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Software engineering — IFPUG 4.1 Unadjusted functional size measurement method — Counting practices manual

Ingénierie du logiciel — Méthode de mesure de la taille fonctionnelle non ajustée de IFPUG 4.1 — Manuel des pratiques de comptage

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 20926 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and system engineering*.

Scope

This International Standard specifies the International Function Point Users Group (IFPUG) Release 4.1 unadjusted Functional Size Measurement Method. It provides:

- clear and detailed description of function point counting
- A foundation to ensure that counts are consistent
- Guidance to allow function point counting of Functional User Requirements from the deliverables of popular software development methodologies and techniques
- A framework to enable automated support for function point counting

The provisions of this International Standard can be applied by anyone using function point analysis for software measurement. It was designed for use by persons new to function point counting as well as those with intermediate and advanced experience.

IFPUG Foreword

Function points are the leading metric of the software world. Although function points originated as a sizing mechanism for software projects, the power and utility of function points have expanded into new uses far beyond that basic purpose. As the twenty-first century approaches, function points are now being applied to all of these tasks:

- Benchmark studies
- Development cost estimating
- Litigation involving software contracts
- Litigation involving software taxation
- Maintenance cost estimating
- Outsource contracts
- Process improvement analysis
- Quality estimating
- Quality measurements
- Sizing all software deliverables (documents, source code, test materials)
- Year 2000 software cost estimating

As usage of function point metrics expands throughout the software world, more and more companies and government agencies are starting function point programs. This implies that the need for certified function point analysts is rising even faster than the demand for other software professionals. Certification would not be possible without a complete and stable set of counting rules for function point analysis.

A great deal of the credit for the rapid expansion of function point metrics should go to the International Function Point Users Group (IFPUG) and its officers, committees, and members. One of the committees that merits commendation is the Counting Practices Committee.

Although the basic principles of function point analysis are simple and straightforward, the real-life application of these principles across thousands of software projects is not simple at all.

If function point counts fluctuated by more than 150% when counted by different individuals (as do lines of code counts) then function points would have no claim to be considered a useful business metric. But thanks to the work of the Counting Practices Committee, the reliability of function point analysis is good enough to allow function points to serve as the basis for contracts, for carrying out scholarly research, for cost estimating, and for creating reliable benchmarks. So far as can be determined, the accuracy of function points is equal or superior to many other business metrics such as internal rate of return, net present value, or return on investment.

The move to version 4.0 of the IFPUG counting practices in January of 1994 was somewhat contentious and controversial. This is because the version 4.0 rules had the affect of reducing function point totals for some applications, by fairly significant amounts.

The move to the version 4.1 rules should be much smoother and less controversial. The reason that 4.1 was selected rather than 5.0 as the name of this release is because the numeric results of the new version are close enough to the version 4.0 rules that recounting will not be necessary.

The major changes in the version 4.1 rules are in the examples, the clarification of some complex counting situations, and improvements in the overall exposition of function point counting principles. Those learning to use function points should find the version 4.1 rules to be easier to understand and apply than the prior versions.

As software itself expands and changes, the rules for counting function points must also be expanded. When Allan Albrecht first introduced function points in October of 1979, many of the kinds of software projects being created in 1999 did not exist. For example, in 1979 software such as multi-tier client-server applications, web applets, and massive enterprise resource planning (ERP) systems were still in the future.

It is a tribute to Allan Albrecht's vision that function point metrics are as useful today as they were in 1979. But without the work of the IFPUG organization and the Counting Practices Committee, function point metrics would not be expanding in utility at the beginning of the twenty-first century. In fact, function points are now used for more business purposes than any other metric in the history of software.

T. Capers Jones
Chief Scientist
Artemis Management Systems

IFPUG Preface

Introduction

The use of function points, as a measure of the functional size of software, has grown in the past decade from a few interested organizations to an impressive list of companies worldwide. The IFPUG method is applicable to measuring all software

IBM CIS & A Guidelines 313

In the late 1970s, Allan Albrecht of IBM defined the concepts that enabled measuring the output of software development projects. These definitions were extended in *IBM CIS & A Guideline 313, AD/M Productivity Measurement and Estimate Validation*, dated November 1, 1984.

Release 2.0

With the growth in the use of function points, there was wider and wider application of the measure. This broadening of the application tested the original description of the measure and made it necessary to create guidelines to interpret the original rules in new environments. This was reflected in Release 2.0 of the *International Function Point Users Group (IFPUG) Function Point Counting Practices Manual.*

Release 3.0

Release 3.0 of the *IFPUG Function Point Counting Practices Manual* was a major milestone in the evolution of functional size measurement. For the first time, the IFPUG Counting Practices Committee made an effort to change the document from a collection of many interpretations of the rules to a truly coherent document that represented a consensus view of the rules of function point counting. In this sense, it was the first step to truly establishing standards for function point measurement which could be applied across organizations.

Release 4.0

Release 4.0 (January 1994) was the next milestone in the evolution of functional size measurement. This release reflected the use of function points early in project development to estimate project size using information engineering disciplines. The rapidly increasing number of graphical user interface (GUI) windows applications mandated that we include GUI counting in the release. Because more counting was occurring across a wider variety of situations, the release placed an emphasis on interpreting and practicing using the counting rules. Examples were included throughout the documentation and case studies supplemented the material. Finally, release 4.0 continued to clarify and increase the consistency of function point counting.

Release 4.1

Release 4.1 (January 1999) provides clarifications to existing rules, new or amended rules which address previously undocumented situations and new hints and examples to aid understanding. The IFPUG Counting Practices Committee has reviewed and processed requests from members, following the Manual Revision Process contained in Chapter 1 of this manual.

The revisions included in 4.1 clarify:

- the identification of a user, an elementary process, and control information
- the differentiation between External Outputs (EOs) and External Inquiries (EQs)
- the identification of Data Element Types (DETs) and Record Element Types (RETs) for data functions
- the identification of Data Element Types (DETs) for transactional functions

Release 4.1 continues the process of clarifying and improving the consistency of function point counting.

Finally, with the exception of the 14 General Systems Characteristics, it was designed to be compliant with existing ISO standards if and when any compliance guide becomes a standard.

Future Releases

This document is meant to be a living one. We must recognize how to count new environments as they are introduced. We need to be able to do this in the context of maintaining the validity of the counts we have already made. This will not be an easy task, yet it is an essential one if we are to be able to measure the progress we are making in delivering value to the users and to the organizations they represent.

The Counting Practices Committee wishes to thank all those who have helped us in our research and in the production of this manual.

Mary S. Bradley
Chairperson, Counting Practices Committee

1 Introduction

Introduction

This chapter defines the objectives of this International Standard and this International Standard revision process. It also describes publications that are related to this International Standard.

The IFPUG method is applicable to measuring all software.

Contents

This chapter includes the following sections:

Objectives of this International Standard

The primary objectives of this International Standard ISO/IEC 20926 are to

- Provide a clear and detailed description of function point counting
- Ensure that counts are consistent with the counting practices of IFPUG affiliate members
- Provide guidance to allow function point counting from the deliverables of popular methodologies and techniques
- Provide a common understanding to allow tool vendors to provide automated support for function point counting

Guidelines for ISO/IEC 20926

The following guidelines were used to develop this release:

- This International Standard is based primarily on the *IFPUG Function Point Counting Practices Manual, Release 4.0.*
- Secondly, this International Standard is based on *IBM CIS & A Guideline 313, AD/M Productivity Measurement and Estimate Validation*, dated November 1, 1984. The function point counting methodology described in 313 is generally referred to as Albrecht 1984.
- Finally, issues not sufficiently covered in the sources listed above were decided by the IFPUG Counting Practices Committee and validated through impact studies.

With its release, this International Standard should be considered the IFPUG standard for function point counting. It is imperative that each IFPUG member takes an active role to ensure counting consistency. IFPUG member adherence to this standard will contribute greatly to counting consistency.

Intended Audience

The standards in this International Standard should be applied by anyone using function point analysis for software measurement. This International Standard was designed for use by persons new to function point counting as well as those with intermediate and advanced experience.

Organization of this International Standard

There are three major parts in this International Standard:

- Preface and introduction
- Overview of function point analysis
- Explanation of the counting practices

Examples are used extensively throughout this International Standard to explain counting practices concepts, rules, and procedures. Detailed examples conclude chapters 6 and 7.

Note: A separate IFPUG Glossary includes definitions of terms used across IFPUG publications.

Preface and Introduction

The Preface and Introduction provide an overview of this International Standard and function point counting.

Overview of Function Point Analysis

The Overview introduces the function point counting procedures and includes a summary example of the procedures.

Explanation of the Counting Practices

Chapter 3 explains the concept of user view.

Chapters 4 through 9 present details about each of the procedure steps introduced in the Overview.

For example, Chapter 4, Determine Type of Count, is the first step in the function point counting procedure. Chapter 9, Calculate Adjusted Function Point Count, is the last step.

Information within chapters 5 through 7 is presented in the following sequence:

- Definitions
- Rules
- Procedures
- Counting Hints
- Examples

Manual Revision Process

This section explains the frequency of changes to this International Standard and defines the change process.

Frequency of Changes

During January of each year, a new version of this International Standard *may* become effective. It will include any new or changed definitions, rules, or counting practices that have been finalized by the Counting Practices Committee (CPC) since the previous January.

Change Process

The following activities outline the process for adding or changing information in this International Standard. Explanations of each activity follow the table.

Step	Action
1	The issue is submitted to the CPC.
2	The issue is assigned for research.
3	The CPC reviews and discusses the issue.
4	The CPC presents a proposed solution to the IFPUG membership.
5	An impact study is initiated if the proposed change would have any impact on existing counts.
6	The final decision is made.
7	The IFPUG membership is informed of the decision.
8	Changes become effective with, and are reflected in, the next release of this International Standard.

Issue Submitted

The reader submits ideas, changes, or issues to the Counting Practices Committee using the Reader's Request Form at the end of this International Standard. If the page is not available, send comments to the address in the front of this International Standard and mark it, "ATTN: Counting Practices Committee."

Research Assigned

A member of the CPC is assigned the responsibility for identifying all alternatives, the rationale, and the potential impact of each alternative if it is implemented. Thorough examination of existing counting standards and historical papers is completed while compiling alternatives. In addition, an effort is made to determine what is thought to be *common practice*.

CPC Review The CPC reviews and discusses the rationale for each alternative, and its potential impact. The review and discussion may result in a proposal for change or the review may lead the committee to reject the change request.

Solution Proposed A proposed solution is made to the IFPUG membership and written comments are solicited.

A copy of the proposed changes is mailed to IFPUG contacts at member organizations. The proposal also may be announced and distributed during an IFPUG conference. The latter depends on the timing of the committee meeting rather than the conference schedule.

Impact Study Initiated The CPC has adopted a conservative stance on initiating impact studies. If it is possible that *common practice* must change, or several organizations or types of applications will be impacted by the change, an impact study is initiated.

The success of the impact study is the responsibility of every IFPUG member. If the CPC receives written feedback indicating there is little or no impact, the study is discontinued.

Final Decision Made The committee makes a final decision using results from research, written comments from members, and the impact study.

The committee can complete more than one iteration of Steps 2 through 5 (research through impact study) before making a final decision. The final decision can result in a change or the committee may decide that a change is not warranted.

Decision Communicated The final decision is communicated in writing to IFPUG members via the IFPUG contact at the various organizations.

If any impact study results contributed to making a decision, the results and a recommendation on how to minimize the impact of the change will also be communicated.

Decision Effective Date This International Standard is updated to reflect the decisions. The effective date of the decisions is the date of the next January release of this International Standard.

Related IFPUG Documentation

This Counting Practices Manual is one module in the IFPUG documentation. All documents complement each other.

The following table describes the other publications.

Document	Description
IFPUG Brochure (Available)	This publication is an introduction to the International Function Point Users Group. It includes a brief history of the organization, introduces function point analysis, and defines the purpose of IFPUG. The brochure also includes a membership application. Audience: This publication is for anyone who wants an overview of IFPUG or an application for membership.
IFPUG: Organizational Structure and Services (Available)	This publication describes IFPUG services, and lists the board of directors, committees, and affiliate members worldwide. Audience: This publication is for anyone who wants background information about IFPUG.
Guidelines for Software Measurement (Release Date: April 1994)	This International Standard provides an overview of software metrics for organizations working to create or improve software measurement programs. This International Standard addresses both system and customer management, provides high-level justifications for software measurement, and examines the components of effective measurement programs. Audience: This International Standard is intended for IFPUG members, Function Point Coordinators, persons who prepare the reports to management, and other persons knowledgeable about and working directly with function points.
Application of Measurement Information (Current release is available as *Function Points as an Asset* Update Release: September 1994)	This International Standard explains how function points are an asset and provides information to assist in implementing the use of function points. Audience: This International Standard is intended for IFPUG members, Function Point Coordinators, persons who prepare the reports to management, and other persons knowledgeable about and working directly with function points.
Quick Reference Counting Guide (Release Date: January 1999)	This quick reference guide is a summary of function point counting rules and procedures. Audience: This summary information is intended for anyone applying function point analysis.
Function Point Analysis Case Studies (Release Dates: Case Study 1: May 1994 Case Study 2: September 1994 Case Study 3: September 1996 Case Study 4: September 1998)	The case studies illustrate the major counting techniques that comprise the Function Point Counting Practices Manual. The cases illustrate function point counts for a sample application. The cases include the counting that occurs at the end of the analysis phase of software development and after system construction. Audience: The case studies are intended for persons new to function point analysis as well as those with intermediate and advanced experience.

Document	Description
IFPUG Glossary (Available with *CPM* and *Function Points as an Asset*)	This is a comprehensive glossary that defines terms used across IFPUG publications. Audience: The glossary is recommended for anyone who receives any of the other IFPUG documents or anyone who needs definitions of IFPUG terms.

Training Requirements

Usability evaluations of this publication have verified that reading this International Standard alone is not sufficient training to apply function point counting at the optimum level. Training is recommended, particularly for those new to function point counting.

Note: For function point training, be sure you are trained using IFPUG certified materials. Call the IFPUG Executive Office at 614-895-7130 for a list of instructors with certified training courses.

In addition to the function point specific information, this International Standard includes the use of structured analysis and design terms, such as business systems and entity. The glossary includes definitions of these terms, but this International Standard does not include detailed explanations of structured analysis and design techniques. Therefore, all of the material will not apply or be helpful if you have not been trained in structured analysis and design techniques.

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2 Overview of Function Point Analysis

Introduction This chapter presents an overview of the function point counting process. It includes the objectives of function point counting and presents a summary and example of the function point counting procedures.

Contents This chapter includes the following sections:

Objectives and Benefits of Function Point Analysis

Function point analysis is a standard method for measuring software development from the user's point of view. The IFPUG method is applicable to measuring all software.

Objectives of Function Point Analysis

Function point analysis measures software by quantifying the functionality the software provides to the user based primarily on logical design. With this in mind, the objectives of function point analysis are to:

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

In addition to meeting the above objectives, the process of counting function points should be:

- Simple enough to minimize the overhead of the measurement process
- A consistent measure among various projects and organizations

Benefits of Function Point Analysis

Organizations can apply function point analysis as:

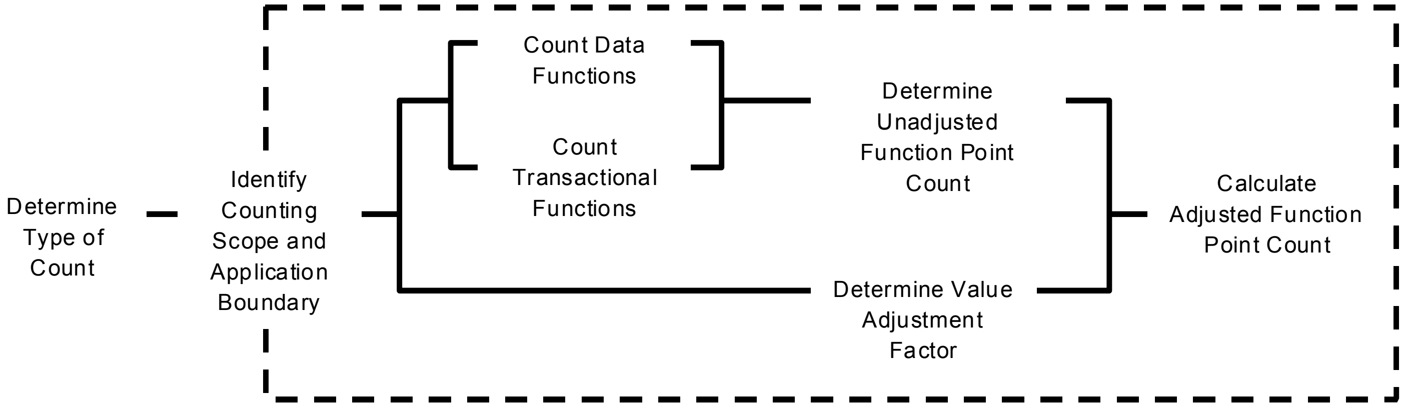
- A tool to determine the size of a purchased application package by counting all the functions included in the package
- A tool to help users determine the benefit of an application package to their organization by counting functions that specifically match their requirements
- A tool to measure the units of a software product to support quality and productivity analysis
- A vehicle to estimate cost and resources required for software development and maintenance
- A normalization factor for software comparison

Refer to other IFPUG documents such as *Function Points as an Asset* for additional information about the benefits of function point analysis, or see the IFPUG web site at http://www.ifpug.org for additional information.

Function Point Counting Procedure

This section presents the high-level procedure for function point counting.

Procedure Diagram



Procedure by Chapter

The following table shows the function point counting procedures as they are explained in the remaining chapters of the manual.

Note: A summary example of the counting procedures is presented on the following pages in this chapter.

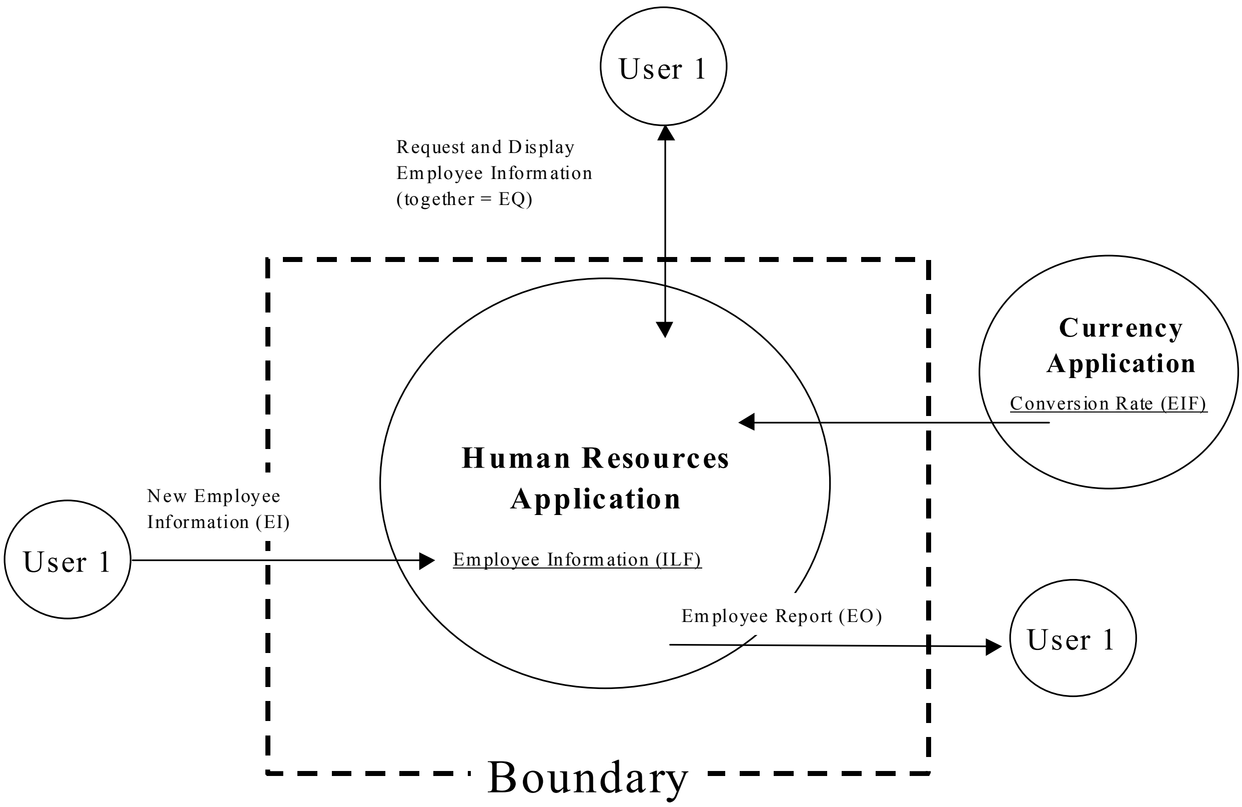
Chapter	Procedure
4	Determine the type of function point count.
5	Identify the counting scope and application boundary.
6	Count the data functions to determine their contribution to the unadjusted function point count.
7	Count the transactional functions to determine their contribution to the unadjusted function point count.
8	Determine the value adjustment factor.
9	Calculate the adjusted function point count.

Summary Counting Example

This section presents a summary example of the function point counting procedure and the components that comprise the count.

Summary Diagram

The following diagram shows the components for the example function point count for a Human Resources Application. Refer to the diagram while reading the remaining paragraphs in this chapter.



Determine the Type of Function Point Count

The first step in the function point counting procedure is to determine the type of function point count.

Function point counts can be associated with either projects or applications. There are three types of function point counts:

- Development project function point count
- Enhancement project function point count
- Application function point count

The example on page 2-4 is for a project function point count, which will also evolve into an application function point count.

Chapter 4 includes detailed definitions of each type of function point count. Chapter 9, the last chapter in this manual, explains the formulas to calculate the adjusted function point count for each of the three types of counts.

Identify the Counting Scope and Application Boundary

The counting scope defines the functionality that will be included in a particular function point count.

The application boundary indicates the border between the software being measured and the user.

The example on page 2-4 shows the application boundary between the Human Resources Application being measured and the external Currency Application. It also shows the application boundary between the Human Resources Application and the user.

Chapter 5 explains counting scope and application boundary.

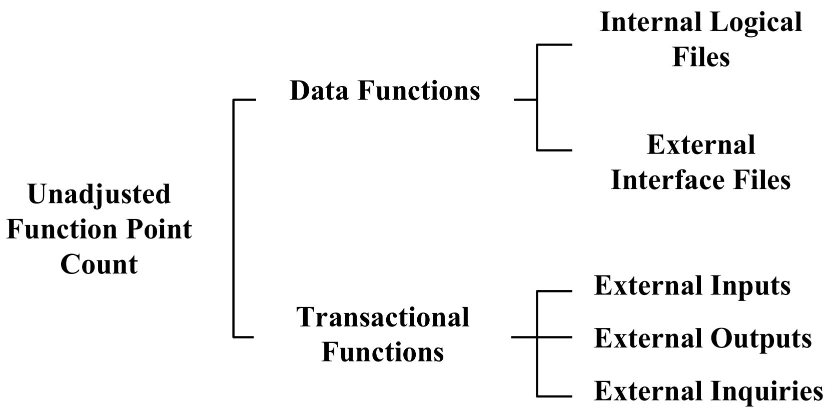
Determine the Unadjusted Function Point Count

The unadjusted function point count (UFPC) reflects the specific countable functionality provided to the user by the project or application.

The application's specific user functionality is evaluated in terms of *what* is delivered by the application, not *how* it is delivered. *Only* user-requested and defined components are counted.

The unadjusted function point count has two function types—data and transactional. These function types are further defined as shown in the following diagram.

The unadjusted functional size reported with ‘unadjusted function point units’ is equivalent to the functional size as defined within ISO/IEC 14143-1:1998.



Count Data Functions

Data functions represent the functionality provided to the user to meet internal and external data requirements. Data functions are either internal logical files or external interface 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.

  The example on page 2-4 shows a group of related employee data maintained within the Human Resources Application.

- An external interface file (EIF) is a user identifiable group of logically related data or control information referenced by the application, but maintained within the boundary of another application. The primary intent of an EIF is to hold data referenced through one or more elementary processes within the boundary of the application counted. This means an EIF counted for an application must be in an ILF in another application.

  The example on page 2-4 shows conversion rate information maintained by the Currency Application and referenced by the Human Resources Application.

Chapter 6 explains the data functions.

Count Transactional Functions

Transactional functions represent the functionality provided to the user to process data. Transactional functions are either external inputs, external outputs, or external inquiries.

- An external input (EI) 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.

  The example on page 2-4 shows the process of entering employee information into the Human Resources Application.

- 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 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, or create derived data. An external output may also maintain one or more ILFs and/or alter the behavior of the system.

  The example on page 2-4 shows the process of producing a report that lists all employees stored in the Human Resources Application.

- An external inquiry (EQ) is an elementary process that sends data or control information outside the application boundary. The primary intent of an external inquiry is to present information to a user through the retrieval of data or control information. 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.

  The example on page 2-4 shows the process of inquiring on employee information (input request) and viewing an employee's information when it appears on a screen (output retrieval).

Chapter 7 explains the transactional functions.

Determine the Value Adjustment Factor

The value adjustment factor (VAF) indicates the general functionality provided to the user of the application.

The VAF is comprised of 14 general system characteristics (GSCs) that assess the general functionality of the application. Each characteristic has associated descriptions that help determine the degree of influence of the characteristic. The degrees of influence range on a scale of zero to five, from no influence to strong influence.

Chapter 8 explains how to determine the value adjustment factor. Note that this is an optional step in the function point counting process.

VAF is the value adjustment factor (if the value adjustment factor was not calculated, VAF is 1.00 then the result of the calculation is functional size, reported with units of 'unadjusted function points'. If the VAF is calculated then the result is reported with units of 'adjusted function points').

Calculate the Adjusted Function Point Count

The adjusted function point count is calculated using a specific formula for a development project, enhancement project, or application (system baseline) function point count.

Chapter 9 includes formulas and detailed explanations for each of the three types of function point counts, and for both unadjusted and adjusted function points.

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3 User View

Introduction

This chapter presents the concept of the user’s role in defining the functional requirements for a project or an application.

Contents

This chapter includes the following sections:

Definition of User View

A *user view* represents a formal description of the user's business needs in the user's language. Developers translate the user information into information technology language in order to provide a solution.

A function point count is accomplished using the information in a language that is common to both user(s) and developers.

A user view:

- Is a description of the business functions
- Is approved by the user
- Can be used to count function points
- Can vary in physical form (e.g., catalog of transactions, proposals, requirements document, external specifications, detailed specifications, user handbook)

Sizing During the Life Cycle of an Application

User requirements evolve rapidly in the early phases of a project. Decisions must be agreed upon by the users and the developer on which functions will be included in an application. These decisions regarding the functions of the project may be influenced by:

- The needs of the organization
- The risk (business and technical) associated with the project
- The resources available (e.g. budget, staff) in the organization for the project
- The technology available in the organization
- The influence of either users or developers through comments and suggestions

At the beginning of a project, the feasibility study is produced. The feasibility study is the highest level of specification and is usually very short; for example:

- The organization needs an application to comply with a new tax law
- The organization needs an application to manage inventory more efficiently
- The organization needs an application to manage human resources more efficiently

After the feasibility study, the user develops requirements that become more precise over time. At some point, the user will consult with software developers to create the detailed requirements. Software developers can get an early start with their own development and implementation requirements based upon the feasibility study. The discussions between the user and the software developers lead to enhanced requirements. The development process varies among different organizations. This manual will consider, for illustration purposes, a model with three categories of requirements documents:

- Initial User Requirements
- Initial Technical Requirements
- Final Functional Requirements.

