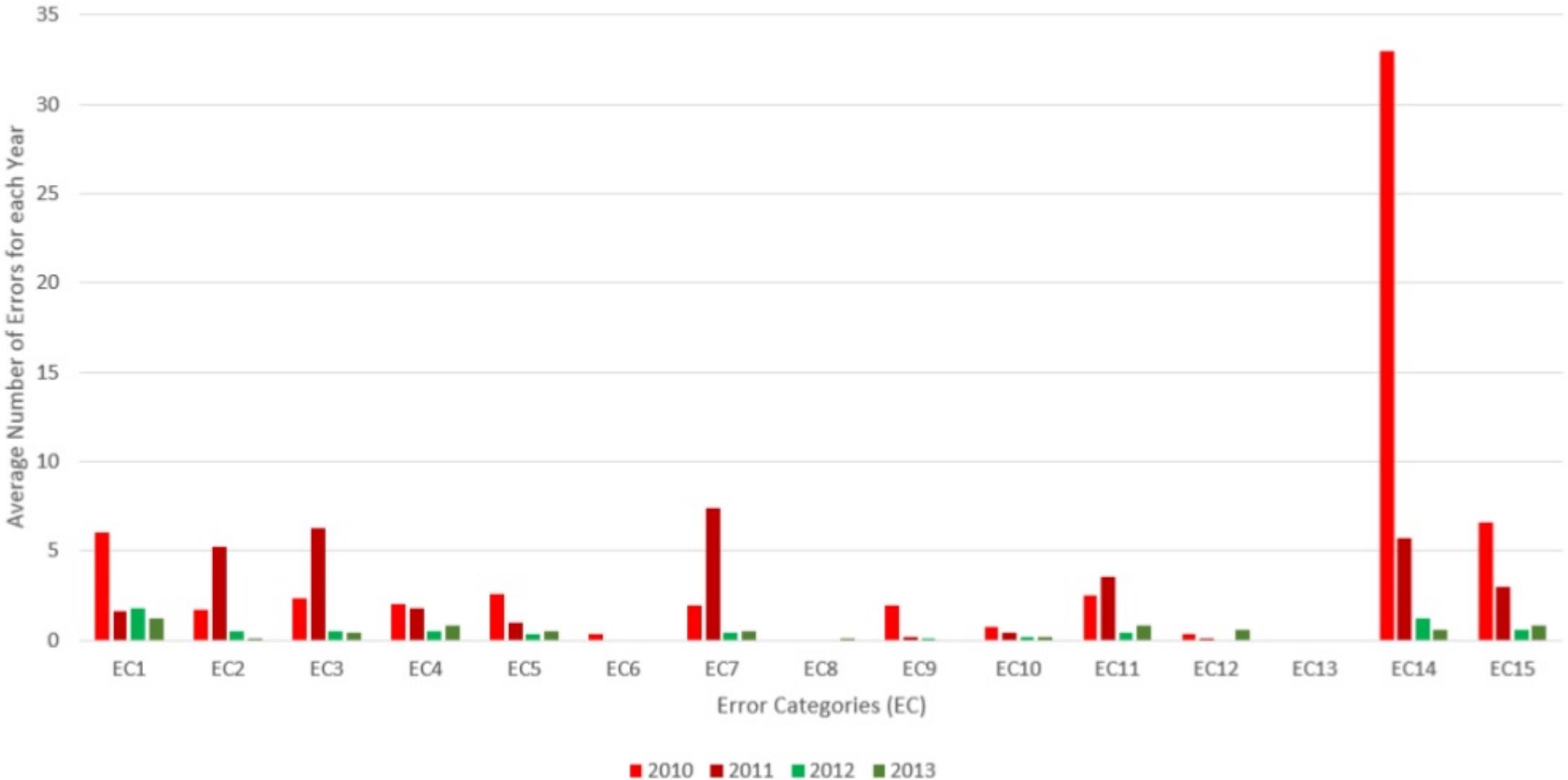
Data and Process concepts defined by IFPUG, and COSMIC-FFP methods

CONCEPTS	IFPUG	COSMIC-FFP
Data objects	ILF: Internal Logical File EIF: External Interface File	Data Group
Process objects	EI: External Input EO: External Output EQ: External Inquiry	Functional Process
Sub-process objects	N/A	E: Entry X: Exit R: Read W: Write

15 Types of Errors in Function Size Measurements

Error Category	Name
EC01	Duplicated Functional Process (FP)
EC02	Lack of list FP before Update FP
EC03	Lack of List FP before Delete FP
EC04	Lack of Retrieve FP before Update FP
EC05	Lack of Data Movement (DM) type Write (W) in Add, Delete and Update FPs
EC06	Redundant DM type W in list FPs
EC07	Multiple Occurrences of the same DM with the same FP
EC08	Each FP should be composed of at least 2 DMs
EC09	Each FP should contain at least 1 Write (W)/ Exit (X) DM
EC10	Each FP should contain at least 1 Entry (E) DM
EC11	List FP Might be included in Update/Delete FP
EC12	Create/Delete/Update Operations might be combined
EC13	Data Group (DG) Duplication

Error Categories Graphs



- Concepts of Estimation
- Earned Value Management
- Forecasting
- Metrics
- Estimation Techniques
- Function Point Analysis (FPA)
- FP Calculation: Thumb Rules
- Efforts , Cost & Duration Calculation
- Use Case Estimation
- Recap Workshop Learnings

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International Function Point User Group

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Project Management Institute

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Software Estimation Techniques - Common Test Estimation Techniques used in SDLC

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Project Management Estimating Tools & Techniques

- Function Point Counting Practices Manual Version 4.3

- Project Management Body of Knowledge 5th Edition



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