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Function Point Analysis

Introduction and Basic Overview as an Alternative to SLOC-based Estimation

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Software Cost Estimation

- Two Main Types of Developed SW Cost Estimation
  - SLOC Based Estimation
  - Function Point Analysis
- What's the Difference?
  - SLOC deals specifically with counting and estimating the Lines of Code for a program. It is explicitly code length-based, usually to apply a $/LOC productivity rate to an estimate.
  - Function Point Analysis quantifies and assigns a value to the actual uses, interfaces, and purposes of a piece of SW. It also adjusts these values depending on the complexity of the program.
- This presentation focuses on Function Point Analysis as an alternative to SLOC – based estimations.

Robert Cringely - **"If automobiles had followed the same development cycle as the computer, a Rolls-Royce would today cost $100, get a million miles per gallon, and explode once a year, killing everyone inside."**

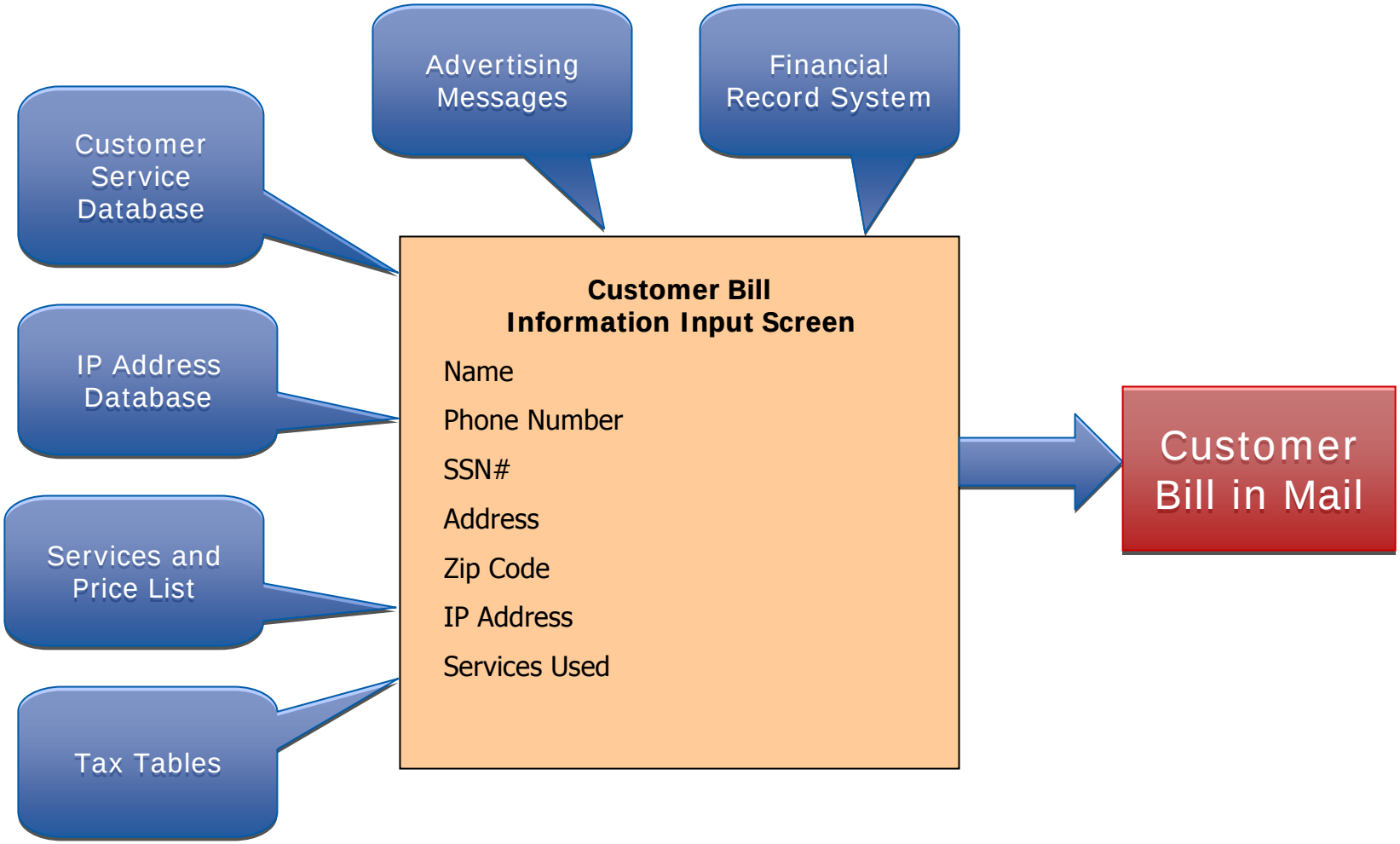
Presentation Agenda

- The Definitions of a Function Point (FP)
- Brief History of FP Analysis
- *What* you need, and *Why* you use Function Points
- Basic “How To Count” Function Points
- Benefits of FP Analysis – Pros and Cons
- Recommendations
- Conclusion
- References
- ≈35 Slides

What is a Function Point?