As with other development methodologies, the Final Functional Requirements Phase is the most accurate phase to count function points.

Phase: Initial User Requirements

This phase represents user requirements prior to the sessions between the users and the software developers. It may have one or more of the following characteristics:

- Incomplete

  For example, Initial User Requirements may lack functions necessary for referential integrity.

- Lack "utility" functionality

  For example, essential validation reports or inquiries may be missing.

- Impossible to implement or very difficult to use

  For example, a user may ask for an on-line inquiry that requires an hour of CPU processing.

- Too general

  For example, requirements may not include the number of fields.

- Varying functional needs, if more than one user is responsible for the project

  For example, the requirements of a specific project may vary from one user to another if they do not have the same functional needs.

- Stated requirements without regard for application boundaries

  For example, current and/or future application boundaries may not have been considered.

- Expressed in a different context or a terminology incompatible with function point analysis

  For example, Initial User Requirements may refer to the physical or manual aspects of the system.

Example

In the Human Resources Department of a corporation, a user expresses his requirements as:

"Whenever I'm working with an employee, I want to be able to view the employee's information by entering his or her name."

This requirement implies the development of an inquiry screen and a group of data on employees. (To keep the example simple, assume that the employee group of data is maintained internally by other employee functions, such as create, update and delete employee, which are not described here).

Functions of the Initial User Requirements example**:**

EQ	inquiry on a specific employee
ILF	employee group of data

Phase: Initial Technical Requirements

This second phase represents the software developers' view of requirements created from the feasibility study. One task of the software developers, among others, is to organize the requirements into existing applications, if any. The Initial Technical Requirements may include elements which are necessary for the implementation, but which are not used in function point counting (e.g., temporary files, index, etc.). This phase may have one or more of the following characteristics:

- Technology dependence

  For example, physical files vary based on the database environment.

- Incorrect identification of the functional needs of the users

  For example, software developers may add functions not requested by the users.

- Terminology unfamiliar to the users

  For example, software developers may refer to physical files rather than to logical groups of data.

- Functionality may be determined by placing too much emphasis on technical constraints

  For example, some developers tend to limit the scope of the requirements by focusing on the computing capacity (CPU) currently available in the organization.

- Boundaries are determined according to the technical architecture of the other applications in the organization

  For example, there may be separate technical requirements for client and server, but they would be contained in the same application boundary when counting function points.

Example

Continuing with the same example, the developer states:

"I recognize the need for an employee inquiry. An index is necessary to speed up the retrieval of specific employees."

Functions of the Initial Technical Requirements might be identified as:

EQ	inquiry on a specific employee
ILF	employee group of data
ILF*	index on the employee file

*According to the IFPUG CPM, index files are not counted. In this example, the index file was incorrectly identified as an ILF to illustrate a potential counting error by software developers.

Phase: Final Functional Requirements

This third phase of requirements results from joint sessions between the user(s) and the software developer(s). The joint sessions are necessary to achieve consistent and complete functional requirements for the application. This phase is the final version of the functional requirements before the development phase begins and has the following characteristics:

- Contains terminology which can be understood by both users and software developers
- Provides integrated descriptions of all user requirements, including requirements from different users
- Is complete and consistent enough to accurately count function points
- Each process and group of data is approved by the user
- The feasibility and usability are approved by the software developers

Example

Continuing with the same example:

User: "Whenever I'm working with an employee, I want to be able to view the employee's information by entering his or her name."

Developer: "I recognize the need for an employee inquiry, but many employees may have the same name. It is not possible to specify an individual employee by typing his/her name; therefore, I suggest an on-line employee list (name, location and social security number) from which to select an employee. An index will be necessary to speed up the retrieval of a specific employee."

User: "I agree that the employee selection list is necessary in this case, and it may also be used for purposes other than selecting an employee."

Result of the discussions between the user and the developer:

- Add the on-line list of employees to the functional requirements and the function point count
- Exclude the employee index from the function point count since it is a technical solution

Functions of the Final Functional Requirements example:

EQ	inquiry on a specific employee
EQ	on-line list of employees
ILF	employee group of data

The Final Functional Requirements document is the final version of the requirements before beginning the development phase. At this time, there should be agreement that the documented requirements are complete, formal and approved. The function point count, assuming no additional changes of scope, should be consistent with the count at the completion of development.

Life Cycle Phase Comparisons

Prior to beginning a function point count, determine the application's life cycle phase and whether you are approximating or measuring. Document any assumptions.

Approximating permits assumptions about unknown functions and/or their complexity to accomplish a function point analysis.

Measuring includes the identification of all functions and their complexity to accomplish a function point analysis.

At an early stage, Initial Users Requirements could be the only document available for function point analysis. Despite the disadvantages, this count can be very useful to produce an early estimate. Uses of function point analysis for approximating at the various life cycle phases is presented below:

Life Cycle Phase	Size can be approximated	Size can be measured
Proposal: users express needs and intentions	yes	no
Requirements: developers and users review and agree upon expression of user needs and intentions	yes	yes
Design: developers may include elements for implementation that are not used for function point analysis	yes	yes
Construction	yes	yes
Delivery	yes	yes
Corrective Maintenance	yes	yes

Note: No specific development life cycle is implied. If using an iterative approach, you may expect to approximate for some time into the application life cycle.

Be aware and measure only new or refined agreed upon user needs and intentions.

Hints to Help with Counting

The following hints may help identify the user view of an application and apply function point analysis.

- Do not assume that one physical file equates to one logical file when viewing data logically from the user perspective.
- Although some storage technologies, such as tables in a relational DBMS or a sequential flat file, relate closely to ILFs or EIFs, do not assume that this is always equal to a one-to-one physical-logical relationship.
- Do not assume all physical files must be counted or included as part of an ILF or EIF.
- Look at the different paper forms currently used by the user(s) when identifying transactional functions.
- A transaction which occurs in multiple physical inputs, transaction files or screens, but which has identical processing logic typically corresponds to one transactional function (EI, EO, EQ).
- Remember that one physical report, screen or batch output file can, when viewed logically, correspond to a number of EOs/EQs.
- Remember that two or more physical reports, screens or batch output files can correspond to one EO/EQ if the processing logic is identical.
- Remember that resorting or rearranging a set of data does not make processing logic unique.

4 Determine Type of Count

Identify Counting Scope and Application Boundary

Introduction

The first step of the function point counting procedure is to identify the type of function point count.

This chapter includes a detailed explanation of the types of function point counts: development project, enhancement project, and application.

Contents

This chapter includes the following sections:

Definitions: Types of Function Point Counts

Function point counts can be associated with either projects or applications. There are three types of function point counts:

- Development project
- Enhancement project
- Application

The following paragraphs define each type of function point count.

Note: Chapter 9 includes the formulas used to calculate the adjusted function point count for each of the three types of counts.

Development Project

The development project function point count measures the functions provided to the users with the first installation of the software delivered when the project is complete.

Enhancement Project

The enhancement project function point count measures the modifications to the existing application that add, change, or delete user functions delivered when the project is complete.

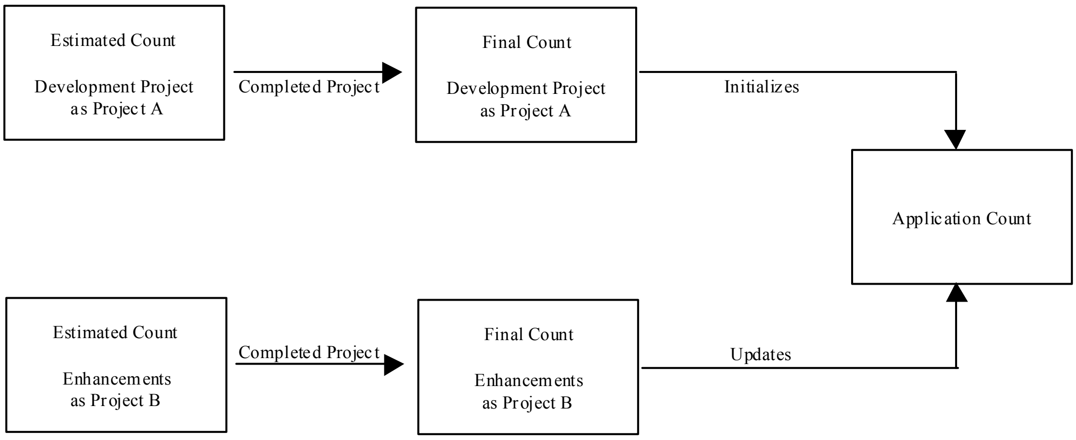
When the functionality from an enhancement project is installed, the application function point count must be updated to reflect changes in the application's functionality.

Application

The application function point count and project count are associated with an installed application. It is also referred to as the *baseline* or *installed* function point count. This count provides a measure of the current functions the application provides the user. This 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.

Diagram of Types of Counts

The following diagram illustrates the types of function point counts and their relationships. (Project A is completed first, followed by Project B.)



Estimated and Final Counts

It is important to realize that early function point counts are estimates of delivered functionality. In addition, as the scope is clarified and the functions developed, it is quite normal to identify additional functionality that was not specified in the original requirements. This phenomenon is sometimes called *scope creep*.

It is essential to update application counts upon completion of the project. If the functionality changes during development, the function point count at the end of the life cycle should accurately reflect the full functionality delivered to the user.

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Determine Type of Count

5 Identify Counting Scope and Application Boundary

Introduction

This chapter defines the terms: purpose of the count, counting scope and application boundary. It includes rules, procedures, and hints to determine boundaries for applications and to establish the scope of the count.

Contents

This chapter includes the following sections:

Definition of Counting Scope and Application Boundary

This section defines counting scope and application boundary and explains how they are influenced by the purpose of the count.

Definition of the Purpose of the Count

The purpose of a function point count is to provide an answer to a business problem.

The purpose:

- Determines the type of function point count and the scope of the required count to obtain the answer to the business problem under investigation
- Influences the positioning of the boundary between the software under review and the surrounding software; e.g., if the Personnel Module from the Human Resources System is to be replaced by a package, the users may decide to reposition the boundary and consider the Personnel Module as a separate application

Examples of purposes are:

- To provide a function point count as an input to the estimation process to determine the effort to develop the first release of an application
- To provide a function point count of the installed base of applications
- To provide a function point count to enable the comparison of functionality delivered by two different suppliers' packages

Definition of the Counting Scope

The counting scope defines the functionality which will be included in a particular function point count.

The scope:

- Defines a (sub) set of the software being sized
- Is determined by the purpose for performing the function point count
- Identifies which functions will be included in the function point count so as to provide answers relevant to the purpose for counting
- Could include more than one application

The *scope* of:

- An enhancement function point count includes all the functions being added, changed and deleted. The boundary of the application(s) impacted remains the same. The functionality of the application(s) reflects the impact of the functions being added, changed or deleted.
- A development function point count includes all functions impacted (built or customized) by the project activities.
- An application function point count may include, depending on the purpose (e.g., provide a package as the software solution):

– only the functions being used by the user

– all the functions delivered

The application boundary of the two counts is the same and is independent of the *scope*.

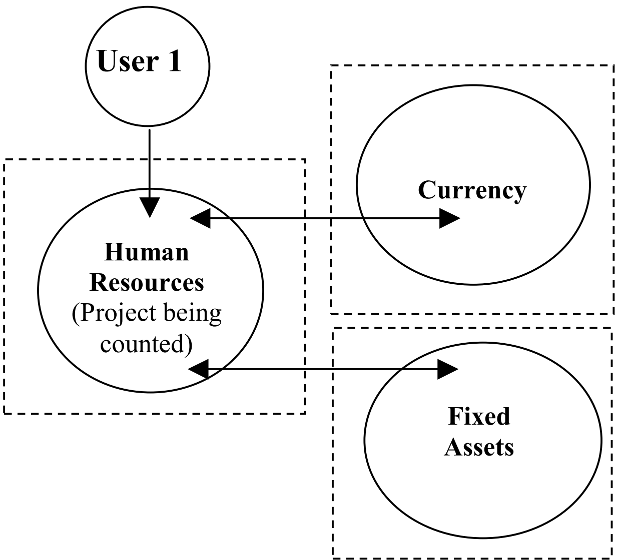
Definition of the Application Boundary

The application boundary indicates the border between the software being measured and the user.

The application boundary :

- Defines what is external to the application
- Is the conceptual interface between the 'internal' application and the 'external' user world
- Acts as a 'membrane' through which data processed by transactions (EIs, EOs and EQs) pass into and out from the application
- Encloses the logical data maintained by the application (ILFs)
- Assists in identifying the logical data referenced by but not maintained within this application (EIFs)
- Is dependent on the user's external business view of the application. It is independent of technical and/or implementation considerations

For example, the following diagram shows boundaries between the Human Resources application and the external applications, Currency and Fixed Assets. The example also shows the boundary between the human user (User 1) and the Human Resources application.



Counting Scope and Application Boundary Rules and Procedures

This section defines the rules and procedures that apply when identifying counting scope and application boundaries.

The position of the application boundary is important because it impacts the result of the function point count. The application boundary assists in identifying the data entering the application which will be included in the scope of the count.

Boundary Rules

The following rules must apply for boundaries:

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

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

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

Counting Scope and Application Boundary Procedures

When you perform a function point count, the following characteristics of the count should be properly documented:

Step	Action
1	Establish the purpose of the count
2	Identify the counting scope
3	Identify the application boundary
4	Document the following items: • The purpose of the count • The counting scope • The application boundary • Any assumptions related to the above

Hints to Help to Identify the Counting Scope and the Application Boundary

Counting Scope

The following hints can help you to identify the counting scope:

- Review the purpose of the function point count to help determine the counting scope.
- When identifying the scope of the installed base function point count (i.e., the functionality supported by the maintenance team), include all functions currently in production and used by the users.

Application Boundary

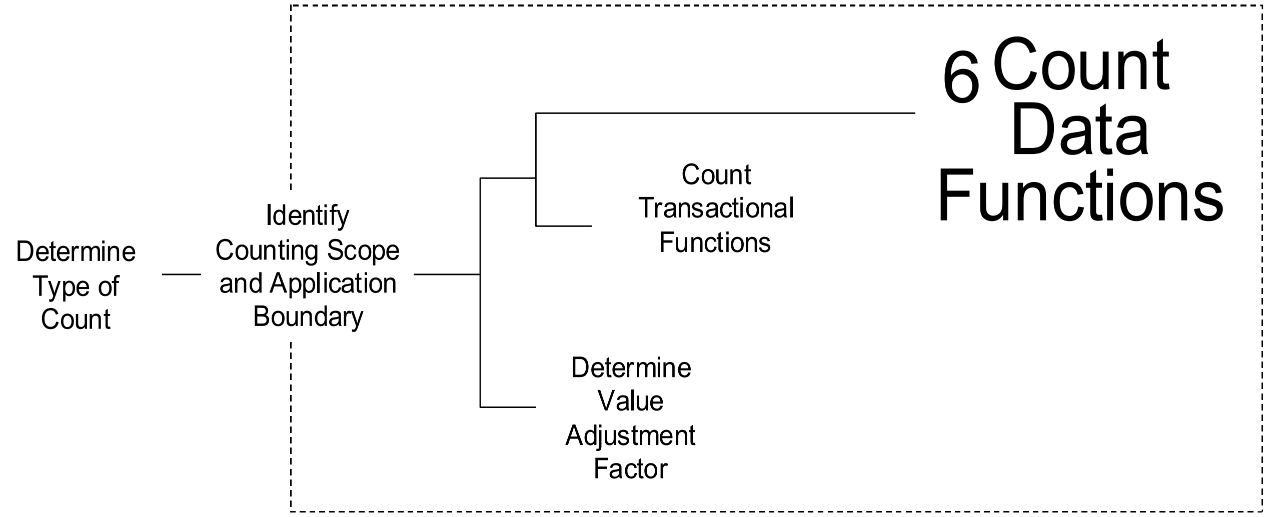
The following hints can help you to identify the application boundary:

- Use the system external specifications or get a system flow chart and draw a boundary around it to highlight which parts are internal and which are external to the application.
- Look at how groups of data are being maintained.
- Identify functional areas by assigning ownership of certain types of analysis objects (such as entities or elementary processes) to a functional area.
- Look at associated measurement data, such as effort, cost, and defects. The boundaries for function points and the other measurement data should be the same.

Hints

The positioning of the application boundary between the software under investigation and other software applications may be subjective. It is often difficult to delineate where one application stops and another begins. Try to place the boundary from a business perspective rather than based on technical or physical considerations. It is important that the application boundary is placed with care, since all data crossing the boundary can potentially be included in the scope of the count.

6 Count Data Functions



Introduction

Data functions represent the functionality provided to the user to meet internal and external data requirements. Data function types are defined as internal logical files (ILFs) and external interface files (EIFs).

The term *file* here does not mean file in the traditional data processing sense. In this case, file refers to a logically related group of data and not the physical implementation of those groups of data.

This chapter includes the definitions for internal logical files and external interface files and explains the counting procedures and rules associated with these functions.

Contents

This chapter includes the following sections:

Continued on next page

Definitions: ILFs and EIFs

This section includes the definitions of the internal logical files (ILFs) and external interface files (EIFs). Embedded terms within the definitions are defined and examples are included throughout this definition section.

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.

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

Difference between ILFs and EIFs

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

Definitions for Embedded Terms

The following paragraphs further define ILFs and EIFs by defining embedded terms within the definitions.

Control Information

Control Information is data that influences an elementary process of the application being counted. It specifies what, when, or how data is to be processed.

For example, someone in the payroll department establishes payment cycles to schedule when the employees for each location are to be paid. The payment cycle, or schedule, contains timing information that affects when the elementary process of paying employees occurs.

User Identifiable

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

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

Maintained

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

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

Elementary Process

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

For example, a user requires the ability to add a new employee to the application. The user definition of employee includes salary and dependent information. From the user perspective, the smallest unit of activity is to add a new employee. Adding one of the pieces of information, such as salary or dependent, is not an activity that would qualify as an elementary process.

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

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

ILF/EIF Counting Rules

This section defines the rules that apply when counting internal logical files and external interface files.

Summary of Counting Procedures

This summary is included to show the rules in the context of the ILF and EIF counting procedures.

Note: The detailed counting procedures begin on page 6-10.

The ILF and EIF counting procedures include the following two activities:

Step	Action
1	Identify the ILFs and EIFs.
2	Determine the ILF or EIF complexity and their contribution to the unadjusted function point count.

ILF and EIF counting rules are used for each activity. There are two types of rules:

- Identification rules
- Complexity and contribution rules

The following list outlines how the rules are presented:

- ILF identification rules
- EIF identification rules
- Complexity and contribution rules, which include:
  - Data element types (DETs)
  - Record element types (RETs)

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 boundary being counted.

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.

Complexity and Contribution Definitions and Rules

The number of ILFs, EIFs, and their relative functional complexity determine the contribution of the data functions to the unadjusted function point count.

Assign each identified ILF and EIF a functional complexity based on the number of data element types (DETs) and record element types (RETs) associated with the ILF or EIF.

This section defines DETs and RETs and includes the counting rules for each.

DET Definition

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

DET Rules

The following rules apply when counting DETs:

- 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.

  For example, an account number that is stored in multiple fields is counted as one DET.

  For 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.

  For example, the result(s) of a calculation from an elementary process, such as calculated sales tax value for a customer order maintained on an ILF is counted as one DET on the customer order ILF.

  For 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.

  For example, if an employee number which 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.

  For 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.

- 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.

  For example, Application X maintains and/or references an ILF that contains a 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.

- 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.*

  For example, in an object oriented (OO) application, the 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.

RET Definition

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

There are two types of subgroups:

- 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 subgroups where the user must use at least one.

For 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)

RET Rules

One of the following rules applies when counting RETs:

- Count a RET for each optional or mandatory subgroup of the ILF or EIF.

Or

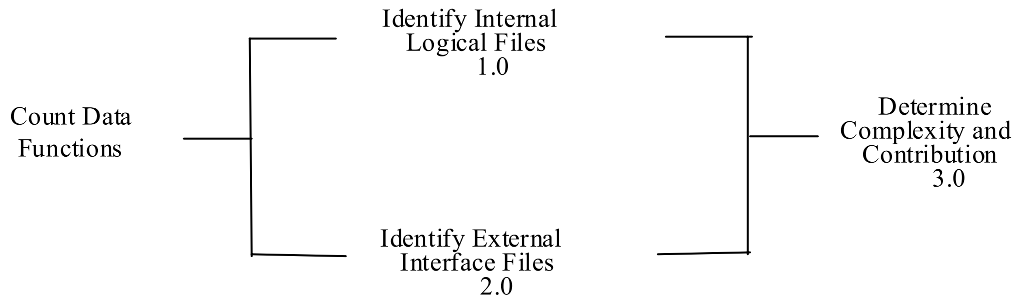
- If there are no subgroups, count the ILF or EIF as one RET.

ILF/EIF Counting Procedures

This section includes detailed explanations of ILF and EIF counting procedures.

Procedure Diagram

The following diagram shows the high-level procedure for counting ILFs and EIFs.



The following paragraphs explain the steps for each activity.

Identification Procedures

Follow these steps to identify ILFs and EIFs:

Step	Action	Rule Set(s) to Use	See Page
1.0	Identify Internal Logical Files	ILF Identification Rules	6-6
2.0	Identify External Interface Files	EIF Identification Rules	6-6
3.0	Determine Complexity and Contribution	Complexity and Contribution Procedures	6-11

Complexity and Contribution Procedures

Follow these steps to calculate ILF and EIF complexity and contribution to the unadjusted function point count.

Step	Action
1	Use the complexity and contribution counting rules that begin on page 6-7 to identify and count the number of RETs and DETs.
2	Rate the functional complexity using the following complexity matrix.

	1 to 19 DET	20 to 50 DET	51 or more DET
1 RET	Low	Low	Average
2 to 5 RET	Low	Average	High
6 or more RET	Average	High	High

Step	Action
3	Translate the ILFs and EIFs to unadjusted function points using the appropriate translation table for either ILFs or EIFs.

ILF Translation Table: Use the following table to translate the ILFs to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	7
Average	10
High	15

EIF Translation Table: Use the following table to translate the EIFs to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	5
Average	7
High	10

For example, a high complexity rating for an EIF translates to 10 unadjusted function points.

Continued on next page

Step	Action
4	Calculate each ILF and EIF contribution to the unadjusted function point count. For example, the following table shows the calculation for one high complexity ILF, two average and one high complexity EIFs.

Function Type	Functional Complexity			Complexity Totals	Function Type Totals
ILF	0	Low	X 7 =	0	
	0	Average	X 10 =	0	
	1	High	X 15 =	15	15
EIF	0	Low	X 5 =	0	
	2	Average	X 7 =	14	
	_1_	High	X 10 =	_10__	24

In this simple example, there are no ILFs of low or average complexity; therefore, the total count for ILFs is 15. For the EIFs, there are no low complexity, 2 average complexity EIFs (14 points) and 1 high complexity (10 points) for an EIF total of 24.

The contributions for ILFs and EIFs will be added to the table that lists all function types. The final total for all function types is the unadjusted function point count. The Appendix includes a table to record the totals for all functions.

Hints to Help with Counting

The following hints may help you apply the ILF and EIF counting rules.

Caution: These hints *are not* rules and should not be used as rules.

- Is the data a logical group that supports specific user requirements?
  - An application can use an ILF or EIF in multiple processes, but the ILF or EIF is counted only once.
  - A logical file cannot be counted as both an ILF and EIF for the same application. If the data group satisfies both rules, count as an ILF.
  - If a group of data was not counted as an ILF or EIF itself, count its data elements as DETs for the ILF or EIF, which includes that group of data.
  - Do not assume that one physical file, table or object class equals one logical file when viewing data logically from the user perspective.
  - Although some storage technologies such as tables in a relational DBMS or sequential flat file or object classes relate closely to ILFs or EIFs, do not assume that this always equals a one-to-one physical-logical relationship.
  - Do not assume all physical files must be counted or included as part of an ILF or EIF.
- Where is data maintained? Inside or outside the application boundary?
  - Look at the workflow.
  - In the process functional decomposition, identify where interfaces occur with the user and other applications.
  - Work through the process diagram to get hints.
  - Credit ILFs maintained by more than one application to each application at the time the application is counted. Only the DETs being used by each application being counted should be used to size the ILF/EIF.
- Is the data in an ILF maintained through an elementary process of the application?
  - An application can use an ILF or EIF multiple times, but you count the ILF or EIF only once.
  - An elementary process can maintain more than one ILF.
  - Work through the process diagram to get hints.
  - Credit ILFs maintained by more than one application to each application at the time the application is counted.

ILF/EIF Counting Examples

Introduction

This section uses a Human Resources (HR) application along with a Security application and a Mail Distribution application to illustrate procedures to identify and count data functions. In addition to this section, examples are in the Case Studies which are included in the IFPUG corresponding documentation.

Caution: The examples in this section and throughout the manual have two purposes:

1. To illustrate how the function point counting rules are applied for a given set of user requirements
2. To allow you to practice using the counting procedures

Each counter must:

- Analyze the specific user requirements that apply for each project or application being counted, and
- Count based on those requirements.

Contents

This section explains the organization of the examples and includes detailed examples for counting ILFs and EIFs.

Organization of the Counting Examples

This section explains how the examples are presented.

Outline of the Organization

The following list outlines the sequence of information in the detailed examples.

For each example:

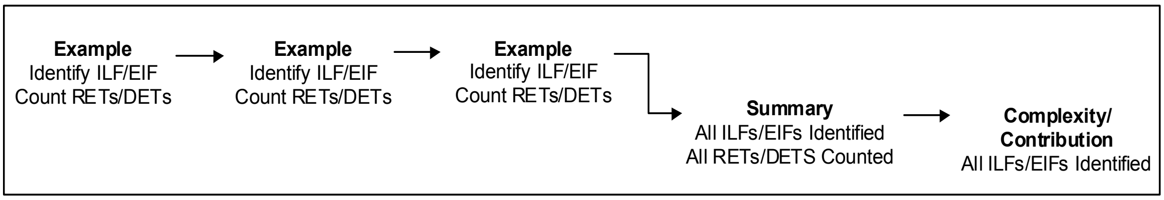
1. The ILFs or EIFs are identified.
2. The RETs and DETs that contribute to the functional complexity are identified and counted.

For all the examples combined:

1. All identified items are summarized, whether or not they were counted as ILFs or EIFs.
2. The complexity and contribution to the unadjusted function point count are determined for all identified ILFs or EIFs.

Diagram of the Organization

The following diagram illustrates the organization of the examples.



