AN INTRODUCTION TO FUNCTION POINTS

Sizing The Software Deliverable

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Presentation Objectives

The primary presentation objectives are to:

- Transfer function point knowledge to:
  the SQGNE attendees
- Demonstrate potential to an organization's stakeholders
  in applying function point analysis to measurement

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Why Sizing is Important

- Requirements - Expectation management

- Estimation - Effective management practice, resource management

- Process Improvement - Process management

- Change Control – Project Management

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Why Function Point Analysis?

Function Point Analysis is a standardized method for measuring the functionality delivered to an end user.

- Consistent method
- Easy to learn
- Available early in the lifecycle
- Acceptable level of accuracy
- Meaningful internally and externally

- Objectives
    - Measure functionality that the user requests and receives
    - Measure software development and maintenance independently of technology used for implementation
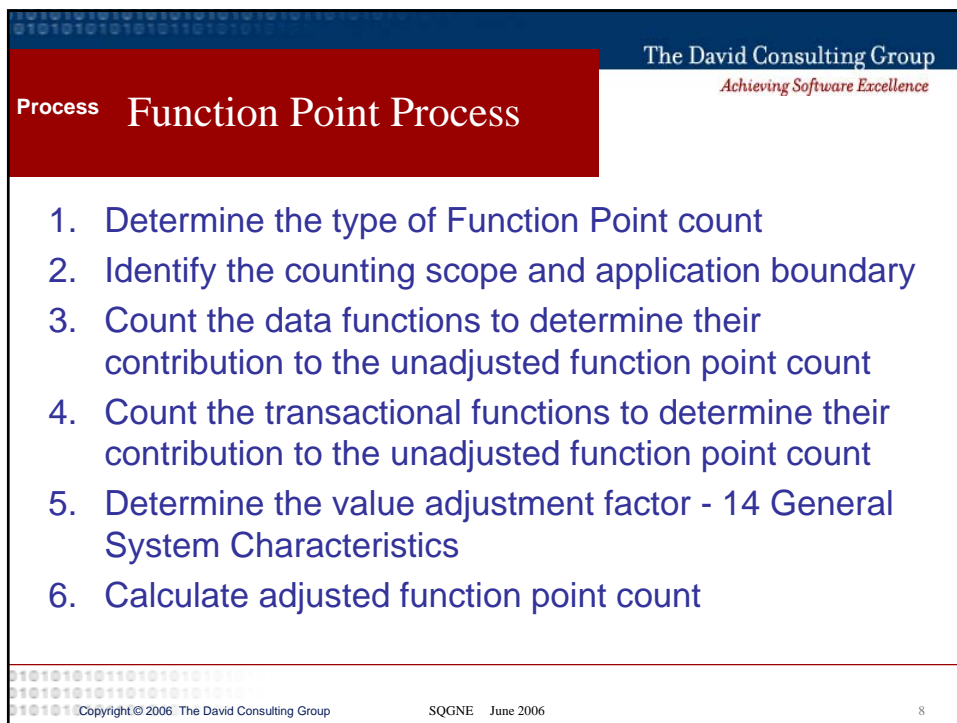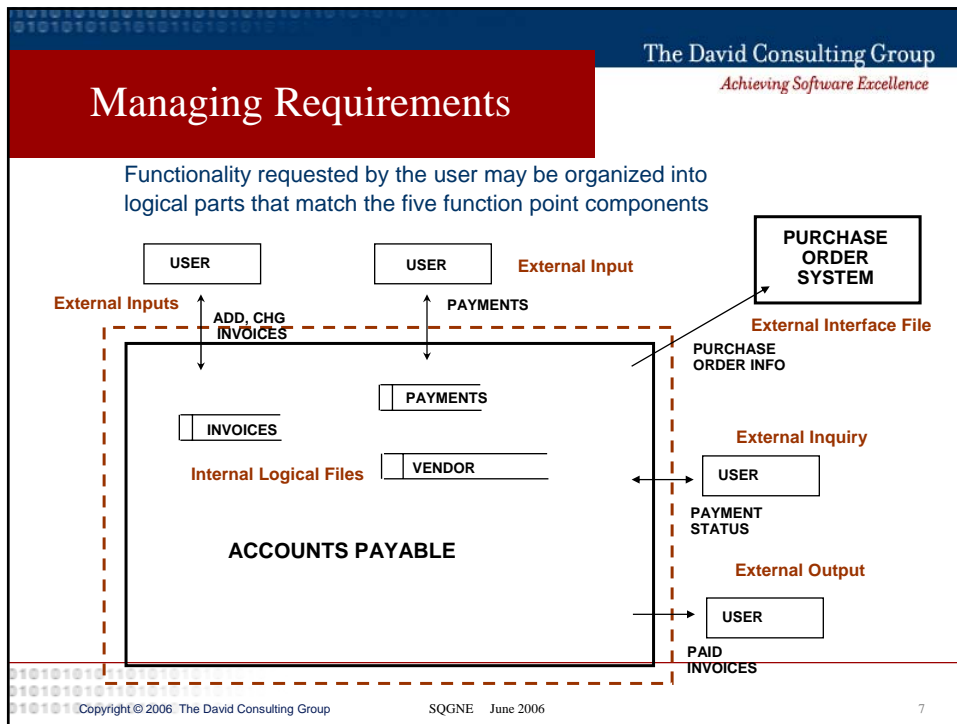
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Slide 1