- IFPUG (International Function Point Users Group):
  - Function Point Analysis (FPA) is a sizing measure of clear business significance. The FPA technique quantifies the functions contained within software in terms that are meaningful to the software users.
  - About Function Point Analysis, http://www.ifpug.org/about/about.htm (2005). Online.
- SCEA:
  - Function points are a size measure that, as the name indicates, considers the number of functions being developed based on the requirements specification.
  - SCEA. *Cost Estimating Body of Knowledge (CEBoK), Module 12 Software Cost Estimation*. 2009. Print.
- So…What does that mean?
  - Simply Speaking: Function Points are the aspects of a SW application that a User recognizes as important to the SW program's actual use.

For the Visual Learner: Cable Company Billing Example



Quick History of FP Analysis

- Allan Albrecht, of IBM, developed the method of Function Point Counting in 1979 in *A New Way of Looking at Tools*
- In 1986, the IFPUG, or International Function Point Users Group, was set up to develop and apply standards to the practice of function point analysis
  - IFPUG has numerous international partners in Europe, Australia, and Asia
- Since 1986, several versions of the Function Point Counting Practices Manual have been published by IFPUG. However, a new version is published only out of necessity in order to keep the standards from changing.

- IFPUG: About Us, http://www.ifpug.org/about/ (2009). Online.

IFPUG Logo

< http://www.ifpug.org/about/>

Getting Started: What do you need?

- The Right Resources
  - The Program's Primary Users
  - Program Developers / People who are familiar with the program (logically)
  - Customers
  - System Analysts
  - Project Managers
  - Function Point Specialists
  - Measurement Analysts

Picture borrowed from the Audi website. They looked like they were working well together.

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What else do you need?

- The Right Documentation
  - Helps give a visual look into the program being counted
    - High-level application architecture
    - A logical data model
    - Detailed design specifications and requirements, including functionality requirements
    - Business function/process models
    - User manuals
    - Screen prints
    - Printed report layouts
    - Function Point Counting Practices Manual

A Note on Documentation

- Function Point Analysis can be performed with as many/few of these documents as are available
  - Documents are only necessary for assisting the analyst to facilitate the visual mapping process for the program with a manager or engineer
  - A high level architecture, design specifications, and function/process models are all sufficient if the analyst can understand them and the manager can explain them
    - This ability to work with preliminary documents is beneficial especially because this is all the cost analyst has to work with in many situations

Where do I get this data?

- ICBD (for the Intelligence Community)
- CARD (for DoD Programs)
- User Interviews
- Customer Interviews
- Programmer Interviews
- Past Similar Systems
  - Like in SLOC-based estimation
  - Gives a great comparison metric
- Common Sense

Why do you need this data?

- Historical Data and Pre-Established Parametric Data
  - Similar programs can be used to establish relationships or to see possible trends in the function growth and development time frame
- Must be able to visualize the logical progression
  - Visual Maps are essential to understanding the flow of the program
- Insight into the program complexity
- Identify important, easily-forgotten features

So, How do you count Function Points?

- Disclaimer: This is just the Basic Idea
- Let's go back to the "ComCable Company" Example
  - Estimate for New Customer Billing System
  - Assuming we're starting from scratch
  - Customer Services maintains Customer Billing Info, enters into the system
  - The information going onto Bill comes from multiple, externally maintained systems

SX4 & Associates

John Hermann
123 King Street,
Waterloo, Ontario
N2L 3X1

Account #123
Billing Date 25-November-1997

Regular Service Charges (26-October to 25-November)	$22.95
Local Calls (71 calls at $0.05 per call)	$3.55

Long Distance Calls

Date	Time	Minutes	Dialed Number	Rate ($/min)	Amount
Thu, Oct 30	7:00pm	12	129	0.10	$1.20
Sun, Nov 2	8:20am	17	199	0.10	$1.70
Sun, Nov 2	10:45am	32	199	0.10	$3.20
Wed, Nov 5	7:43am	21	129	0.07	$1.47
Sat, Nov 8	1:03pm	49	199	0.25	$12.25
Mon, Nov 17	5:20pm	38	129	0.25	$9.50
Sat, Nov 22	11:18pm	19	199	0.07	$1.33
Total Long Distance Calls					$30.65