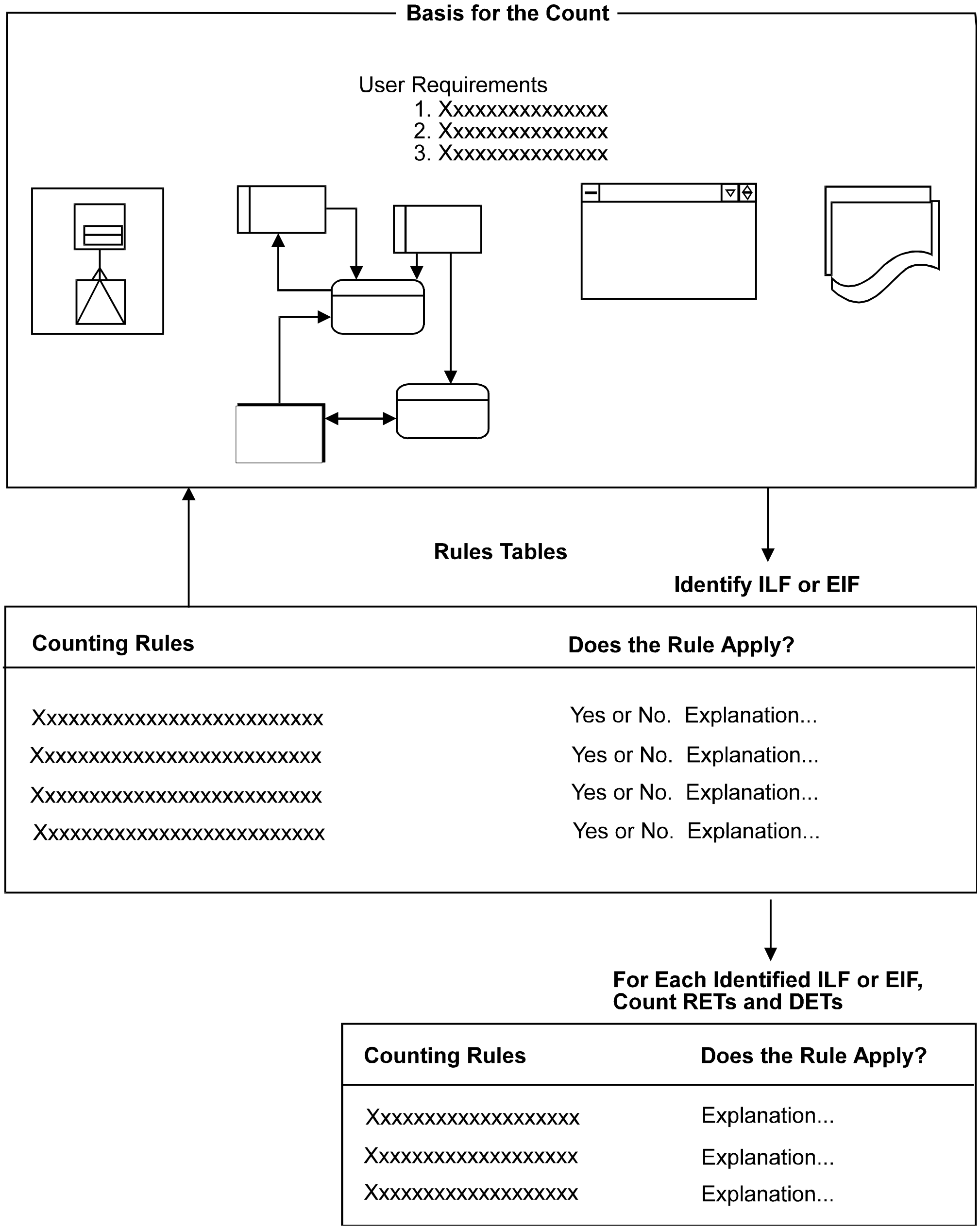
Count for Each Example

Each example includes the following components:

1. Basis for the count
2. Tables applying the counting rules

Diagram of Components

The following diagram illustrates the components for each example and the flow of information.



Basis for the Count

The basis for the count begins each example. As shown in the diagram of components, the count may be based on the following components:

- User requirements
- Data and process models
- Windows, screens, or reports

Note: All components in the diagram are not included in all examples. In some examples, the requirements stand alone as the basis for the count. Other examples include a data or process model, windows, screens, and reports.

Rules Table

The analysis to identify functions is presented in a table that lists the counting rules for the function type. The rules are applied to the components that make up the basis for the count. The analysis is explained in the table in the column "Does the Rule Apply?".

Note: If all the rules apply, the example is counted as an ILF or EIF.

The next table shows the rules and explanation for the complexity for each function type identified.

Summary of ILFs/EIFs Identified

After all the rules are applied for each example, a summary section lists what was counted and what was not counted.

Complexity and Contribution for All ILFs/EIFs

The last section in the examples is the calculation of the complexity and contribution to the unadjusted function point count.

ILF Counting Examples

Introduction

This section uses a Human Resources (HR) application to illustrate procedures to identify and count data functions. In addition to this section, further examples are in the Case Studies which are included in the corresponding IFPUG documentation.

Contents

This section includes the following examples:

Summary Descriptions of ILF Counting Examples

The examples for ILFs are described in the following table.

Example	Summary Description	Page
Application Data	This example requires merging groups of data to identify an ILF.	6-20
HR System Security	This example looks at security for the HR System to identify ILFs.	6-25
Audit Data	This example looks at the implementation to count ILFs.	6-33
Suspended Jobs	This example shows how to count suspense information that is maintained within the application boundary.	6-34
Report Definition	This example shows how to count user defined report definitions maintained within an application.	6-38
Alternate Index	This example moves beyond the user requirements described for the report definition example to focus on requirements for physical implementation.	6-41
Shared Application Data	This example shows how to count data that is maintained by more than one application.	6-42
Different Users/Different Data Views	This example shows that two applications can count the same file with different DETs.	6-48

Example: Application Data

User Requirements

The user requires the ability to enter, inquire, and report on information about jobs.

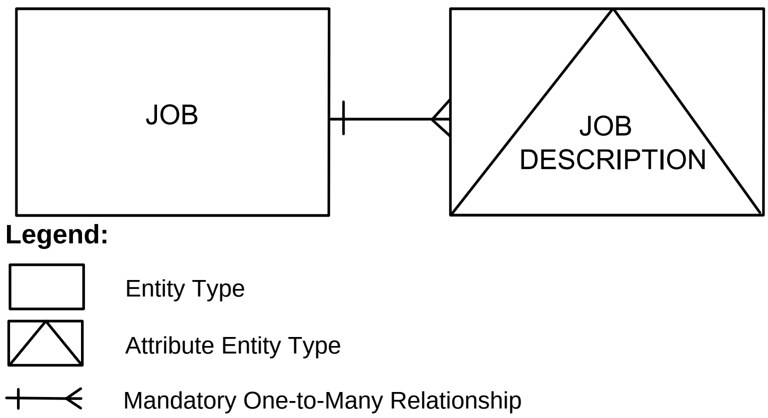
Information that must be maintained together includes

- Job number
- Job name
- Job pay grade
- Job description line number
- Job description lines.

The job descriptions should be a collection of 80-character lines that describe the job.

Entity-Relationship Diagram

The following entity-relationship (E-R) diagram shows two entities that resulted from data normalization. The entities are job and job description.



Job includes

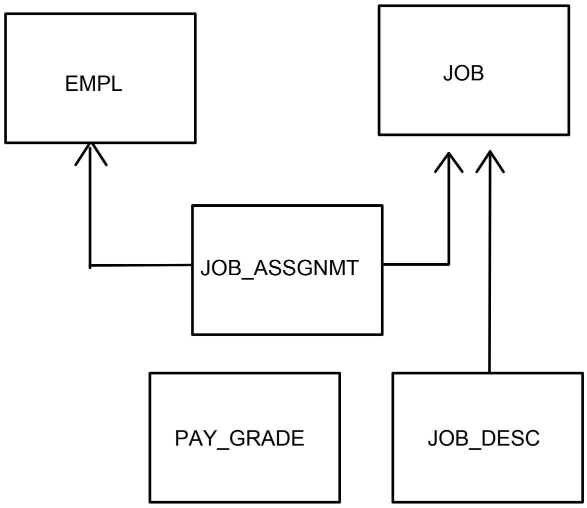
- Job number
- Job name
- Job pay grade.

Job description includes

- Job number
- Job description line number
- Job description lines.

DB2 Structure

The following diagram shows the DB2 structure for the Human Resources Application.



DB2 Tables

This section includes the tables for the DB2 structure for the Human Resources Application.

EMPL Table
- Data Elements
  - NAME
    - FST_NAME
    - MID_INT
    - LST_NAME
  - SSN
  - TYPE
  - #_DEP
  - SUPV_CD
  - HR_RATE
  - US_HOURLY RATE
  - CBU_#
  - LOC_NAME_FK
  - CURRENCY_LOC_FK

JOB_ASSGNMT Table
- Data Elements
  - DATE
  - PERF_RATING
  - SALARY
  - JOB_#_FK
  - SSN_FK

JOB_DESC Table
- Data Elements
  - LINE_#
  - DESC_LINE
  - JOB_#_FK

JOB Table
- Data Elements
  - JOB_NAME
  - JOB_#
  - PAY_GRADE

LOCATION Table
- Data Elements
  - LOC_NAME
  - LOC_ADDR
  - CITY
  - STATE
  - ZIP
  - COUNTRY
  - EMPL_SSN_FK

PAY_GRADE Table
- Data Elements
  - PAY_GRADE
  - PAY_GRADE_DESC

Identify ILFs

The E-R diagram shows two groups of information:

- Job
- Job description

Determine whether each group is an ILF.

The analysis of the job group is shown in the following table.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	No. Job must include the job description entity or table to represent the user requirement to add job information.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The elementary process maintains job, which to the user includes both job and job description entities or tables.

Based on the analysis, job alone, without the description, is not an ILF.

Now, determine whether job description is an ILF.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	No. Job description must include the job entity or table to represent the user requirement to add job information.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The elementary process maintains job, which to the user includes both job and job description entities or tables.

Based on the analysis, the job description alone, without the job, is not an ILF.

From the user perspective, job and job description are used together to add job information to the HR Application. We must combine job and job description entities or tables because they must be maintained together.

There is one logical group from the user perspective. That group is job information.

Apply the ILF counting rules to determine whether the job information is an ILF. The following table shows the analysis.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Together job and job description are used to add job information into the HR System.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The process is that of entering information about jobs.

Based on the analysis, job information is an ILF. Only one ILF is counted by merging the information for the job and job description entities or tables.

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each piece of information associated with the job information ILF and determine whether the DET counting rules apply.

Job includes:

- Job number
- Job name
- Job pay grade.

Job description includes:

- Job number
- Job description line number
- Job description lines.

Note: Because job description is not an ILF by itself, its DETs are included in the total for the job information ILF.

The analysis of the DETs for the job information ILF is shown below:

ILF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable, but job number is counted only once.
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.	There is no data of this type.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

Based on this analysis, count one DET for each unique field, therefore, there are five DETs.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	The groups job and job description are each mandatory subgroups of the job information ILF.
If there are no subgroups, count the ILF or EIF as one RET.	There are two subgroups from the user perspective.

There are two subgroups, therefore, the ILF has two RETs.

The RET and DET totals for the job information ILF are shown in the following table:

RETs	DETs
• Job • Job Description	• Job number • Job name • Job pay grade • Job description line number • Job description line
Total 2 RETs	**Total** 5 DETs

Example: HR System Security

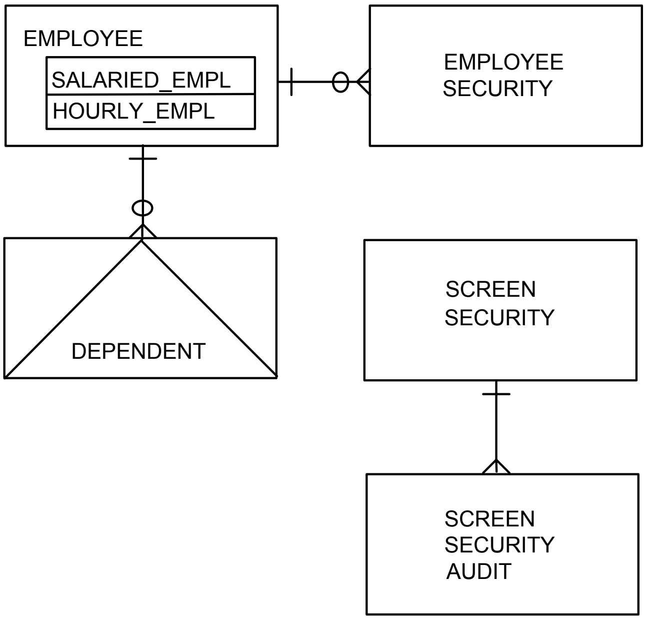
User Requirements

The user requires application security for the Human Resources System for the following reasons:

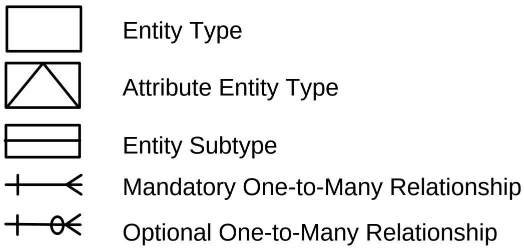
1. To allow or deny user access to each screen in the application
2. To change a user's access to each screen
3. To report on any screen security added or changed using the following data:
   - Identification of the user who is adding or changing security information
   - The user and screen security that was added or changed
   - The user and screen security before and after a change was made
   - Date and time the add or change occurred
4. To assign access to the locations of employees for which each user has the capability to maintain using the following data:
   - User allowed access
   - User social security number
   - Type of access allowed
5. To change a user's access to employees at a location
6. To capture audit data to monitor and report daily security activity. This requirement was determined when a design was implemented to satisfy the user's screen security requirements

Entity-Relationship Diagram

The following diagram shows the entity-relationship (E-R) for the Human Resources System security.



Legend:



Entity Attributes

The following lists show the entity attributes for the security entities from the E-R diagram for the Human Resources System.

EMPLOYEE SECURITY

Data Elements
- User_ID
- Employee_Social_Security_Number
- Type_Of_Access_Allowed
- Location

SCREEN SECURITY

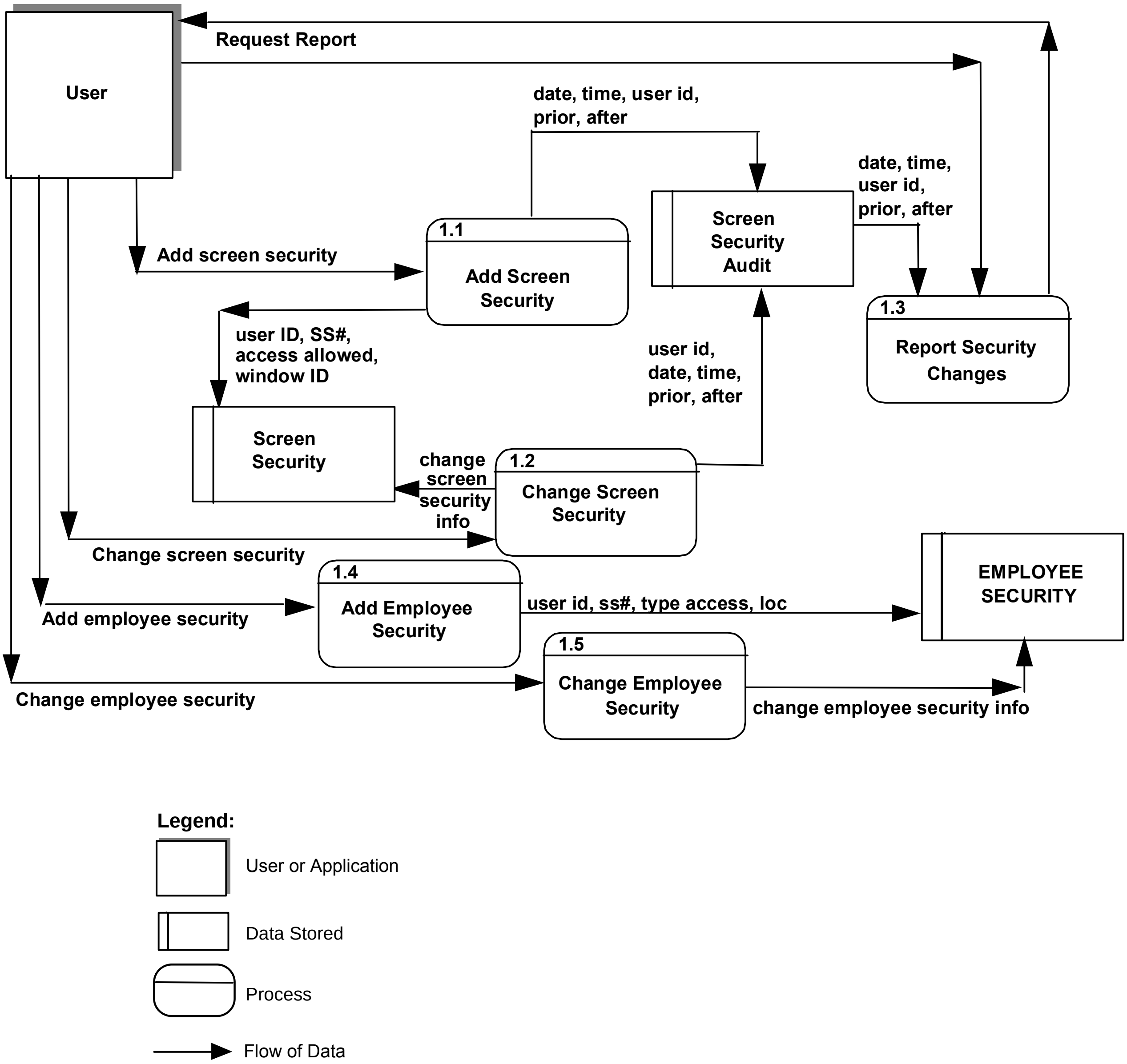
Data Elements
- User_ID
- Employee_Social_Security_Number
- Window_ID
- User_Access_Allowed

SCREEN SECURITY AUDIT

Data Elements
- Date_Time_Change_Made
- ID_Of_User_Making_Change
- User_ID_Before_Change
- User_Access_Before_Change
- Window_ID_Before_Change
- User_ID_After_Change
- User_Access_After_Change
- Window_ID_After_Change

Data Flow Diagram

The following diagram shows the data flow for this example.



Identify ILFs

The user requirements discuss three groups of data:

- Screen security audit
- Screen security
- Employee security

Use the ILF rules to determine if each group is an ILF.

Analyze the screen security audit.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	No, the screen security audit data attributes are maintained only as a part of updating screen security.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes, the processes are that of adding and changing window access security information.

The analysis shows that the screen security audit is not an ILF on its own.

Next, analyze the screen security together with screen security audit.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. The user wants to control which HR information individuals may see or update. Users need to add, change, and monitor the security allowing access to windows.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The processes are that of adding and changing window access security information and saving screen security audit data.

The analysis shows that screen security together with screen security audit data is an ILF.

Analyze the employee security group.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. The user wants to limit who can maintain employee information at a specific location.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The user wants to limit who can maintain employee information. The processes are that of adding and changing employee security information.

Based on the analysis, the employee security information is an ILF.

The analysis shows the following two ILFs:

- Screen security information
- Employee security information

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each field associated with the security data and determine whether the DET counting rules apply.

- Screen security
  - User ID
  - Employee social security number
  - Window ID
  - User access allowed
- Screen security audit
  - Date Time change made
  - ID of user making the change
  - Before the change:
    - User ID before the change
    - User access allowed before the change
    - Window ID before the change
  - After the change:
    - User ID after the change
    - User access after the change
    - Window ID after the change
- Employee security
  - User ID
  - Employee social security number
  - Type of access allowed
  - Location

The following table shows the DET analysis for screen security information.

ILF DET Counting Rules	Does the Rule Apply?
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.	Count the before and after audit images as a total of two DETs.
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.	There is no data of this type.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

Count one DET for each field listed below:

- User ID
- Employee social security number
- Window ID
- User access allowed
- Date Time Change Made
- ID of user making the change
- Before Image (includes: User ID before the change, User access allowed before the change, Window ID before the change)
- After Image (includes: User ID after the change, User access after the change, Window ID after the change)

The following table shows the DET analysis for employee security information.

ILF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable.
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.	There is no data of this type.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	The employee social security number is required to maintain the relationship with the Employee ILF.

Count one DET for each field listed below:

- User ID
- Employee social security number
- Type of access allowed
- Location

For RETs, identify subgroups based on the RET counting rules.

Screen Security

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	The groups screen security and screen security audit are each mandatory subgroups of the screen security ILF.
If there are no subgroups, count the ILF or EIF as one RET.	There are two subgroups, count one RET for each.

There are two subgroups, therefore Screen Security ILF has two RETs.

Employee Security

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	There are no subgroups.
If there are no subgroups, count the ILF or EIF as one RET.	There are no subgroups..

There are no subgroups, therefore Employee Security ILF has one RET.

The RET and DET totals for security are shown in the following table.

RETs	DETs
• Screen security • Screen security audit	• User ID • Employee social security number • Window ID • User access allowed • Date Time Change Made • ID of user making the change • Before Image • After Image
Total 2 RETs	**Total** 8 DETs
• Employee security data	• User ID • Employee social security number • Type of access allowed • Location
Total 1 RET	**Total** 4 DETs

Example: Audit Data for Inquiries and Reports

User Requirements

Analysis of the following user security requirements showed a need for audit data:

1. Allow or deny user access to each screen in the application.
2. Change a user's access to each screen.
3. Report on any screen security added or changed using the following data:
   - Identification of the user who is adding or changing security information
   - The user and screen security that was added or changed
   - The user and screen security before and after a change was made
   - Date and time the add or change occurred.
4. Capture audit data to monitor and report daily security activity. This requirement was determined when a design was implemented to satisfy the user's screen security requirements.

Data Flow Diagram

Refer to page 6-27 for the data flow diagram which is the same for both examples.

Identify ILFs

From the previous Human Resources security example on page 6-25, we know there is one group of data that is screen security.

We will apply the ILF counting rules to determine whether this audit data is a separate ILF.

The following table shows the analysis for screen security audit data.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	No. Screen security audit data must include the screen security entity or table to represent the user requirement to add security information.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. When security access for windows is added or changed, the audit information is maintained.

The group of audit data for screen security is not counted as an ILF on its own because it is part of screen security.

Example: Suspended Jobs

User Requirements

The user requirements lead to a requirement for suspense files.

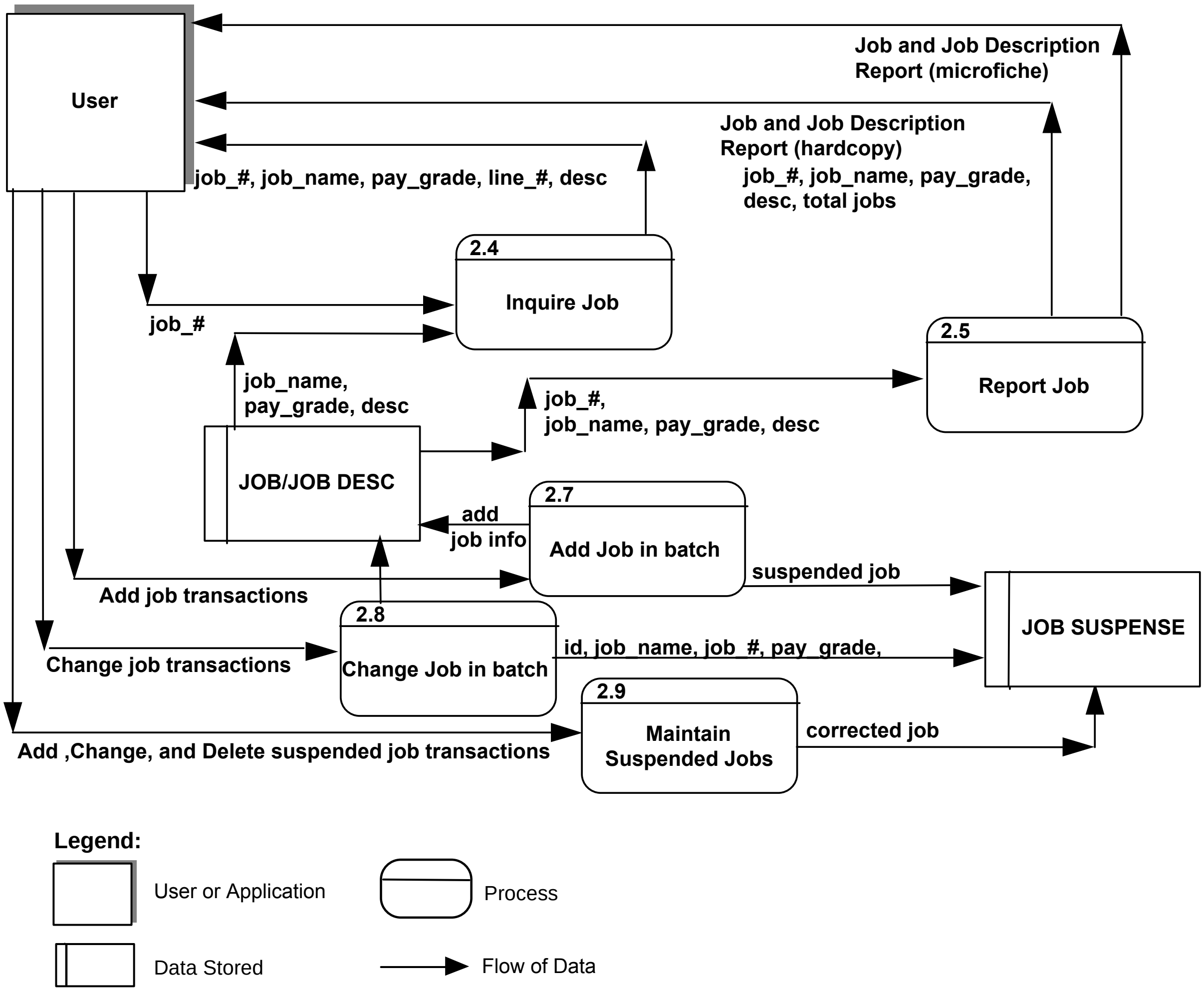
It was decided that adding and changing job information would be accomplished via an off-line process. During the off-line process, the user requires that the suspense file is updated with an error transaction to show any jobs not successfully updated.

The suspense file can be edited through online windows in the application to correct the transaction. Because any piece of the information about the job could be incorrect, all job and job description information is maintained when changing an incomplete or suspended job.

Note: This example examines whether the suspended job information is an ILF.

Data Flow Diagram

The following diagram shows the data flow for this example.



Identify ILFs

Determine whether the suspense information is an ILF.

The following table shows the summary analysis.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Jobs with incorrect information must be corrected to add to the HR application.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The suspense information is modified through a window in the Human Resources application.

The analysis shows that error suspense information is an ILF.

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each field associated with job and job description because any piece of information about the job could be wrong. For each field, determine whether the DET counting rules apply.

Suspended job includes:

- Transaction type
- Suspended job number
- Suspended job name
- Suspended job pay grade.

Suspended job description includes:

- Transaction type
- Suspended job description line number
- Suspended job description lines
- Suspended job number.

ILF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable. Suspended job number and transaction type are DETs that have multiple occurrences. Count each as one DET each.
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.	There is no data of this type.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

Count one DET for each field.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	The suspense information has two mandatory subgroups: - Suspended job - Suspended job description
If there are no subgroups, count the ILF or EIF as one RET.	This rule does not apply because there are subgroups.