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When Can you Use FPs?

PROPOSAL → REQUIREMENTS → DESIGN → CONSTRUCTION → TESTING → DELIVERY → CORRECTIVE MAINTENANCE

- Feasibility Study
- Initial User Requirements
- Initial Technical Requirements
- Final Functional Requirements

Function Points (under Design)
Revised Estimate Counted

Function Points (under Delivery)
Function Points (under Corrective Maintenance)
Actual Size Counted

Function Points (under Final Functional Requirements)
Early Estimate Approximated

Life Cycle Phase	Size can be approximated?	Size can be measured?
Proposal	Yes	No
Requirements	Yes	Yes
Design	Yes	Yes
Construction	Yes	Yes
Delivery	Yes	Yes
Corrective Maintenance	Yes	Yes

Slide 2

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FP Evaluates these Components

- Data Functions
  - Internal Groupings of data called Internal Logical Files (ILF)
  - External Groupings of data or External Interface Files (EIF)
  - The term file does not refer to files in the physical sense, rather refers to logical data stores, entities, objects or super-classes
- Transaction Functions
  - External Inputs (EI)
  - External Outputs (EO)
  - External Inquires (EQ)
- General System Characteristics
- We will explore the definitions of each of these components in the following slides

External Input   External Inquiry   External Output

Internal Logical Files

Application

External Interface File

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Managing Requirements

Functionality requested by the user may be organized into logical parts that match the five function point components

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Process   ## Function Point Process

1. Determine the type of Function Point count
2. Identify the counting scope and application boundary
3. Count the data functions to determine their contribution to the unadjusted function point count
4. Count the transactional functions to determine their contribution to the unadjusted function point count
5. Determine the value adjustment factor - 14 General System Characteristics
6. Calculate adjusted function point count

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**Step 1:
Type of
Count**

Types of Function Point Count

- **Development Project Function Point Count**
  - Measures the functions provided to users with first install of the software delivered when project is complete

- **Enhancement Project Function Point Count**
  - Measures the modifications to existing application add, change or delete user functions delivered when project is complete
  - When functionality is installed, the application count must be updated to reflect changes in the application functionality

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**Step 1:
Type of
Count**

Types of Function Point Count

- **Application Function Point Count**
  - Measures an installed application
  - Also referred to as the baseline or installed count
  - Provides count of the current functions provided to users
  - Number is initialized when the development project function point count is completed
  - It is updated every time completion of an enhancement project alters the application's functions

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Step 2: Boundary

Scope and Boundary

- Definition:
  - A function point count provides an answer to a business problem

- Purpose:
  - Determines the type of function point count and scope of required count
  - Influences the positioning of the boundary between the software under review and the surrounding software

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Step 2: Boundary

Diagramming an Application Boundary

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Step 3:
Data

Internal Logical Files

- 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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Step 3:
Data

ILF Identification Rules

- To identify ILFs, look for groups of data or control information that satisfy the definition of an ILF
- All of the following counting rules must apply for the information to be counted as an ILF:
  - 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 being counted

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**Step 3:
Data**

External Interface Files

- 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 application of the application counted; this means an EIF counted for the application must be an ILF in another application

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**Step 3:
Data**

EIF Identification Rules

- To identify EIFs, look for groups of data or control information that satisfy the definition of an EIF
- All of the following counting rules must apply for the information to be counted as an EIF:
    - 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

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Step 3:
Data

ILF/EIF Difference

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

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Step 3:
Data

Data Example

| Customer Address File | | Completed Orders File |

BILLING SYSTEM

Billing Master

The Customer Address File is used to print the addresses on the bills. No Billing System files are updated with this data.