Total Current Bill $57.15

Billing Summary

Previous Amount	$0.00
Total Current Bill	$57.15
Total Amount Due	$57.15

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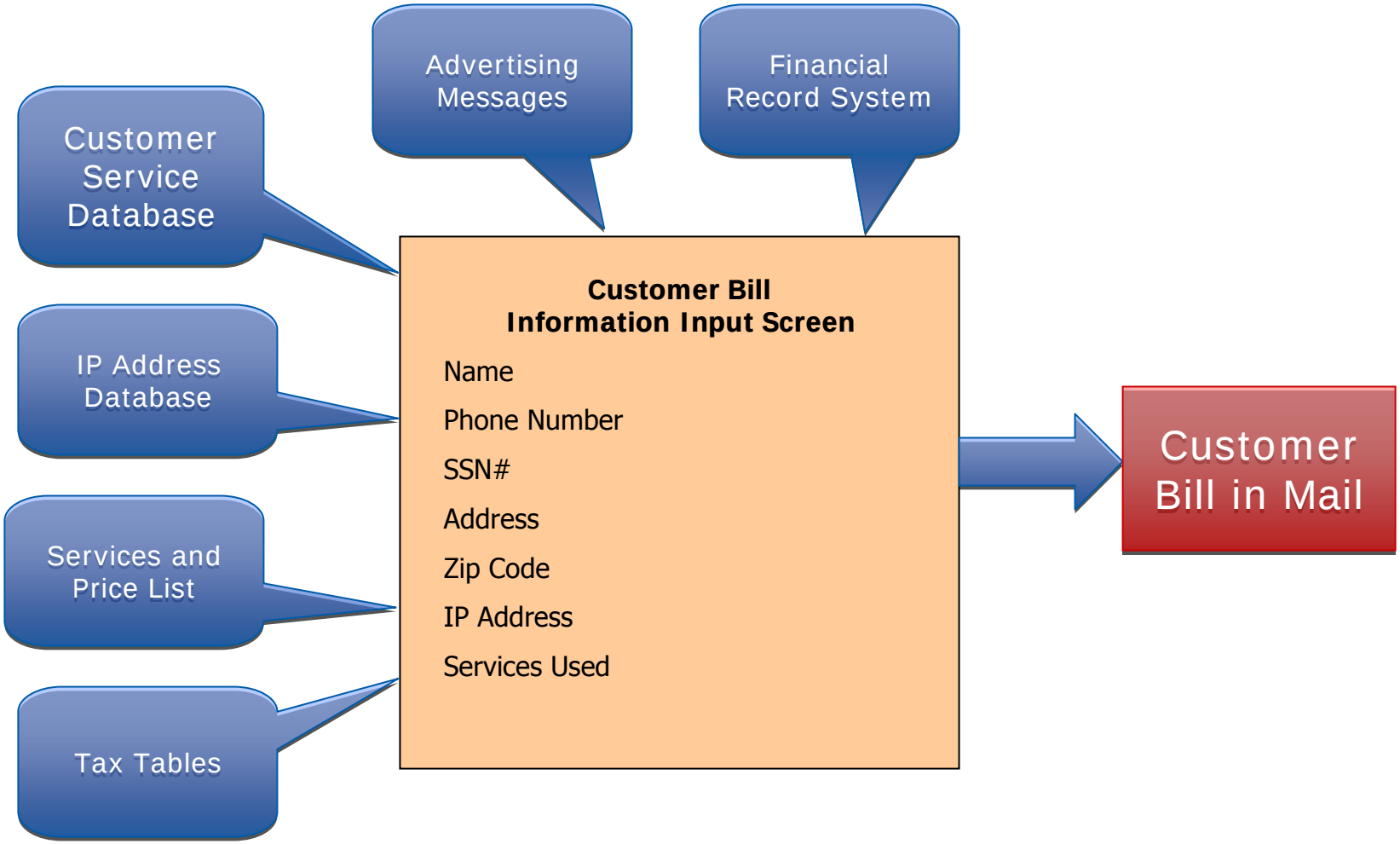
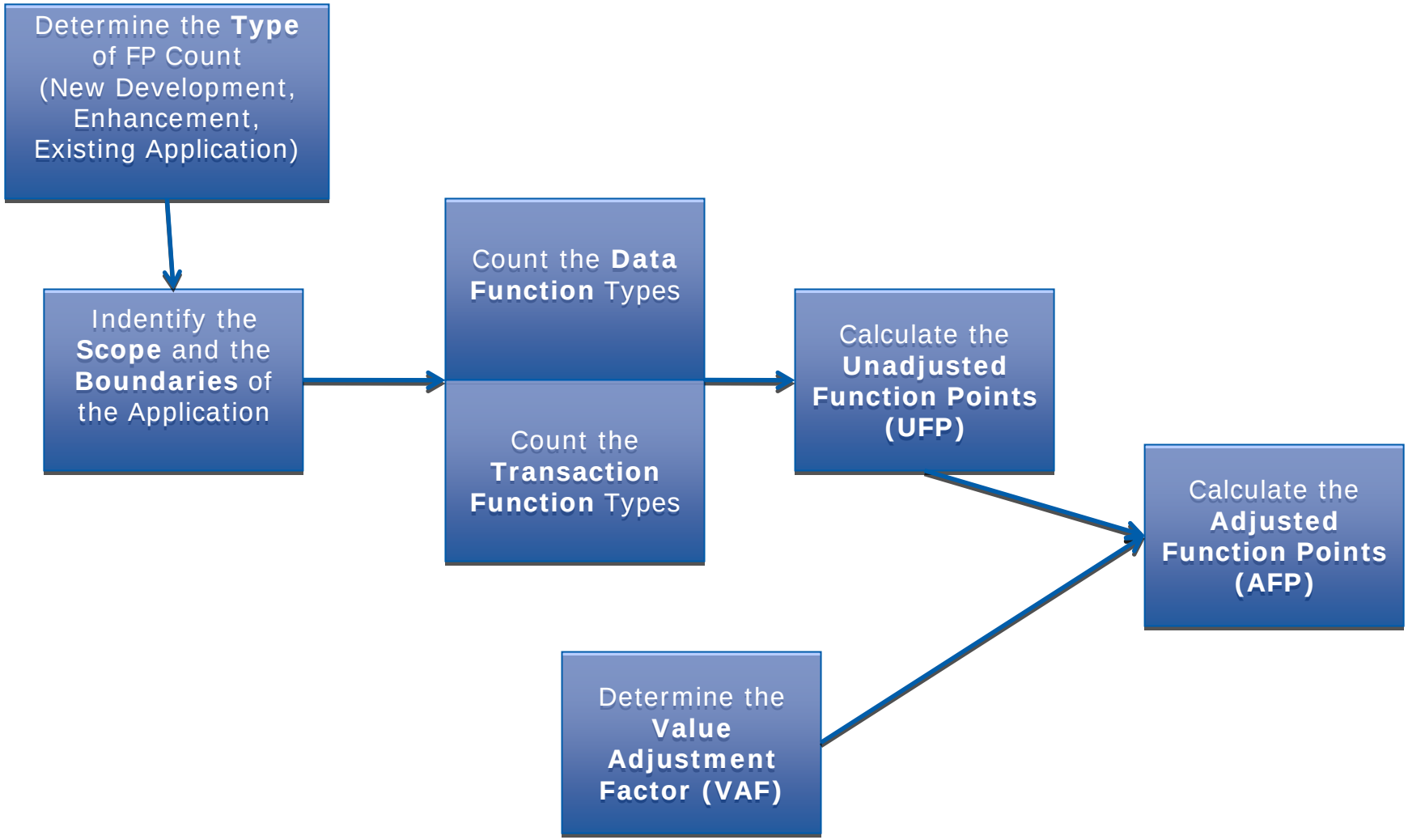
Again, For the Visual Learner