There are two subgroups, therefore, the ILF has two RETs.

The RET and DET totals for the suspense ILF are shown in the following table.

RETs		**DETs**	
• Suspended job • Suspended job description		• Suspended job number • Suspended job name • Suspended job pay grade • Suspended job description line number • Suspended job description • Transaction type	
Total	2 RETs	**Total**	6 DETs

Example: Report Definition

User Requirements

The user requires the ability to perform the following activities:

1. Enter a report definition which includes
   - A unique report identifier
   - A report name
   - Fields used on the report
   - Calculations to generate the report.
2. Reuse the defined report at any time, changing the definition if necessary.
3. View and print a report using the report definition.
4. Inquire on existing report definitions by report name or report identifier.

Identify ILFs

From the user requirements, report identifier, report name, fields on the report, and calculations together make up one logical grouping of data for a report definition because they are maintained as a group.

The following table shows the analysis to determine whether the report definition information is an ILF. See the Case Studies for how the remaining requirements may be counted.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. The data is used to view and report information in the HR application.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The processes are that of adding and changing the definition.

Based on the analysis, the report definition information is an ILF.

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each field associated with the report definition ILF and determine whether the DET counting rules apply.

The report definition ILF includes:

- Report name
- Report identifier
- Fields
- Calculations

The analysis of the DETs for the report definition ILF is shown below:

ILF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable. Fields and Calculations are DETs which have multiple occurrences.
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.	There is no data of this type.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	The report definition does not have subgroups.
If there are no subgroups, count the ILF or EIF as one RET.	Because, there are no subgroups, count the report definition ILF as one RET.

There are no subgroups; therefore, this ILF has one RET.

The RET and DET totals for report definition are shown in the following table.

RETs		**DETs**	
• Report definition group		• Report name • Report identifier • Fields • Calculations	
Total	1 RET	**Total**	4 DETs

Example: Alternate Index

User Requirements

The user needs to inquire on report definitions using the report name as the key to finding the desired definition. To satisfy the user requirement, an alternate index is created using the report name as the key.

Identify ILFs

The following table shows the summary analysis to determine whether the alternate index is an ILF.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	No. From the user perspective, this filter function provides the user with specific attributes of the report definitions created that reference the report definition ILF. This technical filter, necessary to create the inquiry list, does not constitute a business function on its own.
The group of data is maintained through an elementary process within the application boundary being counted.	Not applicable.

Based on the analysis in the table, the alternate index is not a logical group, therefore, it is not counted as an ILF.

Example: Shared Application Data

User Requirements

The HR user requires the ability to maintain information on each new employee.

The information that must be maintained by the HR user includes:

- Employee ID
- Employee Name
- Employee Mailing Address
- Employee Pay Grade
- Employee Job Title

As a result of creating a new employee record, the employee's anticipated Pension Eligibility Date should be automatically calculated and saved with the other employee information.

The Security user requires that a security level be assigned to each new employee. The Security department conducts a background search after each employee is hired and assigns the appropriated security level.

The information that must be maintained by the Security user includes:

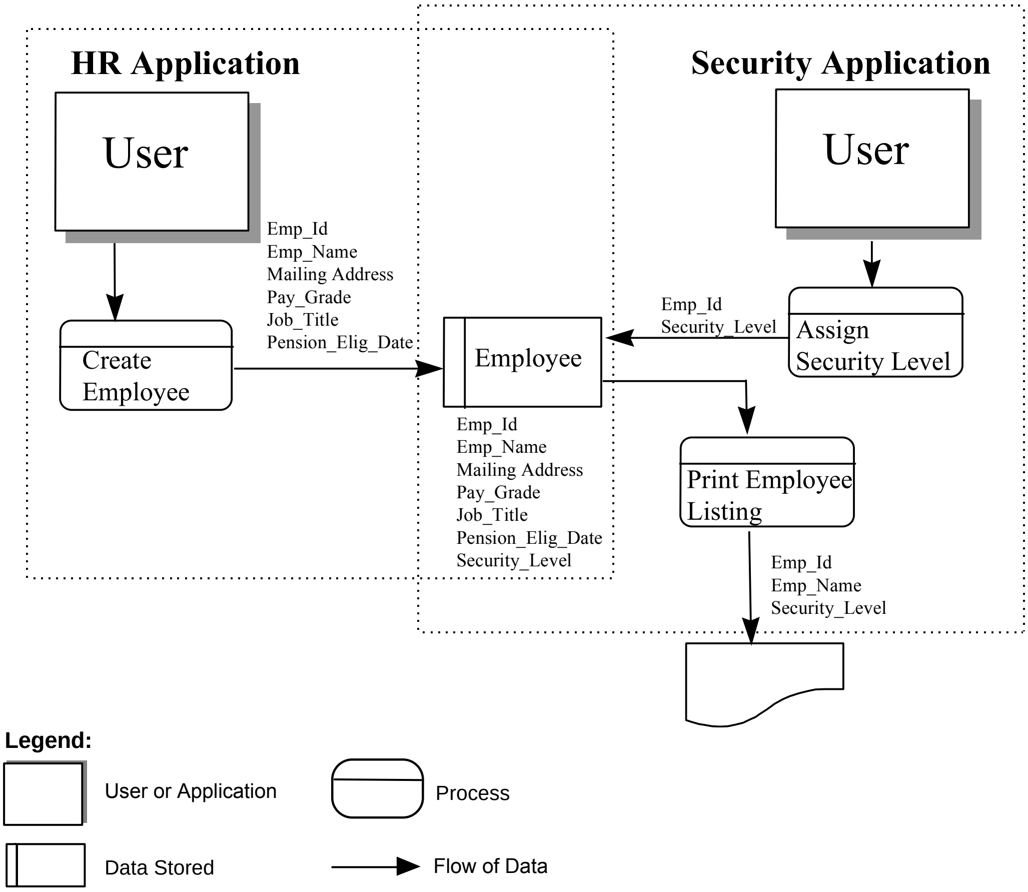
- Employee ID
- Employee Security Level

The Security user also requires a report listing the following information:

- Count of Employee IDs
- Employee Name
- Employee Security Level

Data Flow Diagram

The following diagram shows the data flow for this example.



Identify ILFs

Determine whether the employee information is an ILF for the HR application.

The following table shows the summary analysis.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. This information is recognized and required by the HR users.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The process of creating an employee record is within the boundary of the HR application.

The analysis shows that the employee information is an ILF for the HR application.

Determine whether the employee information is an ILF for the Security application.

The following table shows the summary analysis.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. This information is recognized and required by the Security users.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The process of assigning the employee security level is within the boundary of the Security application.

The analysis shows that the employee information is an ILF for the Security application.

Count RETs and DETs (HR Application)

Count the number of data element types (DETs) and record element types (RETs) for the employee ILF in the HR application.

For DETs, look at each field associated with the employee ILF in the HR application and determine whether the DET counting rules apply.

The following list includes the fields for the employee information:

- Employee ID
- Employee Name
- Employee Mailing Address
- Employee Pay Grade
- Employee Job Title
- Pension Eligibility Date
- Employee Security Level

The analysis of the DETs for the employee ILF in the HR application is shown below:

ILF DET Counting Rules	Does the Rule Apply?
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.	The following fields are recognized by the HR user: • Employee ID • Employee Name • Employee Mailing Address • Employee Pay Grade • Employee Job Title • Pension Eligibility Date
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.	There is data of this type. All of the fields are used within the HR application *except* the Employee Security Level.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	The employee information does not have subgroups.
If there are no subgroups, count the ILF or EIF as one RET.	Because there are no subgroups, count the employee ILF in the HR application as one RET.

There are no subgroups, therefore count one RET for the employee ILF in the HR application.

The RET and DET totals for the employee ILF in the HR application are shown in the following table.

RETs	DETs
• Employee information group	• Employee ID • Employee Name • Employee Mailing Address • Employee Pay Grade • Employee Job Title • Anticipated Pension Eligibility Date
Total 1 RET	**Total** 6 DETs

Count RETs and DETs (Security Application)

Count the number of data element types (DETs) and record element types (RETs) for the employee ILF in the Security application.

For DETs, look at each field associated with the employee ILF in the Security application and determine whether the DET counting rules apply.

The employee ILF includes:

- Employee ID
- Employee Name
- Employee Mailing Address
- Employee Pay Grade
- Employee Job Title
- Anticipated Pension Eligibility Date
- Employee Security Level

The Analysis of the DETs for the employee ILF in the security application is shown below:

ILF DET Counting Rules	Does the Rule Apply?
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.	The following fields are recognized by the Security user: • Employee ID • Employee Name • Employee Security Level
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.	There is data of this type. Only the Employee ID, Employee Name and Employee Security Level are used by the Security application.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	The employee information does not have subgroups.
If there are no subgroups, count the ILF or EIF as one RET.	Because there are no subgroups, count the employee ILF in the Security application as one RET.

There are no subgroups, therefore count one RET for the employee ILF in the Security application.

The RET and DET totals for the employee ILF in the Security application are shown in the following table.

RETs	DETs
• Employee information group	• Employee ID • Employee Name • Employee Security Level
Total 1 RET	**Total** 3 DETs

Example: Different Users/Different Data Views

User Requirements

The information that must be maintained by the HR user includes:

- Employee ID
- Employee Name
- Employee Mailing Address

  The Employee Mailing Address includes the following components:
  - Floor
  - Building Code
  - Street
  - City
  - State
  - Zip Code
- Employee Pay Grade
- Employee Job Title

As a result of creating a new employee record, the employee's anticipated Pension Eligibility Date should be automatically calculated and saved with the other employee information. The HR user requires the ability to produce mailing labels for each employee.

The Mail Distribution user requires the ability to maintain the Building Codes for each employee to reflect changes in the recognized codes.

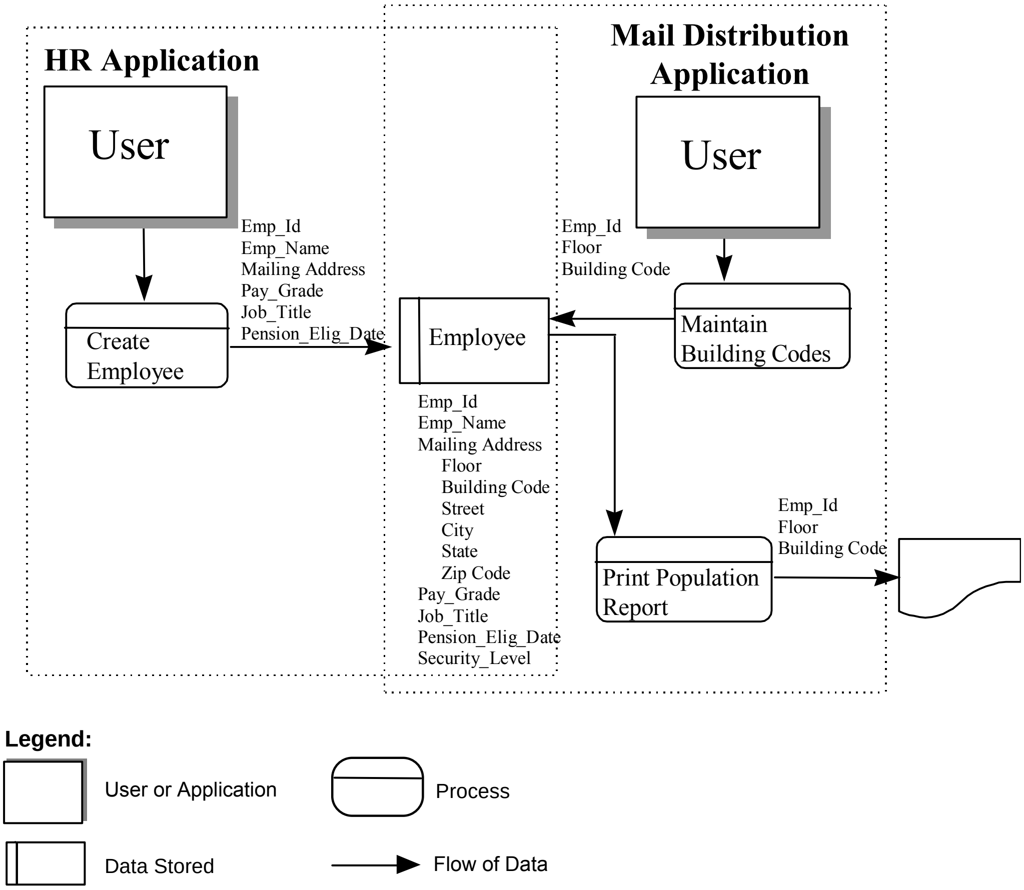
The Mail Distribution user also requires the ability to evaluate the population in each site to determine the most efficient process for delivering the internal mail. A report is produced listing the number of employees located on each floor for each building.

The information that must be maintained or referenced by the Mail Distribution user includes:

- Employee ID
- Floor
- Building Code

Data Flow Diagram

The following diagram shows the data flow for this example.



Identify ILFs

Determine whether the employee information is an ILF for the HR application.

The following table shows the summary analysis.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. This information is recognized and required by the HR users.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The process of creating an employee record is within the boundary of the HR application.

The analysis shows that the employee information is an ILF for the HR application.

Determine whether the employee information is an ILF for the Mail Distribution application. The following table shows the summary analysis.

ILF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. This information is recognized and required by the Mail Distribution users.
The group of data is maintained through an elementary process within the application boundary being counted.	Yes. The process of maintaining building codes is within the boundary of the Mail Distribution application.

The analysis shows that the employee information is an ILF for the Mail Distribution application.

Count RETs and DETs for HR Application

Count the number of data element types (DETs) and record element types (RETs) for the employee ILF in the HR application.

For DETs, look at each field associated with the employee ILF in the HR application and determine whether the DET counting rules apply.

Employee information includes:

- Employee ID
- Employee Name
- Employee Mailing Address
    - Floor
    - Building Code
    - Street
    - City
    - State
    - Zip Code
- Employee Pay Grade
- Employee Job Title
- Pension Eligibility Date
- Employee Security Level

The analysis of the DETs for the employee ILF is shown below:

ILF DET Counting Rules	Does the Rule Apply?
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.	The following fields are recognized by the HR user: • Employee ID • Employee Name • Employee Mailing Address • Employee Pay Grade • Employee Job Title • Pension Eligibility Date
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.	There is data of this type. Only the Employee ID, Employee Name, Employee Mailing Address, Employee Pay Grade, Employee Job Title, and Pension Eligibility Date are used by the HR application.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF. *Or*	The employee information does not have subgroups.
If there are no subgroups, count the ILF or EIF as one RET.	Because, there are no subgroups, count the employee ILF in the HR application as one RET.

There are no subgroups, therefore count one RET for the employee ILF in the HR application.

The RET and DET totals for the employee ILF in the HR application are shown in the following table.

RETs	DETs
• Employee information group	• Employee ID • Employee Name • Employee Mailing Address • Employee Pay Grade • Employee Job Title • Pension Eligibility Date
Total 1 RET	**Total** 6 DETs

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF.	The employee information does not have subgroups.
Or	
If there are no subgroups, count the ILF or EIF as one RET.	Because, there are no subgroups, count the employee ILF in the Mail Distribution application as one RET.

There are no subgroups; therefore, count one RET for the employee ILF in the Mail Distribution application.

Count RETs and DETS for Mail Distribution Application

Count the number of data element types (DETs) and record element types (RETs) for the employee ILF in the Mail Distribution application.

For DETs, look at each field associated with the employee ILF in the Mail Distribution application and determine whether the DET counting rules apply.

Employee information Includes:

- Employee ID
- Employee Name
- Employee Mailing Address
    - Floor
    - Building Code
    - Street
    - City
    - State
    - Zip Code
- Employee Pay Grade
- Employee Job Title
- Anticipated Pension Eligibility Date
- Employee Security Level

The analysis of the DETs for the employee information in the Mail Distribution application is shown below:

ILF DET Counting Rules	Does the Rule Apply?
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.	The following fields are recognized by the Mail Distribution user: • Employee ID • Floor • Building Code
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.	There is data of this type. Only the Employee ID, Floor, and Building Code are used by the Mail Distribution application.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

The RET and DET totals for the employee ILF in the Mail Distribution application are shown in the following table.

RETs	DETs
• Employee information group	• Employee ID • Floor • Building Code
Total 1 RET	**Total** 3 DETs

Summary of ILFs, RETs and DETs Counted

This section gives a summary of the ILFs, RETs, and DETs counted before calculating the complexity and contribution to the unadjusted function point count.

Summary of ILFs Counted

The following table shows the ILF count for the Human Resources System. It also lists the data that was not counted.

ILFs Identification	Not Counted
• Job information • Screen security • Employee security • Suspended jobs • Report definition • Employee information (HR application) • Employee information (Security application) • Employee information (Mail Distribution application)	• Audit data for inquiries and reports • Alternate index

Summary RET and DET Count

The RET and DET counts for the HR Application are recorded in the following table.

ILFs	RETs	DETs
• Job information	2	5
• Suspended jobs	2	6
• Report definition	1	4
• Employee information	1	6

The RET and DET counts for the Security Application are recorded in the following table.

ILFs	RETs	DETs
• Screen security	2	8
• Employee security	1	4
• Employee information	1	3

The RET and DET counts for the Mail Distribution Application are recorded in the following table.

ILFs	RETs	DETs
• Employee information	1	3

ILF Complexity and Contribution

The last section of the ILF examples shows the final steps to determine ILF complexity and contribution to the unadjusted function point count.

The final steps are as follows:

1. Rate the ILF complexity.
2. Translate the complexity to unadjusted function points.
3. Calculate the internal logical files' contribution to the total unadjusted function point count.

Rate ILF Complexity

The functional complexity is rated as low, average, or high. The following ILF complexity matrix is used to rate the ILF complexity.

	1 to 19 DETs	20 to 50 DETs	51 or more DETs
1 RET	Low	Low	Average
2 to 5 RETs	Low	Average	High
6 or more RETs	Average	High	High

The following table shows the functional complexity for each HR Application ILF. The same process would be applied to the Security and Mail Distribution data function types to determine complexity.

ILFs	RETs	DETs	Functional Complexity
1. Job information	2	5	Low
2. Suspended jobs	2	6	Low
3. Report definition	1	4	Low
4. Employee information	1	6	Low

Translate ILFs

The following table translates the internal logical files' functional complexity to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	7
Average	10
High	15

The complexity is recorded in the table in the following section.

Calculate ILF Contribution

The following table shows the total contribution for the ILF functions to the unadjusted function point count for the HR application:

Function Type	Functional Complexity			Complexity Totals	Function Type Totals
ILF	4	Low	X 7 =	28	
	0	Average	X 10 =	0	
	0	High	X 15 =	0	
					28

This total will be recorded on a table that lists all the function types. The final total for all function types is the unadjusted function point count.

The Appendix includes a table to record the totals for all function types.

EIF Counting Examples

Introduction

This section uses a Human Resources (HR) application along with a Security application and a Pension system to illustrate procedures used to count data functions. In addition to this section, further examples are in the Case Studies included in the corresponding IFPUG documentation.

Contents

This section includes the following examples:

Summary Descriptions of EIF Examples

The examples for EIFs are described in the following table.

Example	Summary Description	Page
Referencing Data from Other Applications to generate output	This example identifies EIFs for an application that references data maintained by another application. The data is used to generate an external output.	6-60
Referencing Data from Another Application to use as part of an input process	This example also looks at referencing data from another application. This example identifies EIFs for an application that references data maintained by another application to use for an external input.	6-63
Providing Data to Other Applications	This example shows how you count when other applications retrieve a logical group of data from the application being counted.	6-66
Help Application	This example shows how the HR application counts a Help facility provided by a separate application.	6-67
Data Conversion	This section shows an example of counting when converting to a new application.	6-73
Transaction Input File	This example applies EIF counting rules to a transaction input file processed to add jobs to the Human Resources application.	6-75
Different Users/Different User View	This example shows how the view differs when an EIF is used by multiple applications.	6-77
Multiple Data Uses	This example shows multiple uses for the same data.	6-80

Example: Referencing Data from Other Applications

User Requirements

The user wants the Human Resources System to provide the ability to:

1. Enter, inquire, and report employee information
2. Interface with the Fixed Assets system to retrieve location information for each building. The location information includes name and description information.

Identify EIFs

From the user requirements, there are two groups of information:

- Employee information
- Location information

The following table shows the summary analysis to determine whether the employee information is an EIF.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Users require the ability to inquire and report on employee information.
The group of data is referenced by, and external to, the application being counted.	No. The HR application being counted requires creating employee information.
The group of data is not maintained by the application being counted.	No. The HR application adds, changes, and deletes employee information.
The group of data is maintained in an ILF of another application.	Yes, but the rule does not apply because the ILF is maintained within the application being counted.

Based on the analysis, the employee information is not external to the HR application. It is maintained internally; therefore, it is not an EIF.

The following table shows the analysis to determine whether the location information is an EIF.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Users require the ability to retrieve the information for employee reporting.
The group of data is referenced by, and external to, the application being counted.	Yes. It is maintained externally by the Fixed Asset application.
The group of data is not maintained by the application being counted.	Yes.
The group of data is maintained in an ILF of another application.	At first, it is not clear whether this rule applies. After asking users, we learn that they enter the information into the Fixed Asset application using a screen. Therefore, the group is an ILF and the rule applies.

The location information meets all the requirements for an EIF.

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each field associated with the location EIF and determine whether the rules apply.

The following fields are referenced from the location EIF:

- Building Code
- Building Name
- Building Description
  - Line 1
  - Line 2
  - Line 3
- City
- State
- Country

The following table shows the summary analysis of the DET count.

EIF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable. The Building Description has three lines. Because these are repeating lines, count Building Description as one DET.
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.	This data is maintained by the Fixed Asset System.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

Count one DET for each field.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF.	The location information does not have subgroups.
Or	
If there are no subgroups, count the ILF or EIF as one RET.	Because there are no subgroups, count the location information EIF as one RET.

There are no subgroups; therefore, the location information EIF has only one RET.

The RET and DET totals for the location EIF are shown in the following table.

RETs	DETs
• Location data	• Building Code • Building Name • Building Description Line 1 Line 2 Line 3 • City • State • Country
Total 1 RET	**Total** 6 DETs

Example: Referencing Data from Another Application

User Requirements

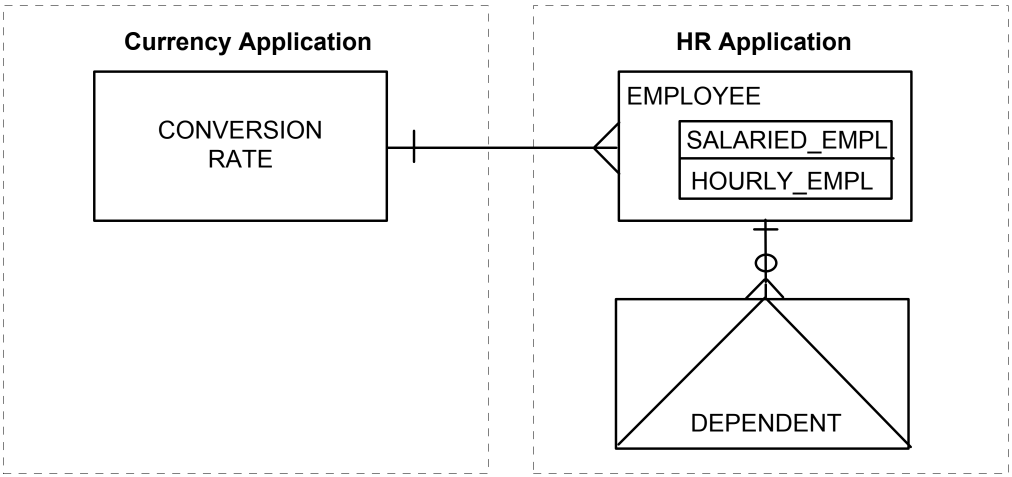
The user requires the Human Resources application to provide the following capabilities:

- All hourly employees must be paid in United States dollars.
- When the user adds or changes employee information, the Human Resources application must access the Currency application to retrieve a conversion rate. After retrieving the conversion rate, the HR application converts the employee's local standard hourly rate to a U.S. hourly rate using the following calculation:

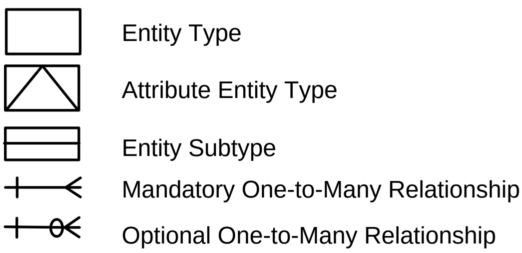
$$\frac{\text{Standard Hourly Rate}}{\text{Conversion Rate}} = \text{US Dollar Hourly Rate}$$

Data Model

The following diagram shows the relationships for this example.



Legend:



The conversion information includes:

CURRENCY
  Conversion_Rate_To_Base_Currency
  Country

Identify EIFs From the requirements, there are two groups of information:

- Conversion information
- Employee information

The following table shows the summary analysis to determine whether the conversion information is an EIF.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Users require that the local currencies are converted to enable the HR application to maintain all needed employee data.
The group of data is referenced by, and external to, the application being counted.	Yes. The rule applies.
The group of data is not maintained by the application being counted.	Yes. The rule applies.
The group of data is maintained in an ILF of another application.	At first, it is not clear whether this rule applies for the conversion information. After asking users, we learn that the information is accessed from a wire service and is counted as an ILF in the Currency application. Therefore, the rule applies.

Because the Currency application provides the conversion rate for the HR application, the group of currency conversion data is an EIF for the HR application. Employee information was previously identified as an ILF.

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each field associated with the conversion EIF and determine whether the rules apply. The following table shows the summary analysis of the DET count.

EIF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable.
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.	This data is maintained by currency system.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

Count one DET for each field.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF.	The conversion information is contained within one entity, therefore there are no subgroups.
Or	
If there are no subgroups, count the ILF or EIF as one RET.	Because there are no subgroups, count the conversion information as one RET.

There are no subgroups; therefore, the conversion information EIF has only one RET.

The RET and DET totals for the conversion information EIF are shown in the following table.

RETs	DETs
• Conversion information	• Conversion rate • Country
Total 1 RET	**Total** 2 DETs

Example: Providing Data to Other Applications

User Requirements

The user has the following requirements for the Currency application:

- Maintain conversion rates for other currencies to U.S. dollars.
- Provide an interface to enable other applications, such as Human Resources, to retrieve conversion information.

Identify EIFs

For this example, determine whether the conversion information is an EIF for the Currency application. The following table shows the summary analysis.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Users require that the local currencies exchange rates are available to enable the Human Resources application to maintain all needed employee data.
The group of data is referenced by, and external to, the application being counted.	No. The Currency application is being counted, and the rates are maintained in that application.
The group of data is not maintained by the application being counted.	No. The rates are maintained by Currency application users.
The group of data is maintained in an ILF of another application.	At first, it is not clear whether the rule applies for the conversion information. After asking users, we learn that the information is accessed via a wire service and is counted as an ILF in the Currency application. This rule does not apply because the data is maintained within the application being counted.

The conversion information is not external to the Currency application; therefore, it is not counted as an EIF for the currency application.

The conversion information is an ILF for the Currency application based on the following rules for an ILF:

- The data is a logical group based on the user's view.
- Data is maintained within the Currency application.
- The data is an ILF for the Currency application.