Completed Orders File updates the Billing Master and cause the bills to be processed.

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Step 3:
Data

Solution

Description	ILF/EIF EI/EO/ EQ	RET/ FTR	DET	Cmplx
CUSTOMER ADDRESS FILE **BILLING MASTER FILE** **COMPLETED ORDERS FILE**	**EIF** **ILF** **-**			

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Step 4:
Trans-
actions

Transactional Functions

- Transactional functions represent the functionality provided to the user for the processing of data by an application
- Transactional functions are defined by their elementary process and primary intent as follows:
  - For the Elementary Processes where the Primary Intent is to maintain an ILF or to alter the behavior of the system:
    - **External Inputs (EIs)**
  - For the Elementary Processes where the Primary Intent is to present information to the user and that perform calculations, derive data, update an ILF or alter the behavior of the system:
    - **External Outputs (EOs)**
  - For the Elementary Processes where the Primary Intent is to present information to the user and that do not perform calculations, derive data, update an ILF or alter the behavior of the system
    - **External Inquiries (EQs)**

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Step 4: Trans-actions

Summary of Functions (EI, EO, EQ)

Function	EI	EO	EQ
Alter the behavior of the system	PI	F	N/A
Maintain one or more ILFs	PI	F	N/A
Present information to the user	F	PI	PI

Legend:
PI: primary intent of the transaction function
F: function of the transaction function, but is not the primary intent and is sometimes present
N/A: the function is not allowed by the transaction function

Step 4: Trans-actions

Summary Of Processing Logic (EI, EO, EQ)

PROCESSING LOGIC	EI	EO	EQ
Validations are performed	C	C	C
Mathematical formulae or calculations are performed	C	M*	N
Equivalent values are converted	C	C	C
Data is filtered and selected using specified criteria to compare multiple sets of data	C	C	C
Conditions are analyzed to determine which are applicable	C	C	C
At least one ILF is updated	M*	M*	N
At least one ILF or EIF is referenced	C	C	M
Data or control information is retrieved	C	C	M
Derived data is created	C	M*	N
Behavior of the system is altered	M*	M*	N
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 of data	C	C	C

Step 4:
Trans-
actions

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Summary Of Processing Logic (EI, EO, EQ)

- Legend:
  - M   it is mandatory that the function type perform the type of processing logic
  - M*   it is mandatory that the function 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
  - N   the function can not perform the form of processing logic

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Step 4:
External
Input

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External Inputs

- An external input is an elementary process that processes data or control information that comes from outside the application's 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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**Step 4:
External
Input**

EI Identification Rules

- All of the following counting rules must apply for data being processed to be counted as an external input:

  - 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 three statements must apply:

    - Processing logic is unique from processing logic performed by other EIs for the application
    - The set of data elements identified are different from the sets identified for other EIs in the application
    - The ILFs or EIFs referenced are different from the files referenced by the other EIs in the application

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**Step 4:
External
Input**

External Input Example

Course Registration Screen

NAME _____   START DATE (PK)_____

SSN   (PK)_____

COURSE # (PK)_____

COURSE TITLE _____

LOCATION _____   ACTION (A, C OR D)_____

(Both Error and Confirmation Messages Occur)

STUDENT and COURSE are updated/referenced.

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Step 4: External Outputs

External Outputs

- An external output (EO) is an elementary process that sends data or control information outside the application's boundary
- The primary intent of an external output is to present information to a user through the 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 and/or alter the behavior of the system

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Step 4: External Outputs

EO Identification Rules

- All of the following counting rules must apply for the elementary process to be counted as an external output:
  - Sends data or control information external to the application's boundary
  - For the identified process, one of the three statements must apply:
    - Processing logic is unique from the processing logic performed by other EOs for the application
    - The set of data elements identified are different from other EOs in the application
    - The ILFs or EIFs referenced are different from files referenced by other EOs in the application

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**Step 4:
External
Outputs**

EO Identification Rules

- In addition, one of the following rules must apply:
  - The processing logic contains at least one mathematical formula or calculation
  - Derived data is created
  - The processing logic maintains at least one ILF
  - The processing logic alters the behavior of the system

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**Step 4:
External
Outputs**

External Output Example

Course Roster Report

Course Name	xxxx	Course Number	xxx
Course Location	xxxxx	Instructor Name	xxxxxxx

Student Name	Address	SSN
xxxxxxx, xxxx x.	xxxxxxxxxxxx xxxxxxxxxxxx	nnn-nn-nnnn
xxxxxxx, xxxx x.	xxxxxxxxxxxx xxxxxxxxxxxx	nnn-nn-nnnn

TOTAL NUMBER OF STUDENTS nnnn

STUDENT and COURSE are referenced.