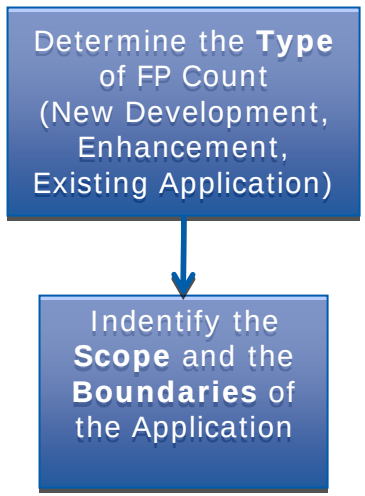


Function Point Counting Process



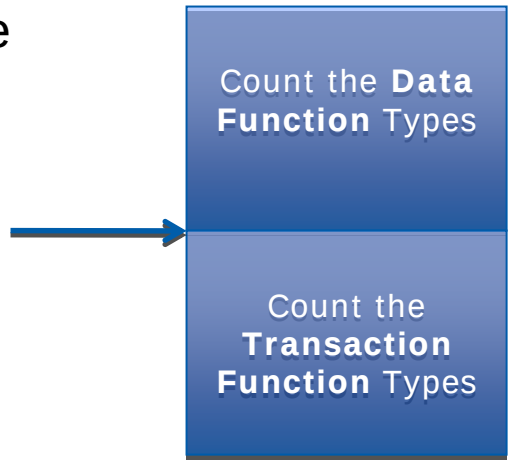
Where are we in the process?