See the previous example in this chapter to review how referencing currency rates may be counted as an EIF.

Example: Help Application

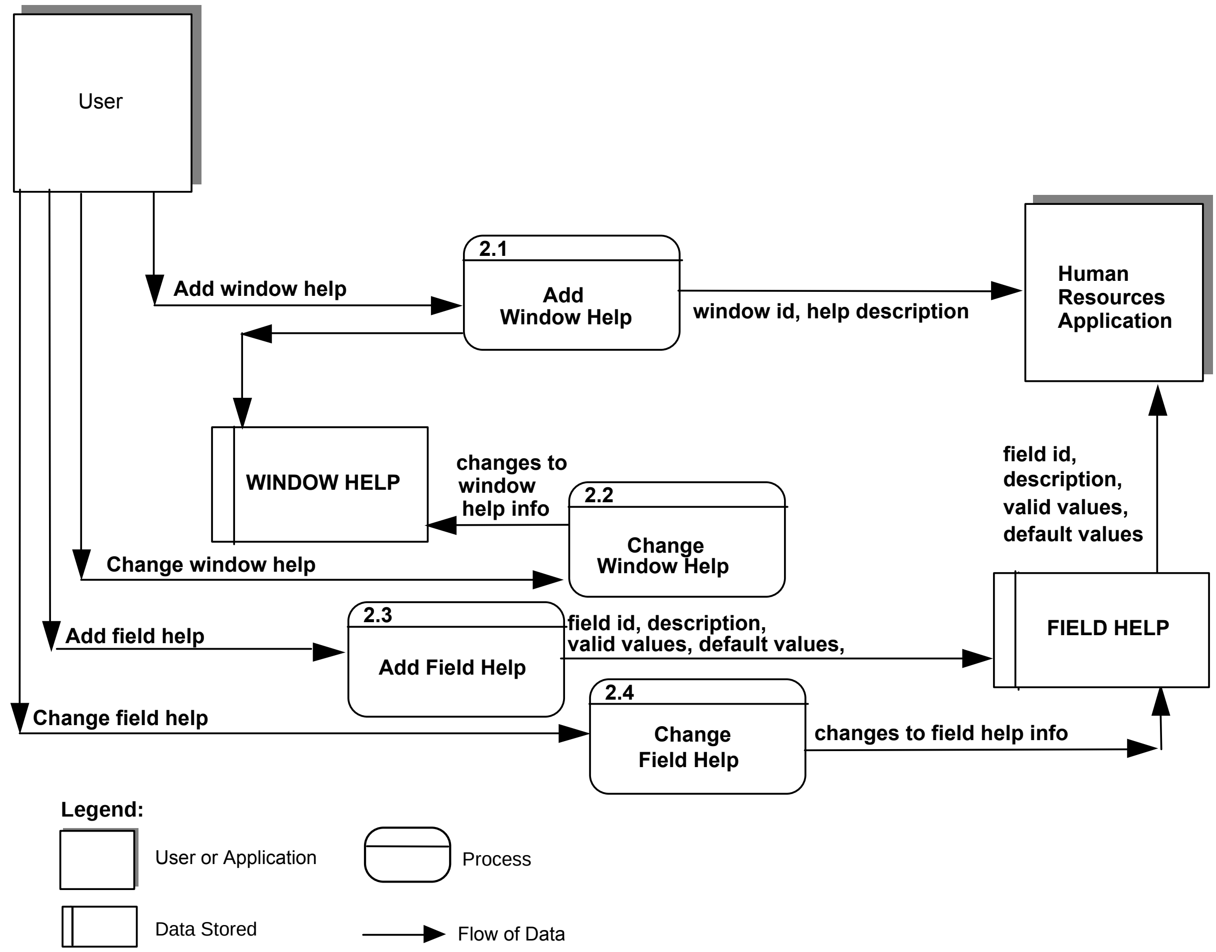
User Requirements

The user requires the Help system to provide:

1. The facility for a user to describe how each window is used to accomplish each business function available on the window.
2. The ability to change window help.
3. The ability to set up a definition, default values, and valid values for each field in the Human Resources application.
4. The ability to change field help.
5. The ability for the Human Resources application to retrieve window and field help for display.

Data Flow Diagram

The following diagram illustrates the data flow for this example.



Identify EIFs

From the requirements for the Human Resources (HR) application, there are two groups of data:

- Window help
- Field help

The following table shows the summary analysis to determine whether window help is an EIF for the HR application.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Users require a centralized window help facility to customize help.
The group of data is referenced by, and external to, the application being counted.	Yes. The data is external to the HR application.
The group of data is not maintained by the application being counted.	Yes. The rule applies.
The group of data is maintained in an ILF of another application.	Yes. It is counted as an ILF in the Help application.

Window help information is an EIF in the HR application because the information is retrieved by the HR application. Window help is maintained in the Help application, where it is counted as an ILF.

The following table shows the summary results of the analysis to determine whether the field help is an EIF.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Users require a centralized field help facility to customize help.
The group of data is referenced by, and external to, the application being counted.	Yes. Field help is maintained by the Help application, therefore, it is external to the HR application.
The group of data is not maintained by the application being counted.	Yes.
The group of data is maintained in an ILF of another application.	Yes.

Field help information is an EIF in the HR application because the information is retrieved by the HR application. The field help information is maintained in the Help system where it is counted as an ILF.

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each field associated with the window and field help and use the DET counting rules to count DETs.

The fields for window help include:

- Window identifier
- Business function description.

The following table shows the DET analysis for window help.

EIF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable.
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.	This data is maintained by the Help system.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

The following list shows the fields for field help:

- Window identifier
- Field indicator
- Field description
- Default values
- Valid values

The following table shows the DET analysis for field help.

EIF DET Counting Rules	Does the Rule Apply?
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.	All fields are user recognizable.
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.	This data is maintained by the Help system.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF.	There are no subgroups for either the window help or field help EIF.
Or	
If there are no subgroups, count the ILF or EIF as one RET.	Because there are no subgroups, count one RET for each EIF (window help and field help).

There are no subgroups; therefore, the help information has only one RET for each EIF.

The RET and DET totals for the window help EIF are shown in the following table.

RETs	DETs
• Window help information	• Window identifier • Business function description
Total 1 RET	**Total** 2 DETs

The RET and DET totals for the field help EIF are shown in the following table.

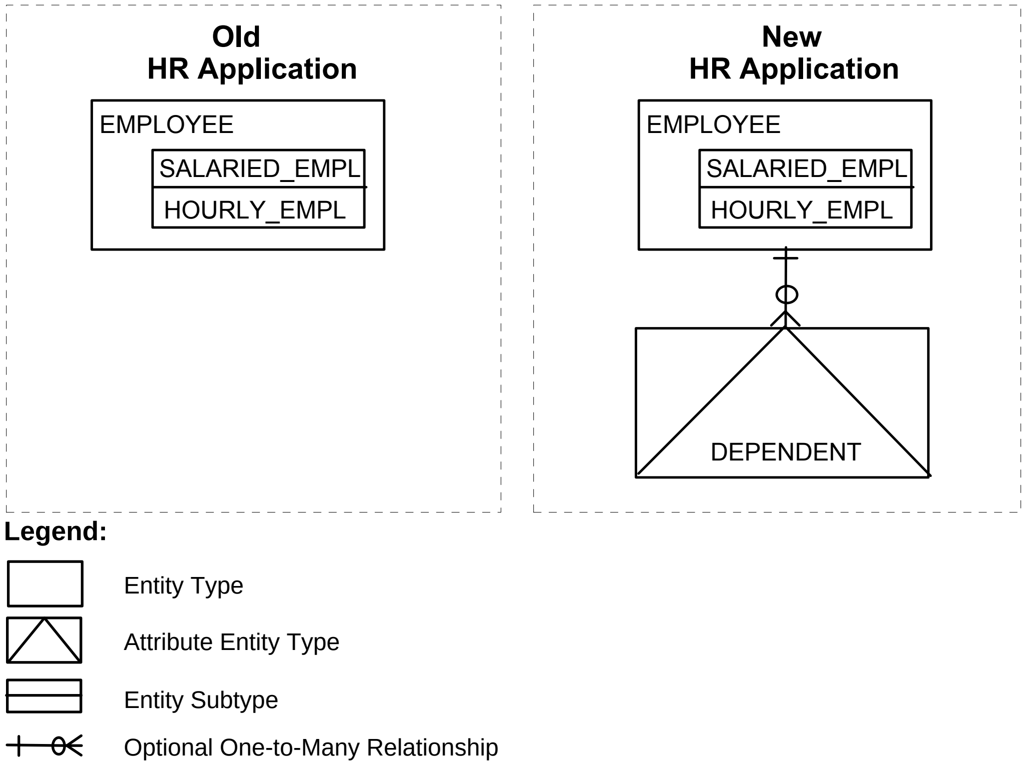
RETs		**DETs**	
• Field help information		• Window identifier	
		• Field indicator	
		• Field description	
		• Default values	
		• Valid values	
Total	1 RET	**Total**	5 DETs

Example: Data Conversion

User Requirements An organization has purchased a new HR application package. The organization is required to convert its employee file from its existing HR System to a replacement system.

The old system did not provide the capability to maintain employee dependent information. The dependent information is initialized when existing employees are migrated to the new application.

Data Model The following diagram shows the data for the two applications.



The employee file from the old HR application is used to add employees to the new HR application.

Identify EIFs From the user requirements, determine whether the old employee file is an EIF. The following table shows the summary analysis.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	No. The old employee file is not a logical group of data from the user perspective.
The group of data is referenced by, and external to, the application being counted.	No. While it is external, it is not referenced, but it is used as an update.
The group of data is not maintained by the application being counted.	Yes. It is not maintained by the HR application.
The group of data is maintained in an ILF of another application.	Yes. It is maintained as an ILF by the old HR system..

The file of employee information is a transaction file of employee information that is migrated to the new system. The conversion process maintains the employee information after it enters the new HR application boundary.

The old employee file is not a logical group of data from the new HR application user perspective, therefore, it is not an EIF. Refer to Chapter 7 to see how the old employee file may be counted as an external input.

Example: Transaction Input File

User Requirements

The user requires the ability to:

1. Add, change, delete, inquire, and report on job information online
2. Add and change job information in batch mode.

Record Layout

The following diagram shows the record layout for this example for adding and changing job information in batch mode.

```
                  1234567891012345678901234567890123456789012345678901234567890123456789012345678901234567
890
0            1         2          3          4         5          6          7         8
1                 ADD|01|SRENG|SENIOR ENGINEER INFORMATION SYSTEMS|05|
2                 ADD|02|SRENG|01|STARTS AT PAY GRADE 05        |
3                 ADD|02|SRENG|02|OTHER PAY GRADES:06 AND 07    |
4                 CHG|01|STENG|                                    |04|
5                 CHG|02|STENG|02|OTHER PAY GRADES:05 AND 06    |
6
7
9
0
1
2
3
4
5
6
7
9
0
1
2
3
4
```


Record Descriptions

The following table includes descriptions for each record type.

Record	Position	Description
01	1-3	Transaction type
	4-5	Record type
	6-10	Job number
	11-45	Job name
	46-47	Job pay grade
02	1-3	Transaction type
	4-5	Record type
	6-10	Job ID
	11-12	Job description line number
	13-41	Job description lines

Identify EIFs

From the user requirements, determine whether the transaction file is an EIF. The following table shows the summary analysis.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. Data is grouped into transactions which enter the application boundary to maintain the job ILF.
The group of data is referenced by, and external to, the application being counted.	Yes. The transaction file is outside the boundary ready to be processed.
The group of data is not maintained by the application being counted.	No. It is not maintained.
The group of data is maintained in an ILF of another application.	No. The transactions entering the boundary to update the job ILF make up the elementary processes. There is no elementary process to update the transaction file.

There are no EIFs for this example. Refer to Chapter 7 to see the explanation of how an input transaction file may be counted as an external input.

Example: Different Users/Different User View

User Requirements

The HR user requires the ability to maintain information on each new employee.

The information that must be maintained by the HR user includes:

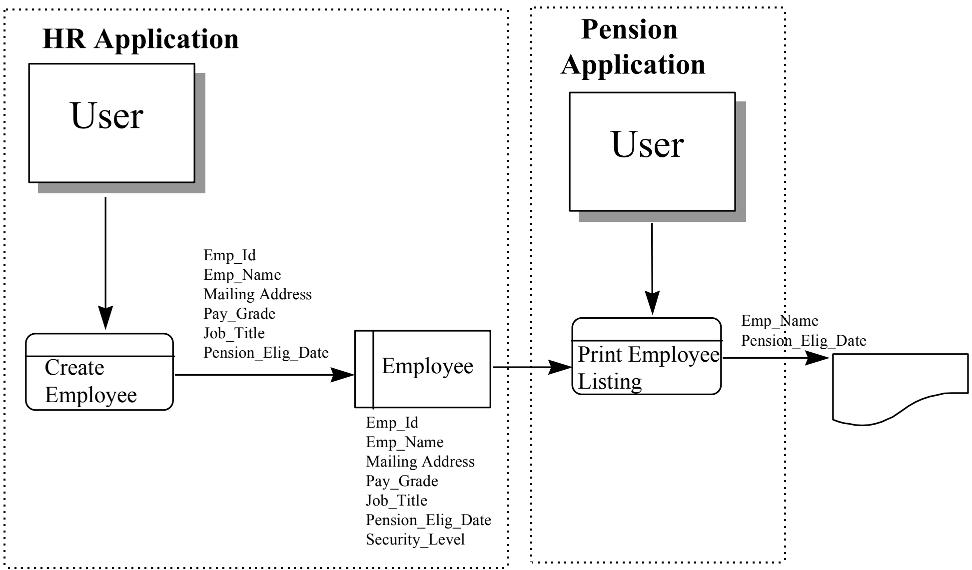
- Employee ID
- Employee Name
- Employee Mailing Address
- Employee Pay Grade
- Employee Job Title

As a result of creating a new employee record, the employee's Pension Eligibility Date is automatically calculated and saved with the other employee information.

The Pension user requires the ability to generate a list of employees with their anticipated Pension Eligibility date.

Data Flow Diagram

The following diagram shows the data flow for this example.



Identify EIFs

From a previous HR application example, we know that the employee information is not an EIF for the HR application.

The following table shows the summary analysis to determine whether the employee information is an EIF for the Pension application.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. The fields are recognized by the Pension user.
The group of data is referenced by, and external to, the application being counted.	Yes. All data is external to the Pension Application.
The group of data is not maintained by the application being counted.	Yes. The data is not maintained by the Pension application.
The group of data is maintained in an ILF of another application.	Yes. The data is maintained by the HR application.

The employee information meets all the requirements for an EIF for the Pension application.

Count RETs and DETs

Count the number of data element types (DETs) and record element types (RETs).

For DETs, look at each field associated with the employee EIF for the Pension application. Use the DET counting rules to count DETs.

The fields for the employee information include:

- Employee ID
- Employee Name
- Employee Mailing Address
- Employee Pay Grade
- Employee Job Title
- Pension Eligibility Date

The following table shows the DET analysis for employee information for the Pension application.

EIF DET Counting Rules	Does the Rule Apply?
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.	Only the Employee Name and the Pension Eligibility Date are recognized by the Pension user.
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.	The Pension application only uses the Employee Name and the Pension Eligibility Date.
Count a DET for each piece of data required by the user to establish a relationship with another ILF or EIF.	There is no data of this type.

The following list shows the fields for the employee EIF for the Pension application:

- Employee Name
- Pension Eligibility Date

For RETs, identify subgroups based on the RET counting rules.

RET Counting Rules	Does the Rule Apply?
Count a RET for each optional or mandatory subgroup of the ILF or EIF.	There are no subgroups.
Or	
If there are no subgroups, count the ILF or EIF as one RET.	Because there are no subgroups, count one RET for each EIF.

There are no subgroups; therefore the employee information has only one RET.

The RET and DET totals for the Employee EIF in the Pension application.

RETs	DETs
• Employee information	• Employee Name • Pension Eligibility Date
Total 1 RET	**Total** 2 DETs

Example: Multiple Data Uses

User Requirements

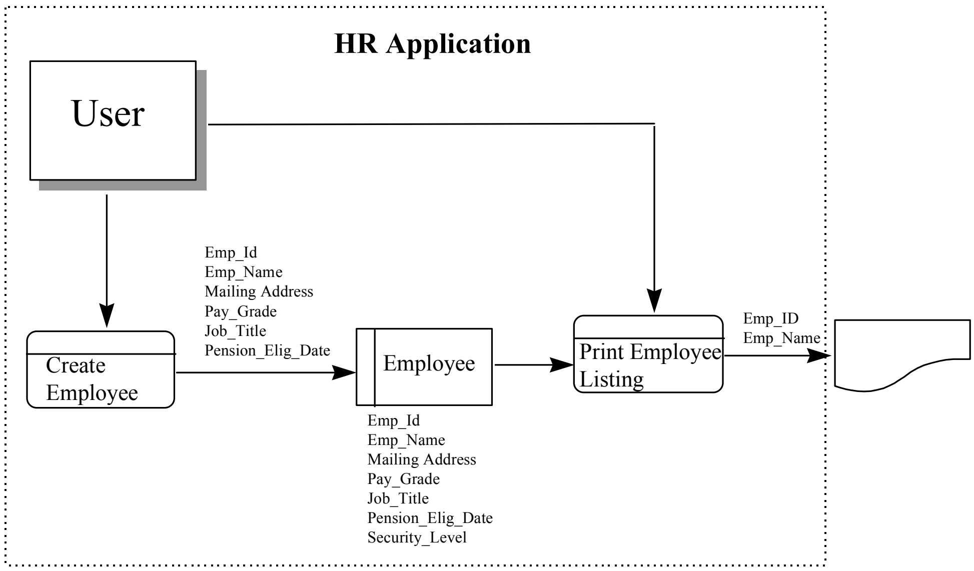
The HR user requires the ability to generate a listing of all of the employees.

The information that must be displayed for each employee includes:

- Employee ID
- Employee Name

Data Flow Diagram

The following diagram shows the data flow for this example.



Identify EIFs

The following table shows the summary analysis to determine whether the employee information that is used to create the employee listing is an EIF for the HR application.

EIF Identification Rules	Does the Rule Apply?
The group of data or control information is logical and user identifiable.	Yes. All data is recognized by the user.
The group of data is referenced by, and external to, the application being counted.	No. The data and the process of producing the employee listing is not external to the HR application.
The group of data is not maintained by the application being counted.	No. The data is maintained by the application.
The group of data is maintained in an ILF of another application.	Not applicable.

The employee listing information used for creating the employee information is not an EIF for the HR application.

Summary of EIFs, RETs and DETs Counted

This section summarizes the EIFs, RETs, and DETs counted before calculating the complexity and contribution to the unadjusted function point count.

Summary of EIFs Identified

The following table shows the EIF count for the HR application. It also lists the data that was not counted.

EIFs Identified	Not Counted
• Location information	• Old HR system employee data
• Conversion information	• Transaction Input File
• Window help	• Employee listing information
• Field help	

The following table shows the EIF count for the Pension application. It also lists the data that was not counted.

EIFs Identified	Not Counted
• Employee information	

Summary RET/DET Count

The RET and DET counts for the HR application are recorded in the following table.

EIFs	RETs	DETs
Location information	1	6
Conversion information	1	2
Window help information	1	2
Field help information	1	5

The RET and DET counts for the Pension application are recorded in the following table.

EIFs	RETs	DETs
Employee information	1	2

EIF Complexity and Contribution

This section describes the final steps to determine EIF complexity and contribution to the unadjusted function point count.

The final steps are to:

1. Rate the EIF complexity.
2. Translate the complexity to unadjusted function points.
3. Calculate the external interface files' contribution to the total unadjusted function point count.

Rate EIF Complexity

The functional complexity is rated as low, average, or high. The following RET/DET matrix rates the EIF complexity.

	1 to 19 DETs	20 to 50 DETs	51 or more DETs
1 RET	Low	Low	Average
2 to 5 RETs	Low	Average	High
6 or more RETs	Average	High	High

Legend:
RET = Record Element Type
DET = Data Element Type

The following table shows the functional complexity for each EIF within the HR application.

EIFs	RETs	DETs	Functional Complexity
Location information	1	6	Low
Conversion information	1	2	Low
Window help information	1	2	Low
Field help information	1	5	Low

Translate EIFs

The following table is used to translate the functional complexity to unadjusted function point counts.

Functional Complexity Rating	Unadjusted Function Points
Low	5
Average	7
High	10

The complexity is recorded in the table in the following section.

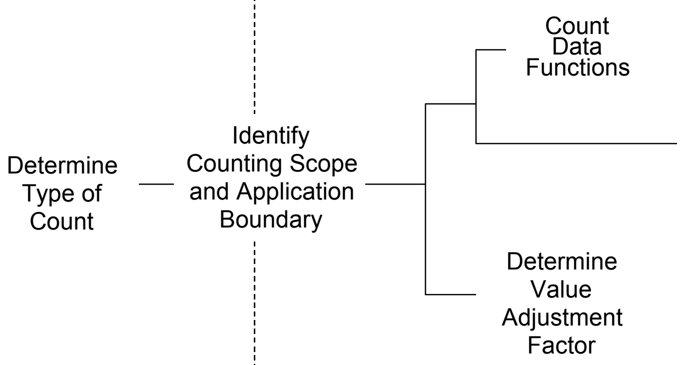
Calculate EIF Contribution

The following table shows the total contribution for the EIF function type within the HR application.

Function Type	Functional Complexity			Complexity Totals	Function Type Totals
EIF	4	Low	X 5 =	20	
	0	Average	X 7 =	0	
	0	High	X 10 =	0	
					20

This total will be recorded on a table that lists all the function types. The final total for all function types is the unadjusted function point count.

The Appendix includes a table to record the totals for all function types.



7 Count Transactional Functions

Introduction

Transactional functions represent the functionality provided to the user for the processing of data by an application. Transactional functions are defined as external inputs (EIs), external outputs (EOs), and external inquiries (EQs).

This chapter defines EI, EO, and EQ transactional functions and includes the associated function point counting rules and procedures. The chapter concludes with detailed examples for each function.

Contents

This chapter includes the following sections:

Continued on next page

Definitions: EIs, EOs and EQs

This section includes the definitions of EIs, EOs and EQs. Embedded terms within the definitions are defined, and examples are included throughout this definition section.

External Inputs

An external input (EI) is an elementary process that processes data or control information that comes from outside the application boundary. The primary intent of an EI is to maintain one or more ILFs and/or to alter the behavior of the system.

External Outputs

An external output (EO) is an elementary process that sends data or control information outside the application boundary. The primary intent of an external output is to present information to a user through processing logic other than, or in addition to, the retrieval of data or control information . The processing logic must contain at least one mathematical formula or calculation, or create derived data. An external output may also maintain one or more ILFs and/or alter the behavior of the system.

External Inquiry

An external inquiry (EQ) is an elementary process that sends data or control information outside the application boundary. The primary intent of an external inquiry is to present information to a user through the retrieval of data or control information from an ILF of EIF. The processing logic contains no mathematical formulas or calculations, and creates no derived data. No ILF is maintained during the processing, nor is the behavior of the system altered.

Summary of the Functions Performed by EIs, EOs and EQs

The main difference between the transactional function types is their primary intent. The table below summarizes functions that may be performed by each transactional function type, and specifies the primary intent of each. Note the primary intent for an EI—this is the main difference from EOs and EQs. Some of the differences between EOs and EQs are that an EO may perform the functions of altering the behavior of the system or maintaining one or more ILFs when performing the primary intent of presenting information to the user. Other differences are identified in the section below that summarizes forms of processing logic used by each transactional function.

	Transactional Function Type:		
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 a user	F	PI	PI

Legend:

PI	the primary intent of the transactional function type
F	a function of the transactional function type, but is not the primary intent and is sometimes present
N/A	the function is not allowed by the transactional function type

Definitions for Embedded Terms

The following paragraphs further define EIs, EOs and EQs by defining terms used within the above definitions.

Elementary Process

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

For example, a user requires the ability to add a new employee to the application. The user definition of employee includes salary and dependent information. From the user perspective, the smallest unit of activity is to add a new employee. Adding one of the pieces of information, such as salary or dependent, is not an activity that would qualify as an elementary process.

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

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

Control Information

Control Information is data that influences an elementary process of the application being counted. *It specifies what, when, or how data is to be processed.*

For example, someone in the payroll department establishes payment cycles to schedule when the employees for each location are to be paid. The payment cycle, or schedule, contains timing information that affects when the elementary process of paying employees occurs.

Maintained

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

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

User

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

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

Processing Logic

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

1. Validations are performed

   For example, when adding a new employee to an organization, the employee process has processing logic that validates the information being added.

2. Mathematical formulas and calculations are performed

   For example, when reporting on all employees within an organization the process includes calculating the total number of salaried employees, hourly employees and all employees.

3. Equivalent values are converted

   For example, an elementary process references currency conversion rates from US dollars to other currencies. The conversion is accomplished by retrieving values from tables, so calculations need not be performed.

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

   For example, to generate a list of employees by assignment, an elementary process compares the job number of a job assignment to select and lists the appropriate employees with that assignment.

5. Conditions are analyzed to determine which are applicable

   For example, processing logic exercised by the elementary process when an employee is added and will depend on whether an employee is paid based on salary or hours worked.

6. One or more ILFs are updated

   For example, when adding an employee, the elementary process updates the employee ILF to maintain the employee data.

7. One or more ILFs or EIFs are referenced

   For example, when adding an employee, the currency EIF is referenced to use the correct US dollar conversion rate to determine an employee's hourly rate.

8. Data or control information is retrieved

   For example, to view a list of possible pay grades, pay grade information is retrieved.

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

   For example, to determine (derive) a patient's registration number (e.g., SMIJO01), the following data is concatenated:

   - the first three letters of the patient's last name (e.g., SMI for Smith)
   - the first two letter of the patient's first name (e.g., JO for John)
   - a unique two-digit sequence number (starting with 01)

10. Behavior of the system is altered

    For example, the behavior of the elementary process of paying employees is altered when a change is made to pay them every other Friday versus on the 15th and the last day of the month.

11. Prepare and present information outside the boundary

    For example, a list of employees displayed for the user.

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

    For example, a user enters several pieces of information to add a customer order to the system.

13. Data is resorted or rearranged

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

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

Summary of Processing Logic Used by EIs, EOs and EQs

The following table summarizes which forms of processing logic may be performed by EIs, EOs, and EQs. For each transactional function type, certain types of processing logic must be performed to accomplish the primary intent of that type.

Form of Processing Logic:	Transactional Functional Type:		
	EI	EO	EQ
1. Validations are performed	c	c	c
2. Mathematical formula and calculations are performed	c	m*	n
3. Equivalent values are converted	c	c	c
4. Data is filtered and selected by using specified criteria to compare multiple sets of data	c	c	c
5. Conditions are analyzed to determine which are applicable	c	c	c
6. At least one ILF is updated	m*	m*	n
7. At least one ILF or EIF is referenced	c	c	m
8. Data or control information is retrieved	c	c	m
9. Derived data is created	c	m*	n
10. Behavior of the system is altered	m*	m*	n
11. Prepare and present information outside the boundary	c	m	m
12. Capability to accept data or control information that enters the application boundary.	m	c	c
13. Resorting or rearranging a set of data	c	c	c

Legend:

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 type **can** perform the form of processing logic, but it is not mandatory

n function type **cannot** perform the form of processing logic

EI/EO/EQ Counting Rules

This section defines the rules that apply when counting EIs, EOs and EQs.