Step 4:
External
Inquiries

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External Inquiries

- 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 the user through the retrieval of data or control information
- The processing logic contains no mathematical formula or calculation, and creates no derived data
- No ILF is maintained during the processing, nor is the behavior of the system altered

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Step 4:
External
Inquiries

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EQ Identification Rules

- All of the following must apply
  - Sends data or control information external to the application's boundary
  - For the identified process, one of the three statements must apply:
    - Processing logic is different from the processing logic performed by other EQs for the application
    - The set of data elements identified are different from other EQs in the application
    - The ILFs or EIFs referenced are different from files referenced by other EQs in the application

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Step 4: External Inquiries

EQ Identification Rules

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- In addition, all of the following rules must apply:
  - The processing logic retrieves data or control information from one or more ILFs or EIFs
  - The processing logic does not contain mathematical formula or calculation
  - The processing logic does not create derived data
  - The processing logic does not alter the behavior of the system
  - The processing logic does not maintain an ILF

Step 4: External Inquiries

External Inquiry Examples

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Screen 1 - input

Restaurant Selection

S	Type
	Italian
x	Mexican
	Bistro

Screen 2 - output

Restaurant Selection

Name:	TACO BELL
Location:	EVERY CORNER
Golden Spoon Rating	**-2**
Price Range	CHEAP
Reservations	Never Needed

College Credits Report

Student	Course Number	Course Date	Credits
xxxxxxxxxxx, xxx	nnnnnnn	nn/nn/nnnn	nnnn
xxxxxxxxxxx, xxx	nnnnnnn	nn/nn/nnnn	nnnn
xxxxxxxxxxx, xxx	nnnnnnn	nn/nn/nnnn	nnnn
xxxxxxxxxxx, xxx	nnnnnnn	nn/nn/nnnn	nnnn
xxxxxxxxxxx, xxx	nnnnnnn	nn/nn/nnnn	nnnn

(Info is retrieved from Course ILF)

Component Complexity

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- FP Counting is based on *Identification Rules* and *Complexity Rules* (CPM)
- Components are assessed based upon complexity:
  - Data Element Types (Number of user variables or fields)
  - File Types Referenced (Number of data groups , either internal or external, that are referenced, read, created or updated)
  - Record Element Types (Number of data sub-groupings or unique record formats)

Components:	Complexity			Total
	Low	Avg.	High	
Internal Logical File (ILF)	X 7	X 10	X 15	
External Interface File (EIF)	X 5	X 7	X 10	
External Input (EI)	X 3	X 4	X 6	
External Output (EO)	X 4	X 5	X 7	
External Inquiry (EQ)	X 3	X 4	X 6	

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FP Terms

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- Unadjusted Function Points (UFPs)
  - The sum of the complexity weighted functions
- Value Adjustment Factor (VAF)
  - Reflects the functionality provided to the user by the 14 General System Characteristics
- Adjusted Function Points (AFPs)
  - The total Function Point count based on the Unadjusted Function Point count multiplied by the Value Adjustment Factor

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Step 5: Determine VAF

General System Characteristics

Data Communication

Distributed Data or Processing

Performance Objectives

Heavily Used Configuration

Transaction Rate

On-Line Data Entry

End-User Efficiency

On-Line Update

Complex Processing

Reusability

Conversion & Install Ease

Operational Ease

Multiple-Site Use

Facilitate Change

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Step 5: Determine VAF

Value Adjustment Factor (VAF)

- The value adjustment factor looks at 14 general system characteristics.
- Each characteristic is given a value
- Once all 14 GSCs have been evaluated, the VAF is computed:

$$\Sigma(DI) = TDI$$
$$(TDI * .01) + .65 = VAF$$

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Step 5: Determine VAF

General System Characteristic Guidelines

- Each general system characteristic descriptions includes guidelines to determine the degree of influence.
- Each guideline contains:
  - A definition of the GSC
  - Rules for determining the score
  - If the rule needs further clarification, hints have been provided to help apply the rules consistently across all platforms.
  - Hints are not intended to cover all situations but are meant to provide additional guidance in determining the appropriate score

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References

For more information:

- The David Consulting Group
  - www.davidconsultinggroup.com

- International Software Benchmarking Standards Group
  - www.isbsg.org.au

- International Function Point Users Group
  - www.ifpug.org

- Software Engineering Institute, Project Sizing & Estimating
  - www.cmu.sei.edu

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