- The **Type** of count that we're performing is a "New Development Count"
  - We assumed that this is the first time a billing system was created
  - No existing code or structure was introduced
- We've already identified the **Scope and Application Boundaries**
  - We know the purpose
  - We know what data goes in / comes out through interfaces and user transactions
  - We know what the User wants



Now We Count the Functions

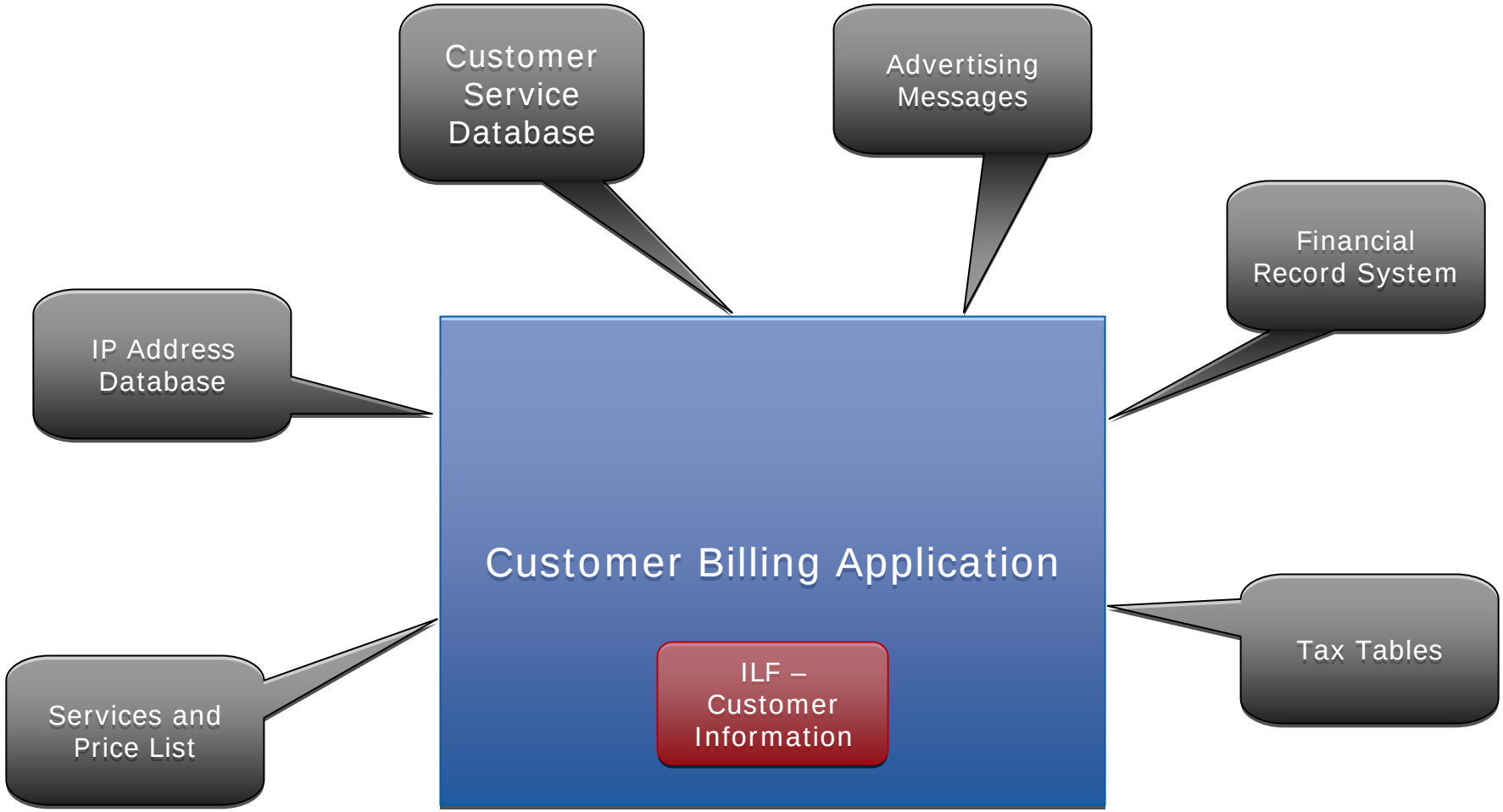
- Two Types of Functions
  - Data Functions
  - Transaction Functions
- Data Functions
  - Made up of the Internal and External “resources” that affect the system
  - Internal Logical Files (ILF) and External Interface Files (EIF)
- Transaction Files
  - Made up of the processes that are exchanged between the user, the internal files, and the external files
  - External Inputs (EI), External Outputs (EO), and External Inquiries (EQ)
- More detail on these on next slide



Indentify the Data Functions

- Remember, we have two types of Data Functions
  - ILFs and EIFs
- ILFs
  - Internal Logical Files are those that are User identifiable groups of data and are maintained by the User
  - Let's assume we have one ILF : "ComCable" Customers
- EIFs
  - External Interface Files are User identifiable groups of data that are maintained by someone Other Than the user.
  - EIF's hold information that is referenced to by an ILF
  - Assume we have six