Summary of Counting Procedures

This summary is included to show the rules in the context of the EI, EO, and EQ counting procedures.

Note: The detailed procedures begin on page 7-18.

The EI, EO and EQ counting procedures include the following steps:

Step	Action
1	Identify the elementary processes.
2	Determine the primary intent of the identified elementary processes, and classify as an EI, EO, or EQ.
3	Validate against the transaction (EI, EO, EQ) identification rules.
4	Determine the transaction (EI, EO, EQ) complexity.
5	Determine the transaction (EI, EO, EQ) contribution to the unadjusted function point count.

The rules are explained in the following paragraphs.

Elementary Process Identification Rules

To identify elementary processes, look for user activities occurring in the application.

All of the following counting rules must apply for the process to be identified as an elementary process.

- 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.

Transactional Functions Counting Rules

To classify each elementary process, determine which of the primary intent descriptions apply, and use the associated rules to identify a specific transactional function type.

Primary Intent Description for EIs

The primary intent of an elementary process is to maintain an ILF or alter the behavior of the system.

External Input Counting Rules

For each elementary process that has a primary intent to maintain one or more ILFs or to alter the behavior of the system, apply the following rules to determine if the function should be classified as an external input. All of the rules must apply for the elementary process to be counted as a unique occurrence of 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 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.

Primary Intent Description for EOs and EQs

The primary intent of the elementary process is to present information to a user.

Shared EO and EQ Counting Rules

For each elementary process that has a primary intent to present information to a user, apply the following rules to determine if the process may be classified as an external output or external inquiry. All of the rules must apply for the elementary process to be counted as a unique occurrence of an external output or external inquiry.

- 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.

Additional External Output Counting Rules

In addition to adhering to all shared EO and EQ rules, one of the following rules must apply for the elementary process to be counted as a unique external output.

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

Additional External Inquiry Counting Rules

In addition to adhering to all shared EO and EQ rules, all of the following rules must apply for the elementary process to be counted as a unique external inquiry.

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

Complexity and Contribution Definitions and Rules

The number of EIs, EOs, and EQs and their relative functional complexities determine the contribution of the transactional functions to the unadjusted function point count.

Assign each identified EI, EO and EQ a functional complexity based on the number of file types referenced (FTRs) and data element types (DETs).

FTR Definition

A *file type referenced* is

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

DET Definition

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

EI Complexity and Contribution Rules

This section defines FTR and DET rules used to determine the complexity and contribution of external inputs.

FTR Rules for an EI

The following rules apply when counting FTRs:

- 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 Rules for an EI

The following rules apply when counting DETs:

- 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.

  For example, job name and pay grade are two fields that the user provides when adding a job.

- 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.

  For example, when the customer order is added to the system, the unit price is automatically retrieved for each ordered item and stored on the billing record. The unit price would not be counted as a DET for the EI because it did not cross the boundary when the user adds the customer order.

  For example, in order to maintain the US hourly rate for hourly employees working in other countries with other currencies, the local hourly rate is provided by the user. During the processing of all the pieces of data provided to add an employee, a conversion rate is retrieved from the currency system to calculate the US hourly rate. The calculated US hourly rate is maintained on the employee ILF as a result of adding the employee. The US hourly rate would not be counted as a DET for the EI because it does not enter the boundary, but is internally calculated (i.e., it is derived data).

- 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.

  For example, if a user tries to add an existing employee to a Human Resources application, the system generates one of several error messages and the incorrect field is highlighted. Count one DET that includes all the system responses which indicate the error conditions, 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.

  For example, if the user can initiate the adding of an employee clicking on the OK button or by pressing a PF key, count one DET for the ability to initiate the process.

EO/EQ Complexity and Contribution Rules

This section defines FTR and DET rules used to determine the complexity and contribution of external outputs and external inquiries.

Shared FTR Rules for EOs and EQs

The following rule applies when counting FTRs for both EOs and EQs:

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

Additional FTR Rules for an EO

The following additional rules apply when counting FTRs for EOs:

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

Shared DET Rules for EOs and EQs

The following rules apply when counting DETs for both EOs and EQs.

- Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.

  <u>For example (EO/EQ)</u>, to generate a list of employees, employee name is a field the user provides when indicating which employees to list.

- Count one DET for each user recognizable, non-repeated field that exits the boundary.

  <u>For example (EO/EQ)</u>, a text message may be a single word, sentence, or phrase—a line or paragraph included on a report to indicate an explanatory comment counts as a single DET.

  <u>For example (EO/EQ)</u>, an account number or date physically stored in multiple fields is counted as one DET when it is required as a single piece of information.

  <u>For example (EO/EQ)</u>, a pie chart might have a category label and a numerical equivalent in a graphical output. Count two DETs —one for designating the category and one for the numerical value.

- If a DET both enters and exits the boundary, count it only once for the elementary process.

- 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.

  For example (EO/EQ), if a user tries to request a listing, but does not have access to the information, count one DET for the system response.

- 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.

  For example (EO/EQ), if the user can initiate the generation of a report by clicking on the OK button or by pressing a PF key, count one DET for the ability to initiate the report.

- 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.

  For example (EO), when a paycheck is printed, a status field on the employee ILF is updated to indicate that the check has been printed. Do not count the status field as a DET since it did not cross the boundary.

- Do not count literals as DETs.

  For example (EO/EQ), literals include report titles, screen or panel identification, column headings, and field titles.

- Do not count paging variables or system-generated stamps.

  For example (EO/EQ), system-generated variables and stamps include

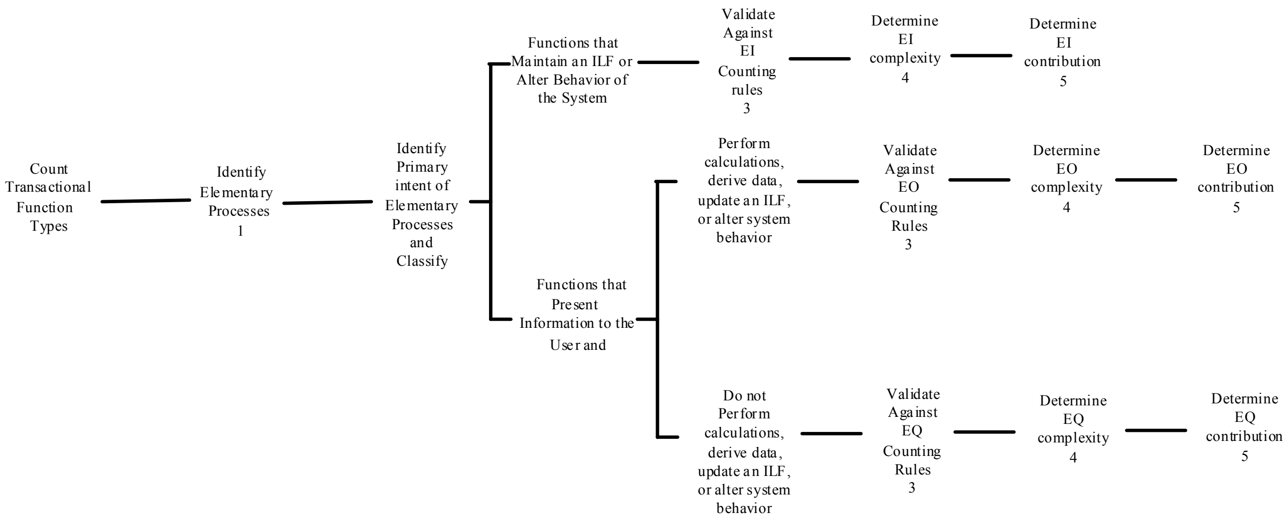
  - Page numbers
  - Positioning information such as "Rows 37 to 54 of 211"
  - Paging commands such as previous, next, and paging arrows on a GUI application
  - Date and time fields if they are displayed.

EI, EO and EQ Counting Procedures

This section includes detailed explanations of EI, EO and EQ counting procedures.

Procedure Diagram

The following diagram shows the high-level procedure for counting EIs, EOs and EQs:



The following paragraphs explain the steps for each activity.

Identification Procedures

Follow these steps to identify EIs, EOs and EQs:

Step	Action	Rule Set(s) to Use	Page #
1	Identify Elementary Processes	Elementary Process Identification Rules	7-10
2	Identify Primary Intent of Elementary Processes, and classify as an EI, EO, or EQ.	Transactional Function Type Counting Rules - Primary Intent Descriptions for:	
		• EIs	7-11
		• EOs and EQs	7-12
For the Elementary Processes where the Primary Intent is to maintain an ILF or to alter the behavior of the system:			
3	Validate against the EI identification rules.	Transactional Function Type Counting Rules: • External Input Counting Rules	7-11
4	Determine EI Complexity	Refer to Complexity and Contribution Procedures	7-21
5	Determine EI Contribution	Refer to Complexity and Contribution Procedures	7-23
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.			
3	Validate against the EO identification rules.	Transactional Function Type Counting Rules: • Shared EO and EQ Counting Rules	7-12
		• Additional EO Counting Rules	7-12

Continued on next page

Step	Action	Rule Set(s) to Use	Page #
4	Determine EO Complexity	Refer to Complexity and Contribution Procedures	7-22
5	Determine EO Contribution	Refer to Complexity and Contribution Procedures	7-23
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.			
3	Validate against the EQ identification rules.	Transactional Function Type Counting Rules: • Shared EO and EQ Counting Rules • Additional EQ Counting Rules	7-12 7-13
4	Determine EQ Complexity	Refer to Complexity and Contribution Procedures	7-22
5	Determine EQ Contribution	Refer to Complexity and Contribution Procedures	7-23

Complexity and Contribution Procedures

Follow these steps to calculate EI, EO and EQ complexity and contribution to the unadjusted function point count:

Step	Complexity Procedure
4	**External Inputs:** Use the Complexity Definitions and Rules for EIs that begin on page 7-16 to identify and count the number of FTRs and DETs. Rate the complexity of the EI using the following complexity matrix.

	1 to 4 DET	5 to 15 DET	16 or more DET
0 to 1 FTR	Low	Low	Average
2 FTRs	Low	Average	High
3 or more FTRs	Average	High	High

Step	Complexity Procedure
4	**External Outputs and External Inquiries:** Use the Complexity Definitions and Rules for EOs or EQs that begin on page 7-16 to identify and count the number of FTRs and DETs. Rate the complexity of the EOs or EQs using the following complexity matrix. Remember to use the cumulative number of FTRs and DETs, ignoring duplicates, to rate the complexity.

	1 to 5 DET	6 to 19 DET	20 or more DET
0 to 1 FTR	Low	Low	Average
2 to 3 FTRs	Low	Average	High
4 or more FTRs	Average	High	High

Step	Contribution Procedure
5	**External Inputs and External Inquiries:** Use the following table to translate the EI or EQ complexity to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	3
Average	4
High	6

Step	Contribution Procedure
5	**External Outputs:** Use the following table to translate the EO to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	4
Average	5
High	7

Hints to Help with Counting EIs, EOs and EQs

The following hints may help you apply the EI, EO and EQ counting rules.

Caution: The hints *are not* rules and should not be used as rules.

- Is data received from 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 the smallest unit of activity from the user perspective?
  - Look at the different paper or on-line forms used.
  - Review the ILFs to identify how the user groups the information.
  - Identify where the user and other application interfaces occur in the process functional decomposition.
  - Look at what happened in the manual system.
  - Note that one physical input or transaction file or screen can, when viewed logically, correspond to a number of EIs, EOs or EQs.
  - Note that two or more physical input or transaction files or screens can correspond to one EI, EO or EQ if the processing logic is identical.
- Is the process self-contained and does it leave the business in a consistent state?
  - Review other external inputs, external outputs and external inquiries to understand how the user works with the information.
  - Work through the process diagram to get hints.
  - Look at what happened in the manual system.
  - Check for consistency with other decisions.
- Is the processing logic unique from other EIs, EOs and EQs?
  - Identify batch inputs or outputs based on the processing logic required.
  - Remember that sorting or rearranging a set of data does not make processing logic unique.
- Are the data elements different from those for other EIs, EOs or EQs?
  - If the data elements appear to be a subset of the data elements of another EI, EO, or EQ, be sure two elementary processes are required by the user—one for the main data elements and one for the subsets.
- Identify the primary intent of the elementary process before classifying it as an EI, EO, or EQ.

- Identification of the elementary process(es) is based on a joint understanding or interpretation of the requirements between the user and the developers.
- Each element in a functional decomposition may not map to a unique elementary process.
- The identification of the elementary processes requires interpretation of the user requirements.
- Count only one FTR for each ILF/EIF referenced even if the ILF/EIF has multiple RETs.

Additional Hints to Help Counting EOs and EQs

- Is the process the smallest unit of activity from the user perspective?
  - An EO or EQ can be triggered by a process inside the application boundary.

    For example, the user requires that a report of all changed employee pay rates be sent to the budgeting area every 8 hours based on an internal clock.

    Situation A. The report contains employee name, SSN, and hourly pay rate which are all retrieved from the employee file. This is the smallest unit of activity from the user's perspective, contains no mathematical formulas or calculations, and no ILF is maintained in the process. This is one EQ.

    Situation B. The report contains employee name, SSN, and hourly pay rate which are all retrieved from the employee file. The report also includes the percentage pay change for the employee which is calculated from the data on the employee file. This is the smallest unit of activity from the user's perspective, and no ILF is maintained in the process However, since the process contains a mathematical formula, this is one EO.
  - Derived data for an EO does not have to be displayed on the output.

    For example, each month, a report is generated listing all employees due for appraisal in the next 30 days. The records are selected by calculating next appraisal date based on the employee's last appraisal date, which is a field on the employee file, and the current date plus 30 days. This would be counted as one EO, and not as an EQ.

Elementary Process Identification Examples

Introduction

This section uses several examples to illustrate procedures for identifying elementary processes.

Contents

This section includes the following examples:

Summary Descriptions of Elementary Process Identification Counting Examples

The examples for elementary process identification are described in the following table.

Example	Summary Description	Page
New Employee/ Dependent Data	This example shows that multiple processes can make up one elementary process.	7-29
Print a Check/ Mark It Paid	This example illustrates the concept of primary intent of an elementary process.	7-32
View Job Assignments	This example shows that entering selection criteria for a report is not an elementary process.	7-34
Print Job Assignments/ Save Criteria	This example shows explicitly saving selection criteria for a later use is a separate elementary process.	7-37
Employee/ Interview Information	This illustrates another example of multiple processes making up one elementary process.	7-39
Employee/ License Information	This is a third example of multiple processes making up one elementary process.	7-42

Example: New Employee/Dependent Data

User Requirements

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

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

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

Adding Employee Information without Dependent Information

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

The following table shows the analysis.

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

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

Adding only Dependent Information

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

The following table shows the analysis.

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

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

Adding an Employee with Dependent Information

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

The following table shows the analysis.

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

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

Send the Transaction File to the Benefits System

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

The following table shows the analysis.

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

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

Conclusions

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

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

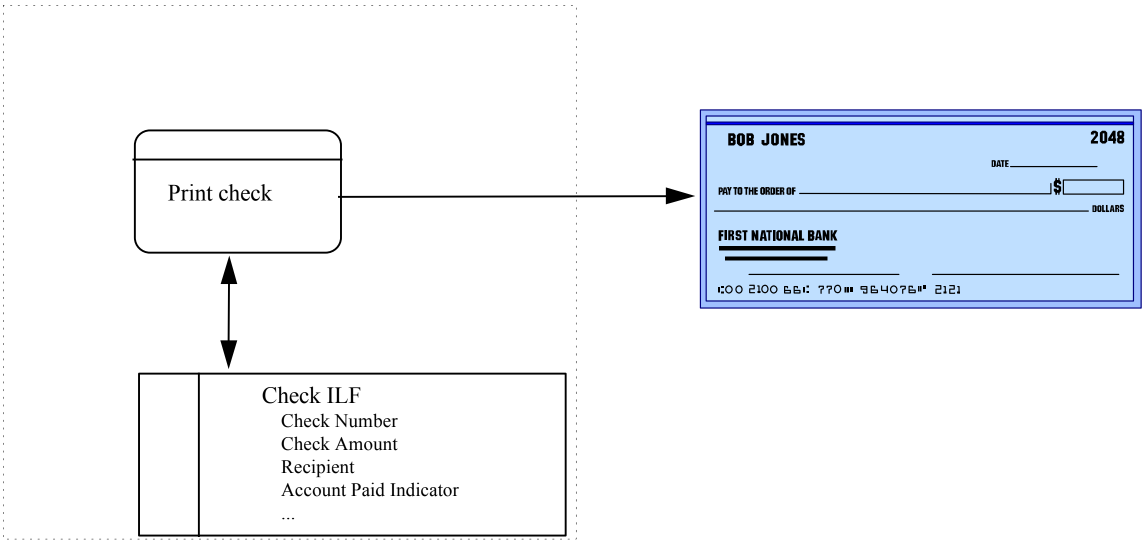
Irrespective of the implementation, there is still one elementary process, adding employee including dependents.

Example: Print a Check/Mark It Paid

User Requirements

Print a check and, as a result, mark the account as paid. All data printed on the check is already stored in the check file.

The following diagram shows the data flow for this example.



Marking the Account as Paid

Determine whether marking the account as paid is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	No, together the printing and marking the field are required to print the check.
The process is self-contained and leaves the business of the application in a consistent state.	No, the process is not meaningful by itself and both are required.

Marking the account as paid does not meet the requirements for an elementary process.

Printing the Check and Marking the Account as Paid

Determine whether printing the check and marking the account as paid is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	Yes, together the printing and marking the field are required to print the check.
The process is self-contained and leaves the business of the application in a consistent state.	Yes, the process is meaningful by itself and both printing and marking are required to complete the process.

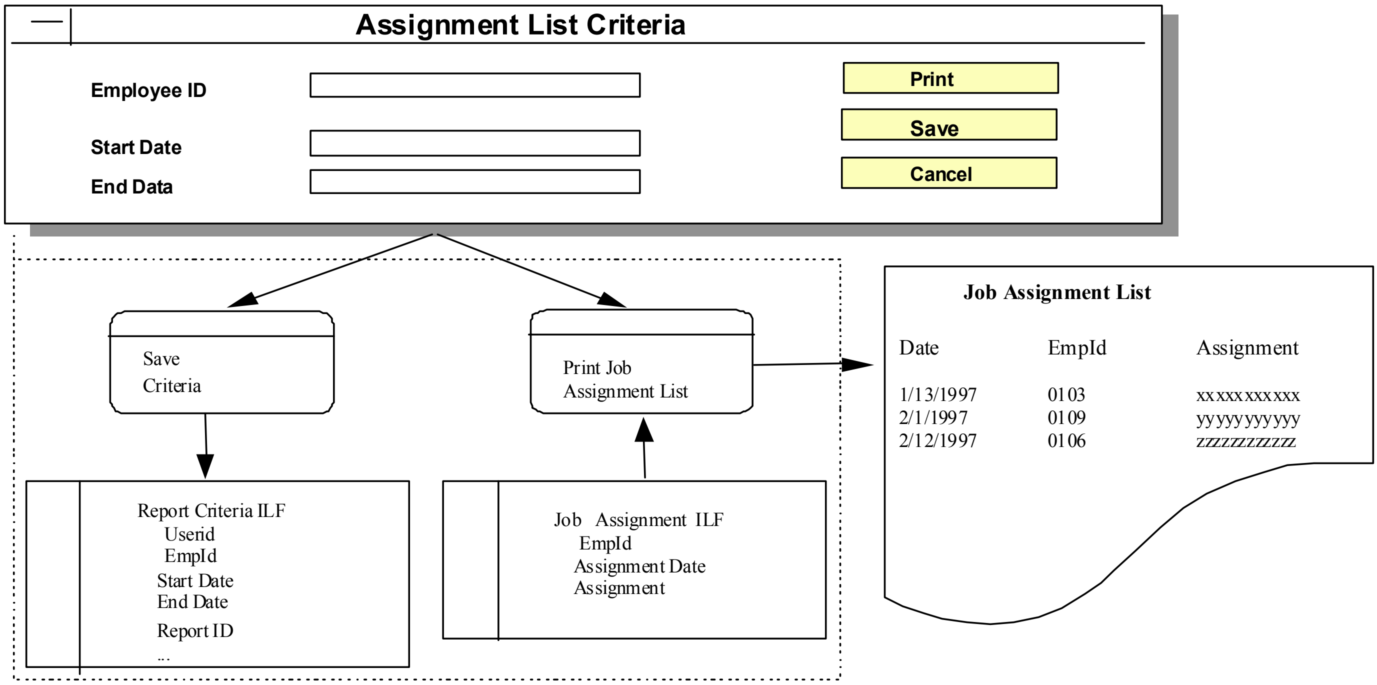
Printing the check and marking the account as paid meets the requirements for an Elementary Process.

The user requirement is to print the check. Marking the field Account Paid Indicator is part of the printing process. Printing and marking together are the smallest unit of activity that is meaningful to the user. The entire process is self-contained and leaves the business of the application in a consistent state.

Example: View Job Assignments

User Requirements View a list of the job assignments within a date range. The user will be able to enter the selection criteria. There is no requirement to store the selection criteria once the report has been generated.

The following diagram shows the data flow for this example.



Enter Selection Criteria

Determine whether entering the selection criteria (without viewing the job assignments) is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	No, together entering the selection criteria and viewing a list are required to be meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	No, it is not self-contained because it cannot be performed independently of viewing the list.

Entering the selection criteria without viewing the job assignments does not meet the requirements for an elementary process.

View Job Assignments

Determine if viewing the job assignments (without entering the selection criteria) is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	No, together entering the selection criteria and viewing a list are required to be meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	No, it is not self-contained because it cannot be performed independently by entering the selection criteria.

Viewing the job assignments without entering the selection criteria does not meet the requirements for an elementary process.

Enter Selection Criteria and View Job Assignments

Determine whether entering the selection criteria and viewing the job assignments is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	Yes, together entering the selection criteria and viewing a list are required to be meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	Yes, it is self-contained because both have to be performed to leave the business in a consistent state.

Entering the selection criteria and viewing the job assignments meets the criteria for an elementary process.

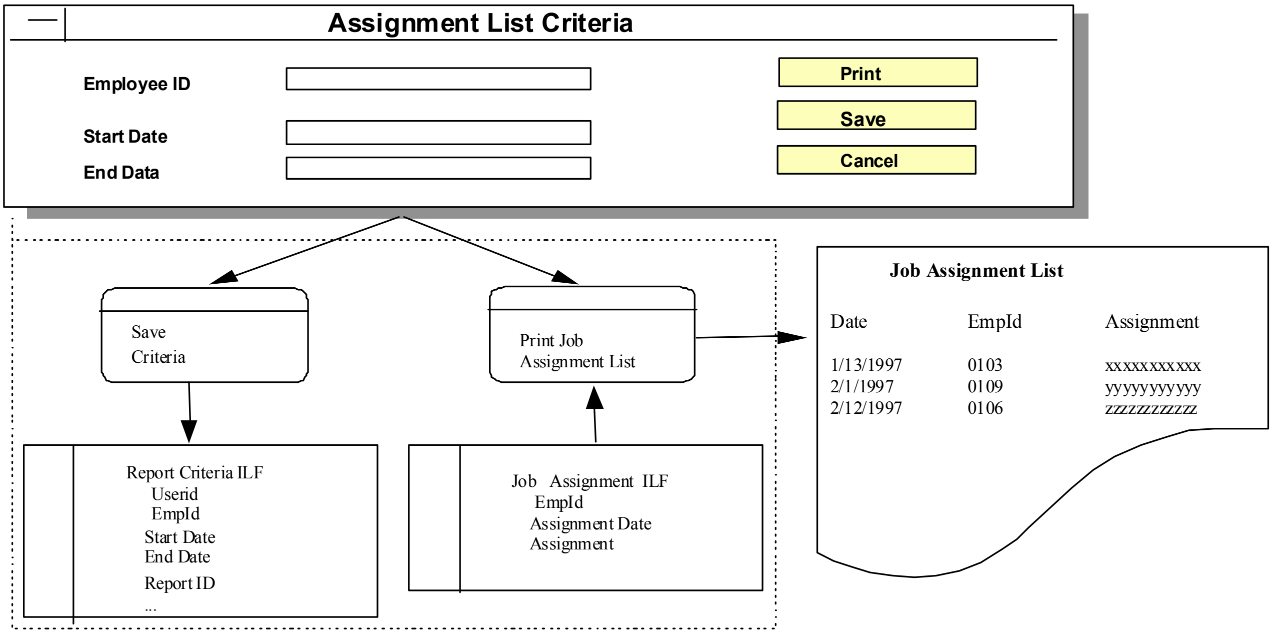
Control information is the input side of an EO or EQ. The request specifying what and/or how data is to be retrieved or generated is part of the elementary process to provide the user data and is not an elementary process itself.

Entering the selection criterion is not the smallest unit of activity that is meaningful to the user. It is not self-contained because it cannot be performed independently of producing the report. Entering the selection criteria and generating the report together comprise the smallest unit of activity that is meaningful to the user, is self-contained and leaves the business in a consistent state.

Example: Print Job Assignments/Save Criteria

User Requirements Print a list of job assignments between a date range. The user will be able to enter the selection criteria. There is a requirement to enable the user to save the selection criteria for later use.

The following diagram shows the data flow for this example.



Save Selection Criteria

Determine whether saving the selection criteria (without printing the job assignments) is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	Yes, saving the selection criteria is the smallest activity and is meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	Yes, saving the selection criteria can be performed independently of printing a list of job assignments.

Saving the selection criteria without printing the job assignments does meet the requirements for an elementary process.

Print Job Assignments

Determine whether printing the job assignments, whether or not the selection criteria, is saved, is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	Yes, printing a list of activity is the smallest activity that is meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	Yes, printing a list of activity can be performed independently of viewing a list of job assignments.

Printing the job assignments together with saving the selection criteria is an elementary process.

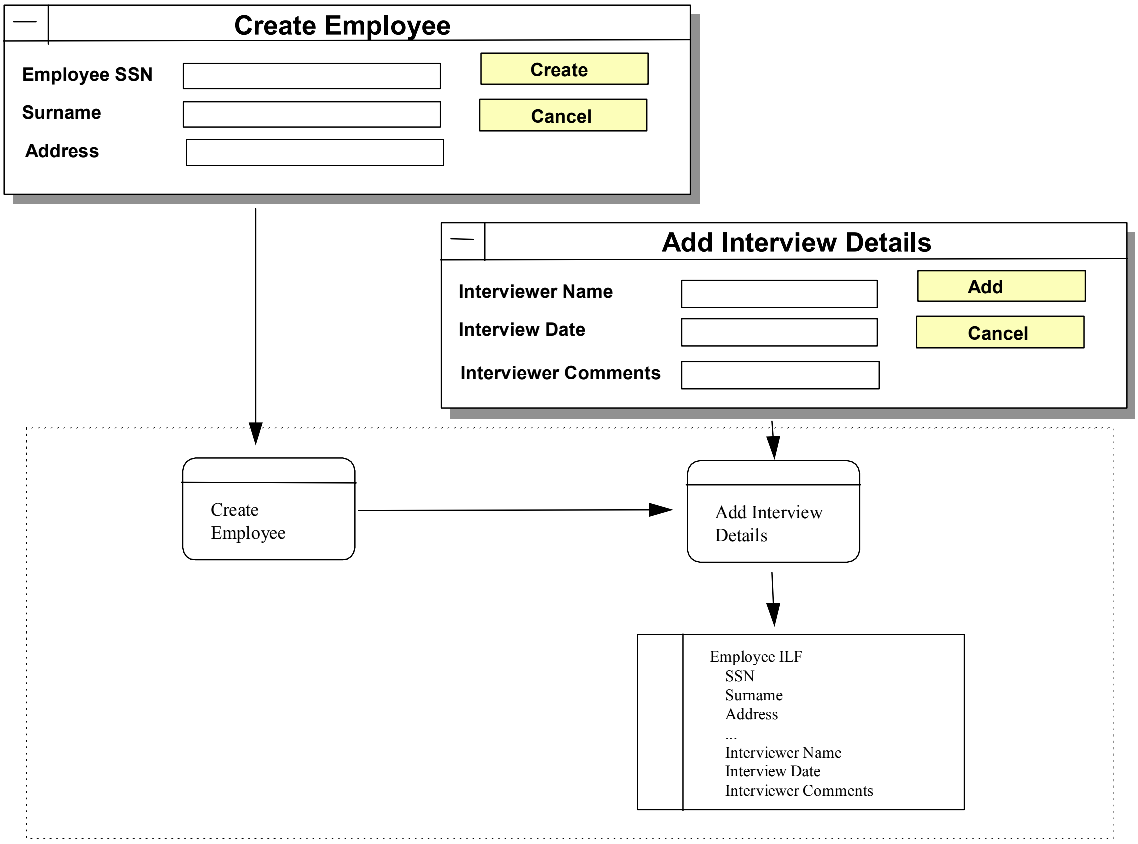
The entering of selection criteria is indeed meaningful to the user because the user can explicitly save the criteria. Either printing the report or saving the criteria can be performed independently, and both leave the business in a consistent state.

Both processes, storing the selection criteria, and generating the report, are self-contained, are meaningful to the business, and leave the business in a consistent state. According to the Elementary Process Identification Rules, there are two Elementary Processes.

Example: Employee/Interview Information

User Requirements When adding a new employee, in addition to the employee's personal data (i.e., Social Security Number, surname, address, etc.), the employee's interview details must be entered. The interview information includes the interviewer's name, the interview date, and the interviewer's comments.

The following diagram shows the data flow for this example.



Entering the Employee's Personal Data

Determine whether entering only the employee's personal information is an Elementary Process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	No, together entering the employee's personal data and entering employee's interview details are required to be meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	No, it is not self-contained because it cannot be performed independently of entering the employee's interview detail.

Entering the employee's personal information without entering the interview details does not meet the requirements for an elementary process.

Entering Employee's Interview Details

Determine if entering only the employee's interview details is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	No, together entering the employee's personal data and entering employee's interview details are required to be meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	No, it is not self-contained because it cannot be performed independently of entering the employee's personal data.

Entering the employee's interview details without the personal data does not meet the requirements for an elementary process.

Entering the Employee's Personal Data and Interview Details

Determine whether entering the employee's personal data along with the interview details is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	Yes, together entering the employee's personal data and entering employee's interview details are required to be meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	Yes, it is self-contained because it leaves the business of the application being counted in a consistent state.

Conclusion

If two input processes are always sequential and dependent (step one and step two are mandatory), then there is one elementary process and one function.

A new employee cannot be recorded until both the employee's personnel data and the employee's interview details are entered. Entering the employee's personnel data alone is not the smallest unit of activity that is meaningful to a user in the business and does not leave the business of the application in a consistent state.

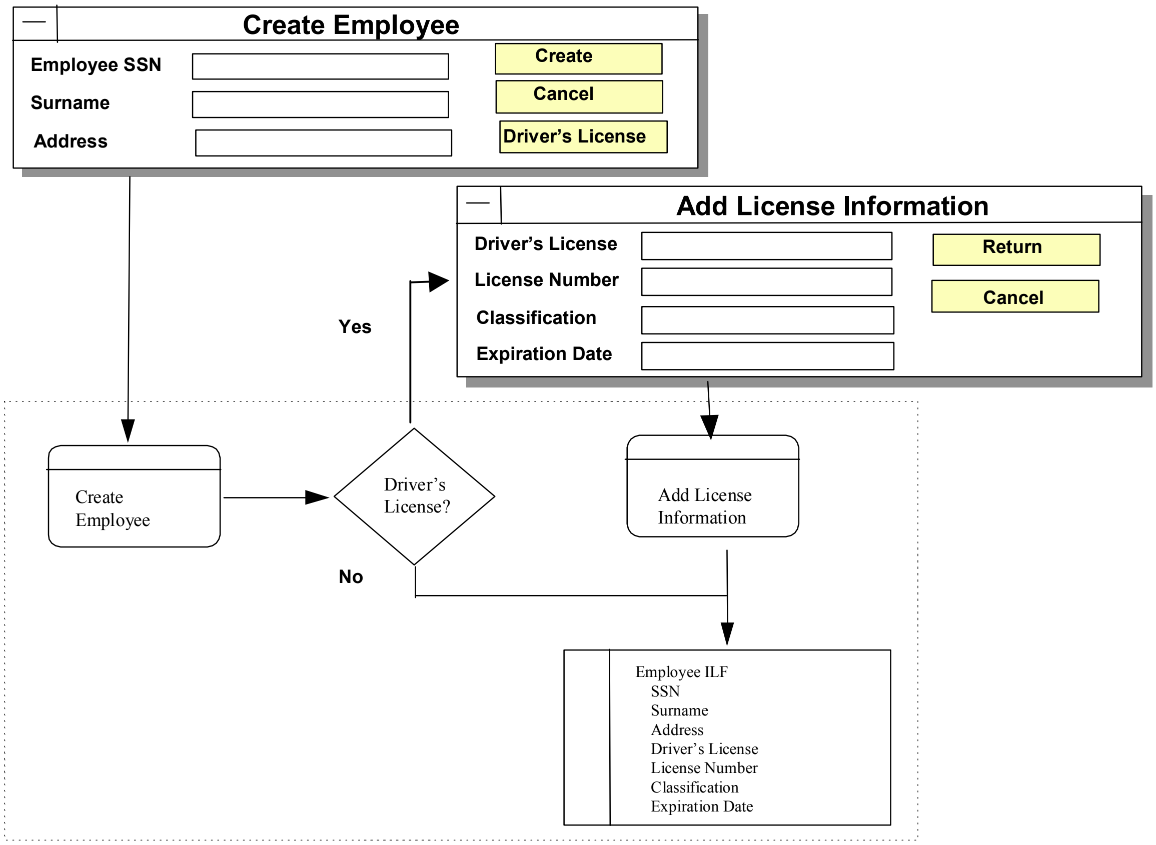
According to the Elementary Process identification rules, there is only one Elementary Process.

Example: Employee/License Information

User Requirements

When adding a new employee, the employee data is entered for Social Security Number, name, address, and whether or not the employee has a driver's license. If the employee does have a driver's license, a secondary process must be completed to record the employee's driver's license number, classification(s), and expiration date.

The following diagram shows the data flow for this example.



Adding an Employee with No Drivers License

Determine whether adding only the employee's personal information is an elementary process for an employee who does not have a driver's license.

The following table show the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	Yes, adding an employee is the smallest activity and is meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	Yes, it is self-contained, because adding an employee leaves the business of the application being counted in a consistent state.

Adding the employee information without adding the license information does meet the requirements of an elementary process for an employee without a drivers license.

Adding License Information

Determine whether entering the drivers license information without the employee's personal information is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	No, recording the employee license is not possible without the activity of adding an employee, therefore it is not meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	No, it is not self-contained because it cannot be performed independently by entering the employee's personal data.

Entering the drivers license information without entering the employee's personal information does not meet the requirements for an elementary process.

Adding Employee and License Information

Determine whether entering an employee's personal information together with the associated license information is an elementary process.

The following table shows the analysis.

Elementary Process Counting Rules	Does the Rule Apply?
The process is the smallest unit of activity that is meaningful to the user.	Yes, adding an employee and recording the employee license is the smallest activity and is meaningful to the user.
The process is self-contained and leaves the business of the application in a consistent state.	Yes, it is self-contained, because adding an employee and recording the employee license leaves the business of the application being counted in a consistent state.

Conclusion

If two input processes are always sequential and dependent, but the second process is optional (but is mandatory if it applies), then there is one elementary process.

There is one Elementary Process, Adding Employee. If an employee does not have a license the step "Add License Information" is not relevant. If an employee does have a driver's license, a secondary screen must be completed to complete the Elementary Process and leave the business of the application in a consistent state

EI/EO/EQ Counting Examples

Introduction

This section uses a Human Resources (HR) application to illustrate procedures used to count transactional functions. In addition to this section, examples are in the Case Studies included in the complementary IFPUG documentation.

Caution: The examples in this section and throughout the manual have two purposes:

1. To illustrate how the function point counting rules are applied for a given set of user requirements.
2. To enable you to practice using the counting procedures.

Each counter must:

- Analyze the specific user requirements that apply for each project or application being counted, and
- Count based on those requirements.

Contents

This section explains the organization of the examples and includes detailed examples for each transactional function.

Organization of the Counting Examples

This section explains how the examples are presented.

Outline of the Organization

The following list outlines the sequence of information in the detailed examples.

For each example:

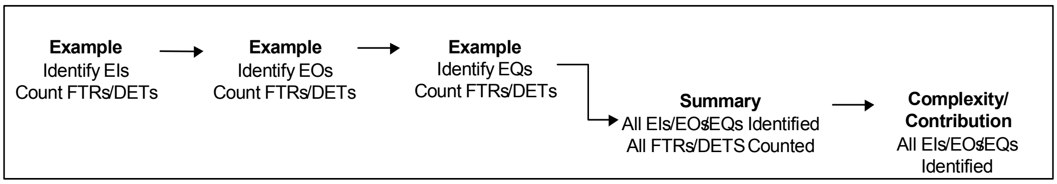
- The EIs, EOs, and EQs are identified.
- The FTRs and DETs that make up the functional complexity are counted.

For all the examples combined:

- Items that were counted and not counted as EIs, EOs, or EQs are summarized.
- The complexity and contribution to the unadjusted function point count are determined for all identified EIs, EOs, or EQs.

Diagram of the Organization

The following diagram illustrates the organization of the examples.



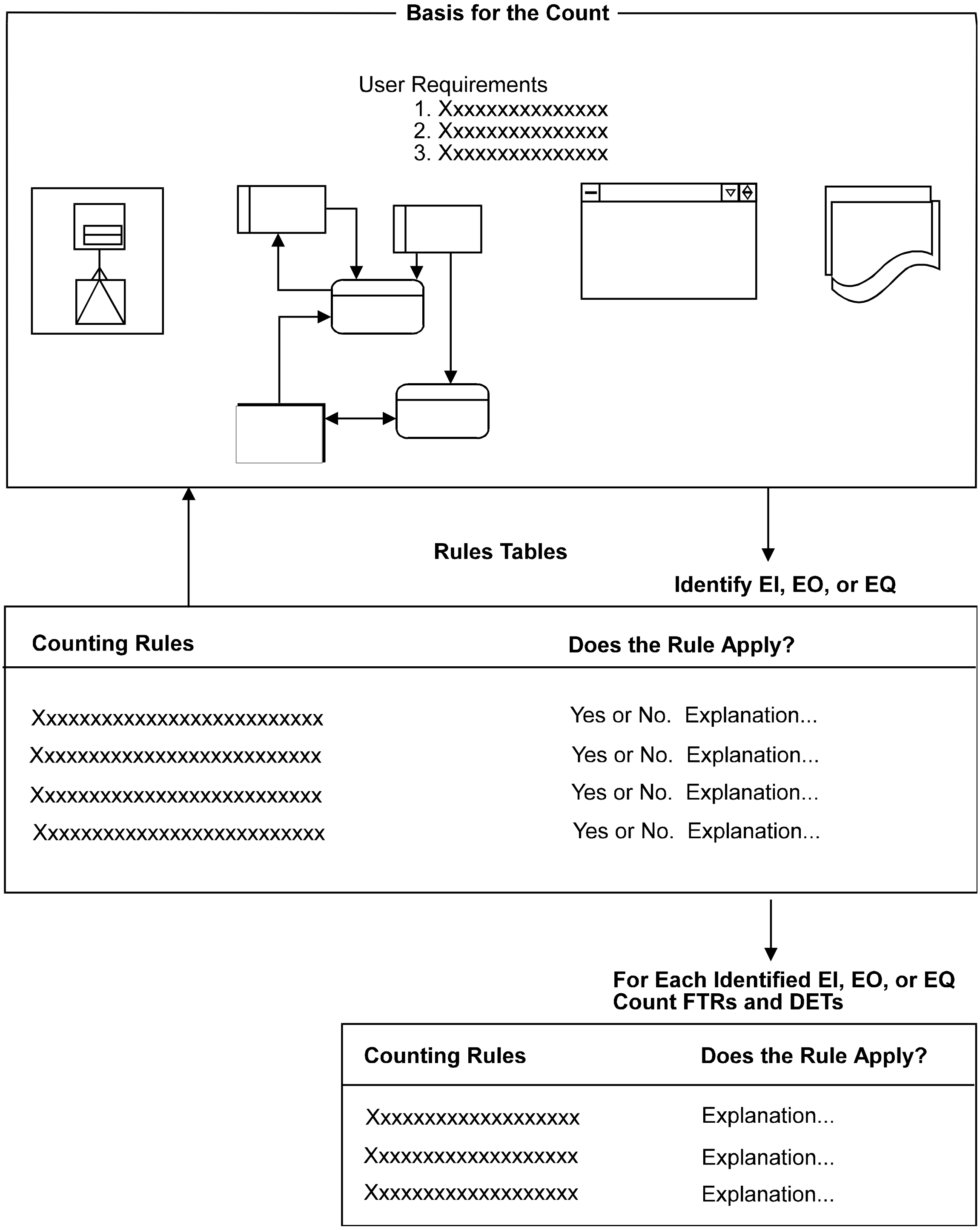
Count for Each Example

Each example includes the following components:

- Basis for the count
- Tables applying the counting rules

Diagram of Components

The following diagram illustrates the components for each example and the flow of information.



Basis for the Count

The basis for the count begins each example. As shown in the diagram of components, the count may be based on the following components included in the examples:

- User requirements
- Data and process models
- Windows, screens, or reports

Note: All components in the diagram are not included in all examples. In some examples, the requirements stand alone as the basis for the count. Other examples include a data or process model, windows, screens, and reports.

Rules Tables

The analysis to identify functions is presented in a table that lists the counting rules for the function type. The rules are applied to the components that make up the basis for the count. The analysis is explained in the table in the column "Does the Rule Apply?"

Note: If all the rules apply, the example is counted as an EI, EO, or EQ.

The next tables show the rules and explanation for types that make up the complexity for each function type identified.

Summary of EIs/EOs/EQs Identified

After all the rules are applied for each example, a summary section lists what was counted and what was not counted.

Complexity and Contribution for All EIs/EOs/EQs

The last section in the examples is the calculation of the complexity and contribution to the unadjusted function point count.

Shared Rules for All Transactional Function Types

The process to analyze all the examples follows the process described earlier in this chapter. Steps of the process are concerned with applying the rules for identifying Elementary Processes, the Primary Intent and the classification of the Transactional Function type into EI, EO, or EQ. The following tables list the rules that must be applied:

Elementary Processing Counting Rules	Does the Rule Apply?
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.	

The answer to both questions must be **'YES'** for the Transactional Function to be an Elementary Process.

Primary Intent	
EI	To maintain an ILF or alter the behavior of the system.
EO	To present information to a user.
	It presents data that is calculated or derived, it updates 1 or more ILFs, or it alters the behavior of the system.
EQ	To present information to a user.
	It presents only data that is retrieved from 1 or more ILFs or EIFs.

Use the description that best matches the primary intent of the Transactional Function type to determine whether it is an EI, EO or EQ. This can be determined by careful and accurate interpretation of the user requirements for the function.

EI Counting Examples

Introduction

This section uses a Human Resources (HR) application to illustrate procedures to count external inputs. In addition to this section, examples are in the Case Studies.

Contents

This section includes the following examples:

Summary Descriptions of EI Counting Examples

The examples for external inputs are listed and described in the following table.

Example	Summary Description	Page
Control Information	This example looks at control information used for reporting.	7-54
Screen Input	This example illustrates counting an online add transaction via a screen.	7-58
Batch with Multiple EIs and Duplicate EIs	This example shows how to count a transaction file with multiple types or formatted record types.	7-62
Correcting Suspended Transactions	This example illustrates counting making corrections to jobs suspended to a file during batch processing of adding or changing jobs.	7-66
EI with Multiple File Types Referenced	This example illustrates using a data flow diagram to count an external input that references multiple files.	7-70
Data Conversion	This example shows how to count the process of converting a group of data to a new format with additional data elements.	7-74
Referencing Data from Another Application	This example looks at why an external interface file (discussed in Chapter 6) is not counted as an external input.	7-77
EI with Screen Output –1	This example illustrates an EI with a calculated field that is displayed.	7-79
EI with Screen Output –2	This example illustrates an EI with a calculated field and embedded EQs.	7-82

Example: Control Information

User Requirements

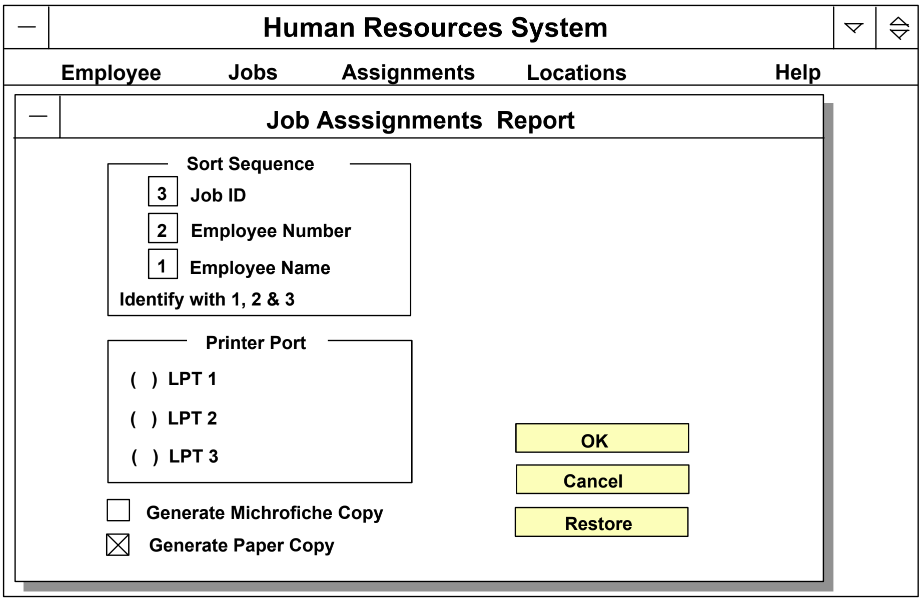
The user requires the ability to control how and when assignment reports are printed. The following list shows the specific user requirements for generating the report:

1. Control the following aspects of report processing:
   - Sort sequence
   - Printer port
   - Whether or not to generate a microfiche copy
   - Whether or not to generate a paper copy
2. Save the job assignment reporting controls.
3. Make and save changes.
4. Send a message to confirm that the controls for the assignment reports have been added or changed, and that the report is being generated.

Note: This example shows only the requirement to add the group of assignment report control information. The Case Studies illustrate counting the entire user requirement.

Example Window

The following Job Assignments Report window is used to establish controls for reporting assignments.



JR-1

OK — Processes report request

Cancel — Returns to pull down menu

Restore — Restores previous values

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

EI Counting Rules	Does the Rule Apply?
The data or control information is received from outside the application boundary.	Yes.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	The data entering the boundary will eventually be used as control data. It is business data stored on the Report Control ILF.
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.	Yes. No other EI has been identified that performs this function.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: There is 1 EI.

Step 4. Determine the Complexity

FTR Counting Rules	Does the Rule Apply?
Count an FTR for each ILF maintained.	The report control ILF is maintained.
Count an FTR for each ILF or EIF read during the processing of the external input.	The report control ILF is read.
Count only one FTR for each ILF that is both maintained and read.	The report control ILF is maintained and read. It is counted only once.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
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.	Sort Sequence, Printer Port, Output Format.
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.	Not applicable.
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.	User message.
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.	OK button.

Conclusion: The DET count is 5.

Complexity

1 FTR and 5 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EI	3 FP

Example: Screen Input

User Requirements

The user requires the ability to

- Add job information online
- Generate an error message and highlight incorrect fields so that the error may be corrected online
- Save job information added

Example Screen

The following Job Data screen is used to add a new job.

```
Action:_    7=Prior  8=Following  9=Save
                                       Job Data

Job number:       RD15379305

Job name:         May Issue - Print Covers

Pay grade:        JRNY05A


Line No           Job Description
  01              Print Covers 4-Up, Lacquer Finish.
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

F1=Help  F7=Scroll up  F8=Scroll down  F12=Cancel
```

Enter: returns to calling screen.
F12: returns to calling screen.
F1: shows screen or field level help.
Action 7: shows prior job data, if present.
F7: scrolls up 10 job description lines.
Action 8: shows following job data, if present.
F8: scrolls down 10 job description lines.

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

The following table shows the summary analysis of the user requirements using the EI data counting rules for the function, add a new job.

EI Counting Rules	Does the Rule Apply?
The data or control information is received from outside the application boundary.	Yes. Job data is received across the boundary.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	Yes, the Job ILF is maintained.
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.	Yes. The requirement to generate an error log makes the function unique.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: Adding a job is 1 EI.

Refer to the Case Studies to see how the change and delete requirements and associated screens are counted.

Step 4. Determine the Complexity

FTR Counting Rules	Does the Rule Apply?
Count an FTR for each ILF maintained.	The job ILF is read and updated.
Count an FTR for each ILF or EIF read during the processing of the external input.	The job ILF is read.
Count only one FTR for each ILF that is both maintained and read.	The job ILF is maintained and read, but it is counted only once.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
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.	Job number, Job name, Job pay grade, Job description line number (Repeated), Job description line (Repeated).
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.	Not applicable.
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.	Error messages.
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.	Add action.

Conclusion: The total DET count is 7.

Complexity

1 FTR and 7 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EI	3 FP

Example: Batch with Multiple EIs and Duplicate EIs

User Requirements

The user requires the ability to

- Add and change job information in batch mode.

Note: The focus of this example is adding a job in batch mode. The previous example looked at the online mode. The Case Studies illustrate counting all user requirements for adding jobs in both online and batch modes.

Construction Requirements

It was decided that during the batch process, any jobs not successfully updated would error into a suspense file, which will be separately maintained. (See next example)

Record Layout

The following diagram shows the record layout for this example.

```
                  1234567891012345678901234567890123456789012345678901234567890123456789012345678901234567
890
0            1         2         3         4        5         6         7         8
1                 ADD│01│SRENG│SENIOR ENGINEER INFORMATION SYSTEMS│05│
2                 ADD│02│SRENG│01│STARTS AT PAY GRADE 05       │
3                 ADD│02│SRENG│02│OTHER PAY GRADES:06 AND 07   │
4                 CHG│03│STENG│                                 │04│
5                 CHG│04│STENG│02│OTHER PAY GRADES:05 AND 06   │
6
7
9
0
1
2
3
4
5
6
7
9
0
1
2
3
4
```


Record Descriptions

The following table includes descriptions for each record type.

Record	Position	Description
01	1-3	Transaction type
	4-5	Record type
	6-10	Job number
	11-45	Job name
	46-47	Job pay grade
02	1-3	Transaction type
	4-5	Record type
	6-10	Job number
	11-12	Description line number
	13-41	Description line

Where Record Types are:

01 Add record for a new job

02 Add record for descriptions of a new job

Step 1. Identify the Elementary Process - Transaction Type 01

Does the Transactional Function meet the requirements of an Elementary Process?	No. A job without a description is not meaningful to the user.

Step 1. Identify the Elementary Process - Transaction Type 02

Does the Transactional Function meet the requirements of an Elementary Process?	No. A description cannot exist without the job it is describing. The data would be inconsistent.

Step 1. Identify the Elementary Process - Transaction Types 1 + 2

Does the Transactional Function meet the requirements of an Elementary Process?	Yes. Job and description are meaningful to the user.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

EI Counting Rules	Does the Rule Apply for combination of "Add Job Record 01 and Add Job Record 02?"
The data or control information is received from outside the application boundary.	Yes.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	Job, Suspended Job.
For the identified process, <u>one</u> of the following three statements must apply:	
• Processing logic is unique from the processing logic performed by other external inputs for the application.	Yes. This function is unique from the on-line case, however different validation rules apply, and there is a requirement concerning suspended jobs in the event of a failure.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: The combined Transaction Type 01 + 02 is 1 EI.

Step 4. Determine the Complexity

FTR Counting Rules	Does the Rule Apply?
Count an FTR for each ILF maintained.	Job, Suspended Job.
Count an FTR for each ILF or EIF read during the processing of the external input.	Job.
Count only one FTR for each ILF that is both maintained and read.	The job ILF is maintained and read, but it is counted only once.

Conclusion: The FTR count is 2.

DET Counting Rules	Does the Rule Apply?
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.	Job number, Job name, Job pay grade, Job description line number (Repeated), Job description line (Repeated). Record Type is physical therefore not counted.
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.	Not applicable.
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.	Not applicable. Errors are recorded in a suspense file.
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.	Transaction type.

Conclusion: The DET count for adding a job is 6.