ILFs and EIFs



Transaction Functions

- Transaction Functions are the inputs, outputs, and data retrievals through logical processing
- Types: External Inputs, External Outputs, External Inquiries
- External Inputs (EI)
  - Unique process, data goes INTO application from outside the boundary
  - Intent is to maintain / alter the system
- External Output (EO)
  - Data comes OUT of the system
  - Intent is to present information to a user
  - Performs Calculation, Derives Data, or Updates ILF
- External Inquiries (EQ)
  - Data comes OUT of the system
  - Intent is to present information to a user
  - Performs NO calculations, Derives NO data, Updates NO ILFs

Transaction Functions in the Example

- **External Inputs**
- (on INPUT screen)
  - Add Record Feature
  - Change Record Feature
  - Delete Record Feature

- **External Outputs**
  - The Customer Bill Report
  - Print Report Feature

- **External Inquiries**
- (on INPUT screen)
  - Report Look-Up Feature

Input Screen and Customer Bill

Customer Service Input Screen

Customer Information

Name:_____

Phone Number:_____

SSN#:_____

Address:_____

Zip Code:_____

IP Address:_____

Services Used:_____

Add | Change | Delete | Print | Look-Up

Print Bill

Bill Output

ComCable Customer Bill

Name

Phone Number

SSN#

Address

Zip Code

IP Address

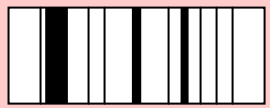
Services Used

Taxes

Hidden Fees

Total

Advertisement Info



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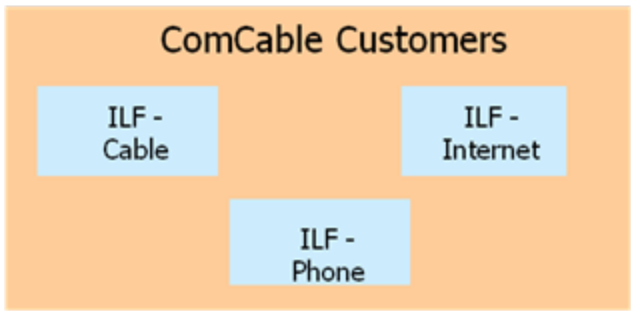
Great, so how many Function Points?

- Here is where **Complexity** comes into play
- EIFs and ILFs are broken up into two parts
  - Record Element Types (RET)
  - Data Element Types (DET)
- EI, EO, and EQs are broken into two parts
  - File Types Referenced (FTR)
  - Data Element Types (DET)

RETs and DETs

- In ILFs and EIFs, Record Element Types (RET) are the largest user-identifiable subgroup of elements
  - Our ILF has 3 examples: Cable, Phone, and Internet Customers WITHIN ComCable Customers
  - EIF Example: Customer's Current Balance Due within the Financial Record System
- Data Element Types (DETs) are the different elements within each RET
  - The Cable Customer RET has Name, Number, SSN, etc. as DETs
  - The Customer's Current Balance Due has "Balance Due" as a DET



FTRs and DETs

- Counted for EI, EO, and EQ
- Same basic definitions as RETs and DETs for ILF/EIF
- File Types Referenced (FTRs) are the larger, user-identifiable subgroups within the EI, EO, EQ that are *Referenced To*
- Data Element Type (DET) is the data subgroup within an FTR
  - These DETs are only counted ONCE for the same logical process: if already counted by an earlier process, then they can't be counted again

Example of RET, FTR, DET Counts

ILF/EIF	RET	DET			EI/EO/EQ	FTR	DET
ILF-ComCable Customers	Cable Customers	Name Number SSN Address Zip Code Service Used			EI – Cable Customer - Add Record	ILF – ComCable Customers	Name Number SSN Address Zip Code IP Address Service Used
ILF-ComCable Customers	Phone Customers	Name Number SSN Address Zip Code Service Used			EI – Cable Customer – Change Record	ILF – ComCable Customers	Name Number SSN Address Zip Code IP Address Service Used
ILF-ComCable Customers	Internet Customers	Name Number SSN Address Zip Code IP Address Service Used			EO – Customer Bill	ILF – ComCable Customer EIF- Services/ Price EIF – Zip Code EIF – Financial Records EIF – Advertisements EIF – Tax Table	ALL OF ABOVE Total Due Taxes Bar Code
EIF – Zip Code	Zip Code Table	Zip Code					

Putting it ALL Together

- These tables give function point values to the different RET/FTR DET combinations
- Each ILF, EIF, EI, EO, EQ is counted separately, then added up
- Ex. The Customer Bill EO has >3 FTRs, >6 DETs, therefore HIGH complexity, 7 Function Points
- The total of these Function Points = Unadjusted Function Point (UFP) count

ILF / EIF

RET's	DATA ELEMENTS		
	1-19	20 - 50	> 50
1	Low	Low	Ave
2-5	Low	Ave	High
> 5	Ave	High	High

Rating	Values	
	ILF	EIF
Low	7	5
Average	10	7
High	15	10

EI

FTR's	DATA ELEMENTS		
	1-4	5-15	> 15
0-1	Low	Low	Ave
2	Low	Ave	High
3 or more	Ave	High	High

EO and EQ

FTR's	DATA ELEMENTS		
	1-5	6-19	> 19
0-1	Low	Low	Ave
2-3	Low	Ave	High
> 3	Ave	High	High

Rating	VALUES		
	EO	EQ	EI
Low	4	3	3
Average	5	4	4
High	7	6	6

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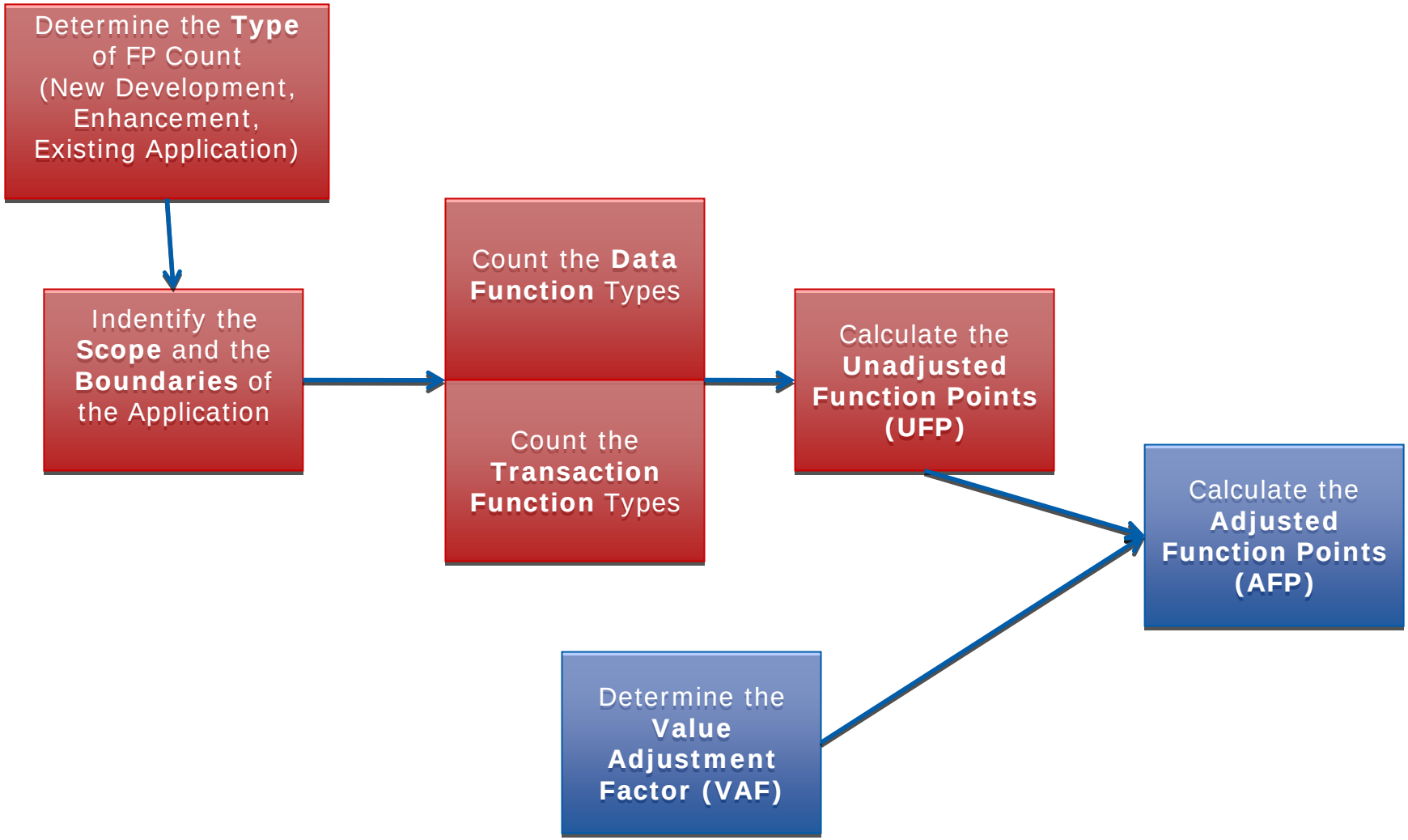
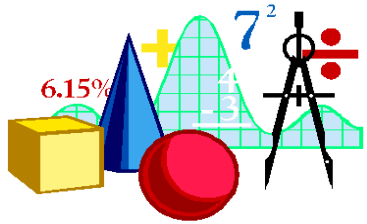
Next Step in the Process



Value Adjustment Factor

- The factor that normalizes the Unadjusted Function Point count
- Calculated by asking the 14 General System Characteristic Questions
  - Purpose is to apply further valuation to system complexity
  - Sums up “Degrees of Influence” for each GSC
- VAF calculation can be performed at **Any** point in the FP counting process
  - Any Added / Changed / Deleted functionality of a system results in VAF recalculation

$$VAF = 0.65 + [(\Sigma \text{ Deg. Of Influence}) / 100]$$



General System Characteristic Questions

- These questions help to describe the complexity of a program
- The analyst assigns a value of 1 – 5 Degrees of Influence for most questions

1	*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 physical components of the application.
3	*Performance:* Describes the degree to which response time and throughput performance considerations influenced the application development.
4	*Heavily Used Configuration:* Describes the degree to which computer resource restrictions influenced the development of the application. Heavily used operational configurations may require special considerations when designing 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:* On-line User Interface describes the degree to which data is entered or retrieved through interactive transactions. On-line User Interface for data entry, control functions, reports, and queries are provided in the application.
7	*End-User Efficiency:* Describes the degree of consideration for human factors and ease of use for the user of the application measured. The on-line functions provided emphasize a design for user efficiency.

General System Characteristic Questions

8	*On-Line Update:* Describes the degree to which internal logical files (ILF) are updated on-line. The application provides on-line updates for the ILF's.
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. A conversion / installation plan and/or tools were provided and tested during the system test phase.
12	*Operational Ease:* Describes the degree to which the application attends to operational aspects, such as start-up, back-up, and recovery processes. The application minimizes the need for manual activities, such as tape mounts, paper handling, and direct, on-location manual intervention.
13	*Multiple Sites:* Describes the degree to which the application has been developed for different hardware and software environments.
14	*Facilitate Change:* Describes the degree to which the application has been developed for easy modification of processing logic or data structure. Made up of two parts: Flexible Query and Business Data Control Data.

Adjusted Function Point Count (AFP)

- The “Final” Function Point count
- Applies the Value Adjustment Factor (VAF) to the Unadjusted Function Point (UFP)

$$AFP = UFP * VAF$$

- Some certain situations, such as an Enhancement Function Point Count, require additional math

Function Points in Cost Estimation

- Major metric is $ / Function Point (Cost)
- Function Point / Person-Month (Productivity)

- For Very Similar Systems: SLOC / Function Point (Cost)

- Like all cost estimation, ALL of these metrics require GOOD historical data

Pros and Cons of Function Points

- General Benefits (not necessarily benefits over SLOC):
  - Independent of Technology
  - Independent of Programming Languages
  - Requirements are the only thing needed for a FP Count
  - SLOC can grow but Functionality usually stays the same
  - Provides a method of easier communication with business groups
  - Clear view of size, cost, and productivity
  - Keeps all parties involved in estimate
  - Provides a naturally strong base of documentation

- Cons:
  - Can be very time-consuming
  - Requires a good base of historical data and past function point counts
  - Requires a trained function point counter
  - Counting techniques can vary from counter to counter
  - There are no COTS packages available for FP Counting that are recognized by IFPUG
  - Suffers some of the same pitfalls as the Build-Up methodology
  - Incurs the inherent risk when using analogies

Recommendations

- Begin counting Function Points alongside counting SLOC
  - Need historical data before relying on FP's completely
  - Strengthens FP knowledge and ability within group
- Count Function Points for past programs
  - Again, need to build a firm base of historical data
  - FP counting training and practice
- Compare Results
  - How long it takes to produce function point-based estimates
  - How Accurate / Precise (margin of error)
  - Customer preference

Conclusion

- Function Point Analysis quantifies a system or application's functional uses
- Function Points are a solid alternative to SLOC counting for developed SW estimation
  - Independent of Technology / Programming Languages
  - Relatively simple
  - Great communication device
- Can be completed at all stages of development
- Should Test and Practice
  - Gain a base of historical data
  - Compare to SLOC
  - Pick up where SLOC leaves off
- To Reiterate: This presentation is not trying to assert Function Point Analysis as dominant over SLOC-based estimation
  - FPA is presented as an oft-overlooked alternative to SLOC

Thank You

- For more information, see the references page and visit some of the sites given
- Contact me with questions, comments, concerns, etc.
- Tucker Moore – TASC
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  - (703) 449-3646
  - (703) 785-8650

Resources

- SCEA. *Cost Estimating Body of Knowledge (CEBoK), Module 12 – Software Cost Estimation*. 2009. Print.
- IFPUG Website, <http://www.ifpug.org/about/> (2009). Online.
- IFPUG. Function Point Counting Practices Manual. 2009. Print.
- Q/P Management Group – Lori Holmes
- Software Metrics, <http://www.softwaremetrics.com> (2009). Online.
- Total Metrics, <http://www.totalmetrics.com> (2009). Online.