Complexity

2 FTRs and 6 DETs.	Complexity is Average

Step 5. Determine the Contribution

Contribution is 1 Average Complexity EI	4 FP

Example: Correcting Suspended Transactions

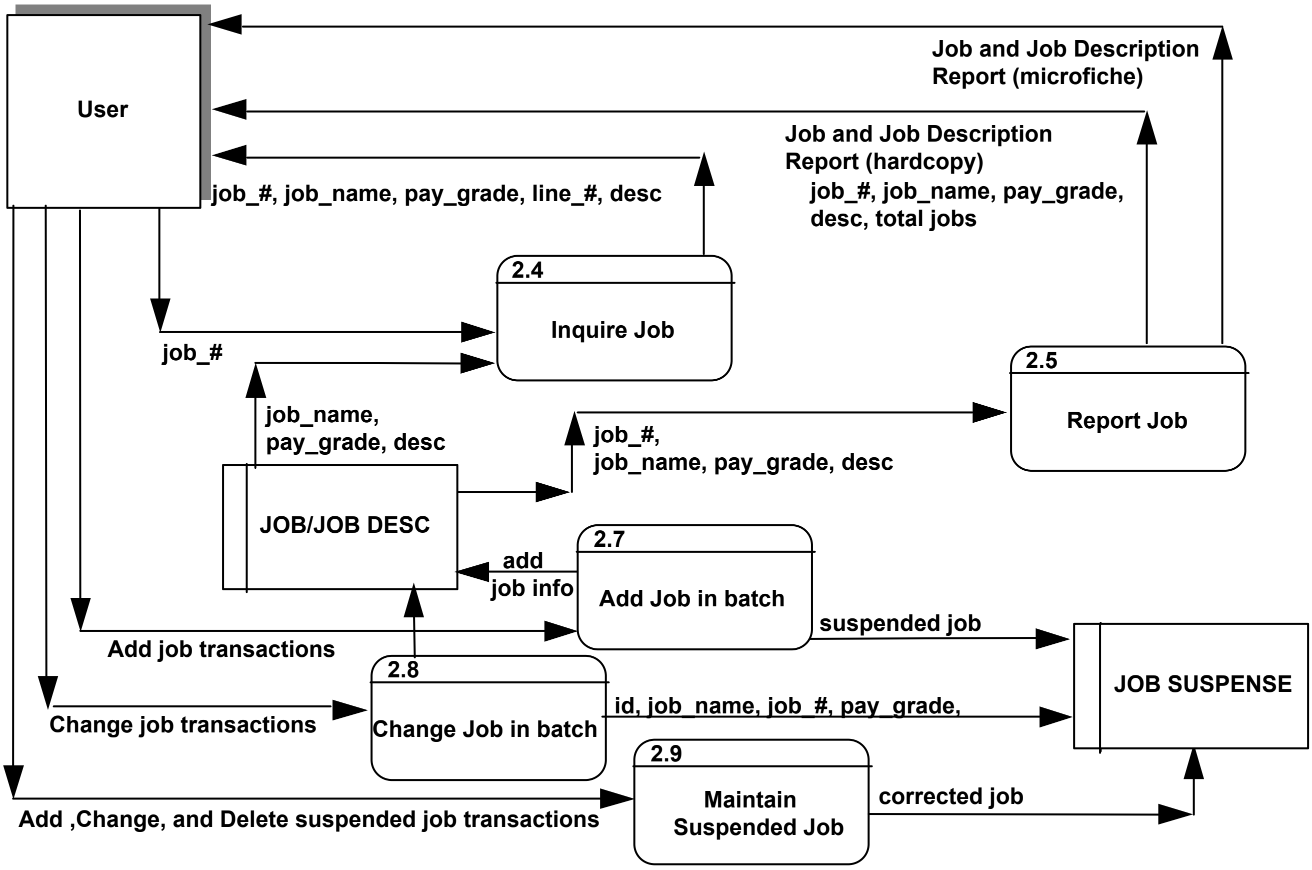
User Requirements

It was decided that during the batch process that any jobs not successfully updated would error into a suspense. The user requires a screen to access and edit the transactions that are incorrect.

Note: The focus of this example is only the requirement to correct suspended transactions. The Case Studies illustrate counting the entire user requirement.

Data Flow Diagram

The following diagram shows the data flow for this example.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

EI Counting Rules	Does the Rule Apply for the Suspense File?
The data or control information is received from outside the application boundary.	Yes. Data for correcting the transaction in error is received across the boundary.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	Yes. The suspense file is updated.
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.	Yes. No other EI has been identified that performs this function.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: There is 1 EI.

Step 4. Determine the Complexity

FTR Counting Rules	Does the Rule Apply?
Count an FTR for each ILF maintained.	Job Suspense.
Count an FTR for each ILF or EIF read during the processing of the external input.	Job Suspense.
Count only one FTR for each ILF that is both maintained and read.	Job Suspense is maintained and referenced, but it is counted only once.

Conclusion: FTR count is 1.

DET Counting Rules	Does the Rule Apply?
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.	Transaction type, Job number, Job name, Job pay grade, Job description line number (Repeated), Job description line (Repeated). The Record Type is physical and is, therefore, not counted. All other fields are user recognizable.
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.	Not applicable.
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.	There are no messages.
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.	Enter key.

Conclusion: The DET count is 7. Note that the transaction type is spaced within Job Suspense and may be maintained by the user.

Complexity

1 FTR and 7 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EI	3 FP

Example: EI with Multiple File Types Referenced

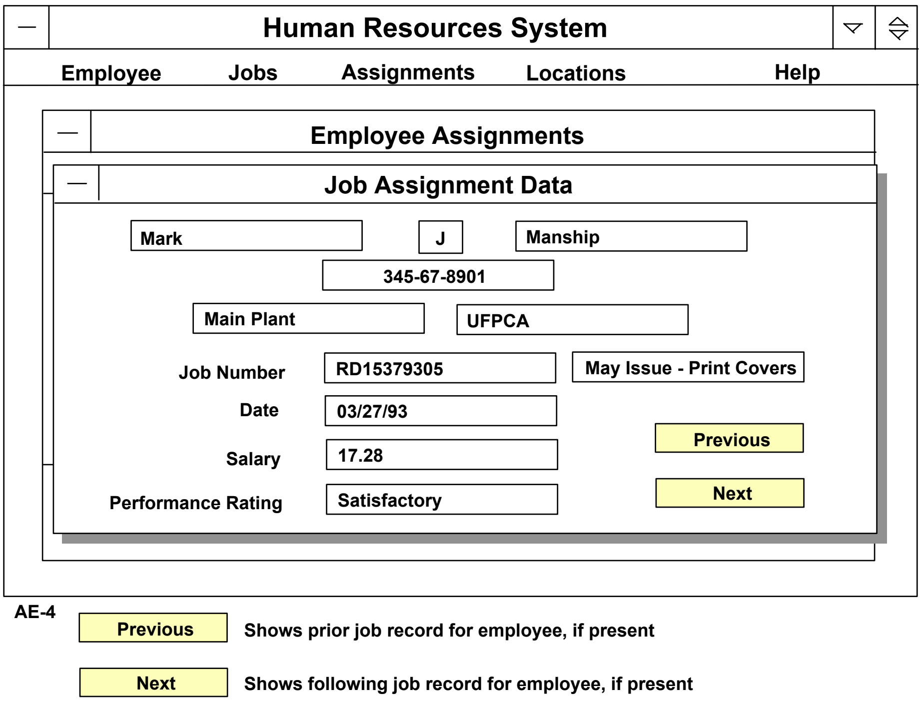
User Requirements

The user requires the ability to add job assignments.

Note: The focus of this example is only the requirement to add job assignments. The Case Studies illustrate counting the entire user requirement.

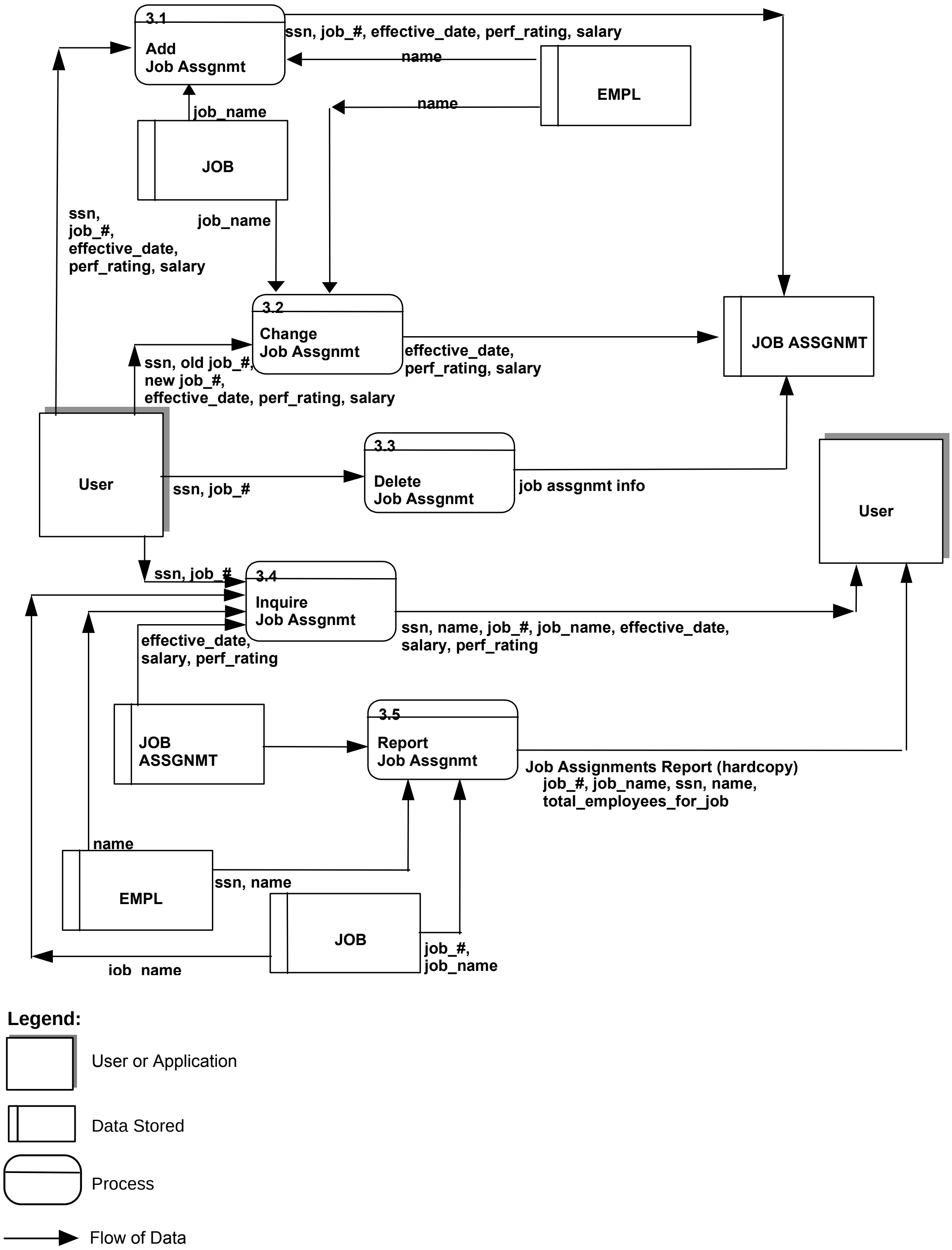
Example Window

The following diagram shows an example of the window to add job assignments.



Data Flow Diagram

The following diagram shows the data flow for the job assignment process.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

EI Counting Rules	Does the Rule Apply?
The data or control information is received from outside the application boundary.	Yes.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	Yes. The Job Assignment ILF is maintained.
For the identified process, <u>one</u> of the following three statements must apply:	
• Processing logic is unique from the processing logic performed by other external inputs for the application.	Yes. No other EI has beeen identified that performs this function.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: There is 1 EI.

Step 4. Determine the Complexity

FTR Counting Rules	Does the Rule Apply?
Count an FTR for each ILF maintained.	Job Assignment.
Count an FTR for each ILF or EIF read during the processing of the external input.	Job assignment is read. The employee ILF is read to ensure that employee exists and to display employee name. The job ILF is read to ensure that the job exists and to display job name.
Count only one FTR for each ILF that is both maintained and read.	Job assignment is both maintained and read, but it is counted only once.

Conclusion: The FTR count is 3

DET Counting Rules	Does the Rule Apply?
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.	Social security number, Job number, Effective date, Salary, Performance rating.
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.	There are no fields of this type.
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.	Error message.
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.	A command key is required to save the transaction.

Conclusion: The total DET count is 7.

Complexity

3 FTR and 7 DETs.	Complexity is High

Step 5. Determine the Contribution

Contribution is 1 High Complexity EI	6 FP

Example: Data Conversion

User Requirements

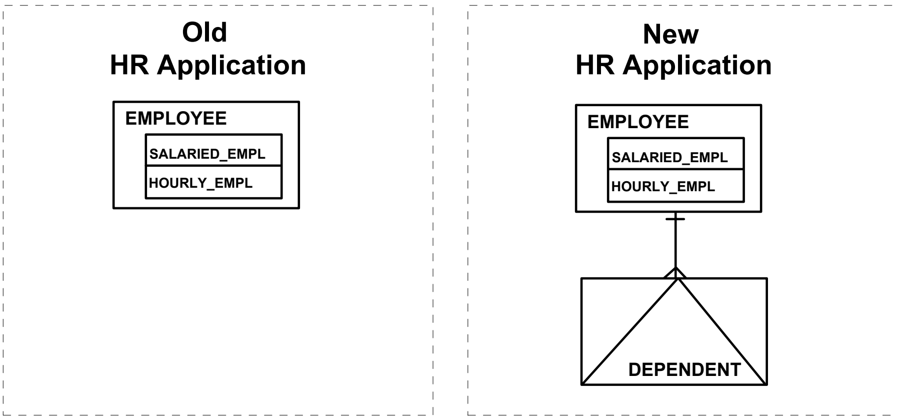
The user has purchased a new HR application package. The user requires the ability to migrate existing employee information to the new application.

The old system did not let the user maintain employee dependent's information. The dependent's information is initialized when existing employees are migrated to the new application.

Note: Chapter 9 explains how this one-time data conversion is included in the project function point counts but excluded from the application counts.

Data Diagrams

The following diagram shows the data for the old and new applications.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

EI Counting Rules	Does the Rule Apply?
The data or control information is received from outside the application boundary.	Yes. Data from the employee file of the old HR application crosses the boundary.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	Yes. The employee ILF is maintained.
For the identified process, <u>one</u> of the following three statements must apply:	
• Processing logic is unique from the processing logic performed by other external inputs for the application.	Yes. No other EI has beeen identified that performs this function using data from this source.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: There is 1 EI.

Step 4. Determine the Complexity

FTR Counting Rules	Does the Rule Apply?
Count an FTR for each ILF maintained.	The employee ILF is maintained.
Count an FTR for each ILF or EIF read during the processing of the external input.	The employee ILF is read.
Count only one FTR for each ILF that is both maintained and read.	The employee ILF is maintained and read, but it is counted only once.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
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.	Name, Social security number, Number of dependents, Type code, Supervisory level, Standard hourly rate, Collective bargaining unit number, Dependent social security number, Dependent name, Dependent birth date, Location name.
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.	There are no fields of this type.
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.	Not applicable.
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.	Not applicable.

Conclusion: The DET count is 11.

Complexity

1 FTR and 11 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EI	3 FP

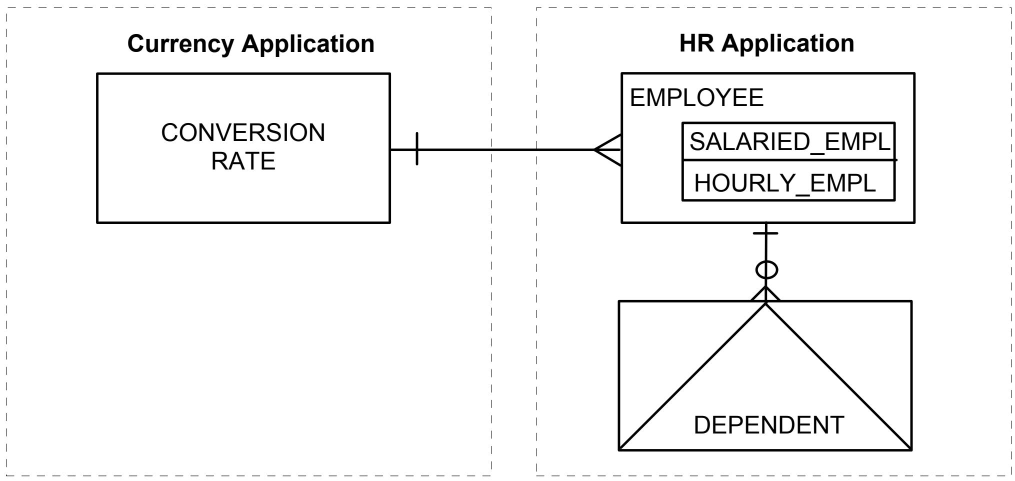
Example: Referencing Data from Another Application

User Requirements The user requires the Human Resources application to provide the following capabilities:

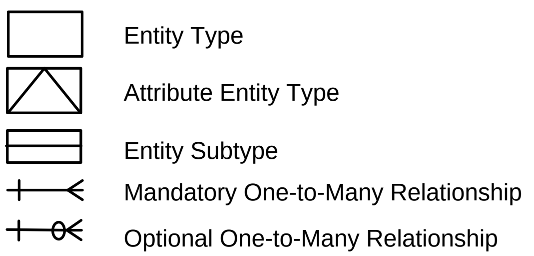
- All hourly employees must be paid in United States dollars.
- When adding or changing employee information, the Human Resources application must access the Currency application to retrieve a conversion rate. After retrieving the conversion rate, the HR application converts the employee's local standard hourly rate to a U.S. hourly rate using the following calculation:

$$\frac{\text{Standard Hourly Rate}}{\text{Conversion Rate}} = \text{U.S. Dollar Hourly Rate}$$

The following diagram shows the relationship for this example.



Legend:



Conversion Information

The conversion information includes

CURRENCY

- Conversion_Rate_To_Base_Currency
- Country

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	No. Referencing the data is only meaningful when assciated with adding an employee.

Conclusion: There is not an EI for the retrieval of conversion onformation. Refer to the EIF counting examples in Chapter 6 to see why conversion information may be counted as an EIF.

Example: EI with Screen Output - 1

User Requirements The user requires the ability to save a sales transaction for a customer. The cost of each item is to be shown, and the transaction total must be displayed for review before the information is saved.

Example Screen The following sales transaction screen is a simplification to illustrate how output fields are counted. The user enters the customer name and transaction date. As each item and quantity required is entered, the system calculates and displays the costs as shown.

```
                                 Sales Transaction

 Customer Name: __________________________________________
 Transaction Date: ________


                Item           Qty     at          Item Cost        Item Total Cost
     __________________________ _____ $____.__          $____.__
     __________________________ _____ $____.__          $____.__
     __________________________ _____ $____.__          $____.__
     __________________________ _____ $____.__          $____.__
     __________________________ _____ $____.__          $____.__
     __________________________ _____ $____.__          $____.__

                                                Sub Total $____.__
                                                Sales Tax $____.__
                                                Total     $____.__

F1=Save
```

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

EI Counting Rules	Does the Rule Apply?
The data or control information is received from outside the application boundary.	Yes. Transaction data is received across the boundary.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	Yes, the sales transaction ILF is maintained.
For the identified process, <u>one</u> of the following three statements must apply:	
• Processing logic is unique from the processing logic performed by other external inputs for the application.	Yes. No other EI has been identified that performs this function.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: There is one EI

Step 4. Determine the Complexity

FTR Counting Rules	Does the Rule Apply?
Count an FTR for each ILF maintained.	The sales transaction ILF is maintained.
Count an FTR for each ILF or EIF read during the processing of the external input.	The sales item ILF is referenced to recover the item cost.
Count only one FTR for each ILF that is both maintained and read.	Not applicable. The sales transaction ILF is maintained and read, but is counted only once.

Conclusion: The FTR count is 2.

DET Counting Rules	Does the Rule Apply?
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.	The following input DETs are counted: Customer name Transaction date Item (repeated) Quantity (repeated) The following output DETs are counted: Item cost (repeated) Item total cost (repeated) Transaction sub total Sales tax Transaction total total
Do <u>not</u> 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.	The output DETs are counted; although they are derived, they do cross the 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.	A message is returned in the event of an error.
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.	Action: The F1 key.

Conclusion: The total DET count is 11.

Complexity

2 FTRs and 11 DETs.	Complexity is Average

Step 5. Determine the Contribution

Contribution is 1 Average Complexity EI	4 FP

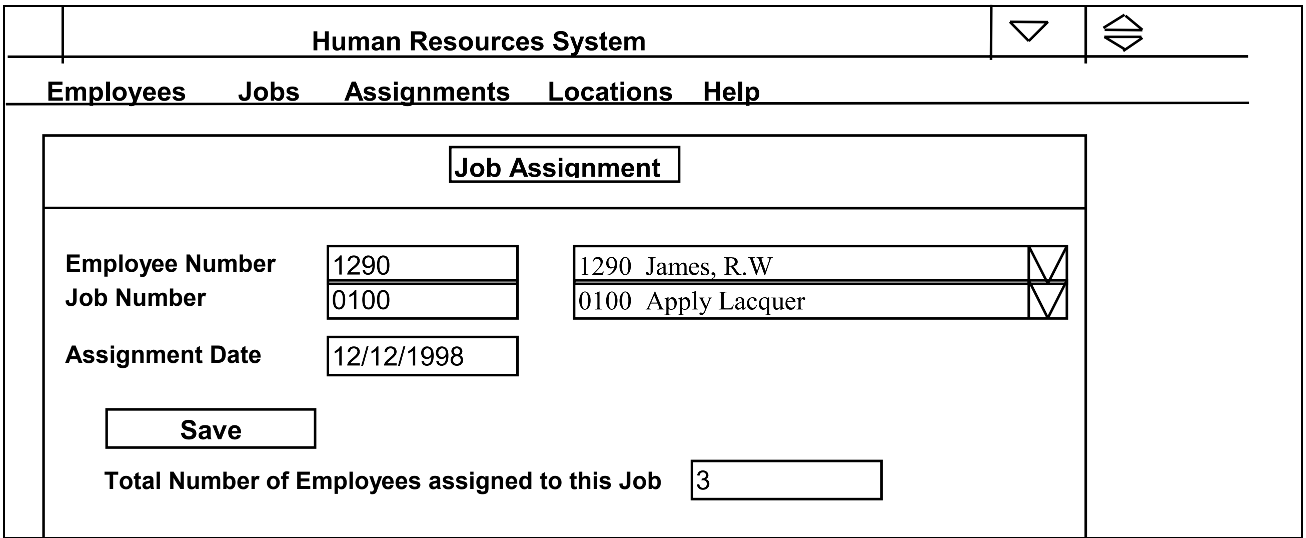
Example: EI with Screen Output - 2

User Requirements

The user requires the ability to assign a job to an employee. In order to select an employee and job, the user requires the ability to reference the employee and job files using 2 drop down lists. The employee list is required to show the employee number and name. The jobs list is required to show the job number and its description. The number of employees assigned to the job is to be displayed after the record is saved.

Example Screen

The following Job Assignment screen is a simplification to illustrate how output fields are counted. The user selects the employee from a drop down list showing the employee name and employee number. On selection, the system needs the employee number for the assignment. The user selects the job from a dropdown list showing the job number and its description. The system needs the job number for the assignment. When the assignment is saved, the systems determines the number of employees and displays it to the user.



It is clear that the inquiry on jobs and employees are two separate elementary processes (EQs); They are not analyzed here.

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EI?	Yes. The primary intent is to maintain an ILF.

Step 3. Validate against the EI Counting Rules

EI Counting Rules	Does the Rule Apply?
The data or control information is received from outside the application boundary.	Yes.
At least one ILF is maintained if the data entering the boundary is not control information that alters the behavior of the system.	Yes, the job assignment ILF is maintained.
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.	Yes. No other EI has been identified that performs this function.
• The set of data elements identified is different from the sets identified for other external inputs for the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external inputs in the application.	Not applicable.

Conclusion: Creating a Job Assignment is 1 EI.

Step 4. Determine the Complexity

FTR Counting Rules	**Does the Rule Apply?**
Count an FTR for each ILF maintained.	The job assignment ILF is maintained.
Count an FTR for each ILF or EIF read during the processing of the external input.	The job assignment ILF is read.
Count only one FTR for each ILF that is both maintained and read.	The job assignment ILF is maintained and read, but it is counted only once.

Conclusion: The FTR Count is 1.

DET Counting Rules	**Does the Rule Apply?**
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.	The following input DETs are counted: Employee number Job number Assignment date The following output DETs are counted: Employees assigned to a job The Employee name and Job name DETs in the dropdowns are not counted as DETs, as they are part of separate EQs.
Do <u>not</u> 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.	The output DET is counted, although it is derived, it does cross the 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.	A message is returned in the event of an error.
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.	There is only one way the function can be invoked, via the Save key.

Conclusion: The DET count is 6.

Complexity

1 FTR and 6 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EI	3 FP

Summary of EIs, FTRs and DETs Counted

This section gives a summary of EIs, FTRs, and DETs counted before calculating the complexity and contribution to the unadjusted function point count.

Summary of EIs Counted

The following table shows the EIs counted for the HR application. It also lists the data that was not counted.

EIs Counted	Not Counted
Control information Add job information (screen input) Add job information (batch input) Correct suspended transactions Employee job assignment Employee migration EI with Screen Output -1 EI with Screen Output -2	Referencing data from another application.

Summary FTR/DET Count

The FTR and DET counts are recorded in the following table.

External Input	FTRs	DETs
Assignment report information	1	5
Add job information (screen input)	1	7
Add job information (batch input)	2	6
Correct suspended transactions	1	7
Employee job assignment	3	7
Employee migration	1	11
EI with Screen Output -1	2	11
EI with Screen Output -2	1	6

External Input Complexity and Contribution

This last section shows the final steps to determine EI complexity and contribution to the unadjusted function point count.

The final steps are as follows:

1. Rate the EI complexity.
2. Translate the complexity to unadjusted function points.
3. Calculate the external inputs' contribution to the total unadjusted function point count.

Rate EI Complexity

The following ***complexity matrix*** rates the EI complexity.

	1 to 4 DETs	**5 to 15 DETs**	**16 or more DETs**
0 to 1 FTR	Low	Low	Average
2 FTRs	Low	Average	High
3 or more FTRs	Average	High	High

Legend:

FTR = File Type Referenced

DET = Data Element Type

The following table shows the functional complexity for each EI.

External Input	FTRs	DETs	Functional Complexity
Assignment report information	1	5	Low
Add job information (screen input)	1	7	Low
Add job information (batch input)	2	6	Average
Correct suspended jobs	1	7	Low
Employee job assignment	3	7	High
Employee migration	1	11	Low
EI with Screen Output -1	2	11	Average
EI with Screen Output -2	1	6	Low

Translate EIs The following table translates the external inputs' functional complexity to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	3
Average	4
High	6

The complexity is recorded in the table in the following section.

Calculate EI Contribution The following table shows the total contribution for the EI function type.

Function Type	Functional Complexity			Complexity Totals	Function Types Totals
EI	5	Low	X 3 =	15	
	2	Average	X 4 =	8	
	1	High	X 6 =	6	
					29

This total will be recorded on a table that lists all the functions. The final total for all functions is the unadjusted function point count.

The Appendix includes a table to record the totals for all the function types.

EO Counting Examples

Introduction This section uses a Human Resources (HR) application to illustrate procedures used to count external outputs. In addition to this section, examples are in the Case Studies included as complementary IFPUG documentation.

Contents This section includes following examples:

Summary Descriptions of EO Counting Examples

The examples for EOs are described in the following table.

Example	Summary Description	Page
Hard Copy Report Output	This example looks at counting a hard copy report.	7-92
Online Reporting	This example shows the count for an online report.	7-96
Transaction Sent to Another Application	This example illustrates a transaction generated by one application and sent to another application.	7-100
Error/Confirmation Messages	This example shows why error or confirmation messages are not counted as an external output.	7-103
Notification Message	This example illustrates how notification messages are counted.	7-104
EO Triggered without Data Crossing the Boundary	This example illustrates the concept that an EO can be triggered without data crossing the boundary.	7-108
Primary Function of an EO	This example illustrates that an EO can update a file.	7-111
EO Transaction File	This example illustrates the existence of calculations determines that the elementary process is an EO and not an EQ.	7-115

Shared Rules for All Transactional Function Types

The process to analyze all the examples follows the process described earlier in this chapter. Steps of the process are concerned with applying the rules for identifying Elementary Processes, the Primary Intent and the classification of the Transactional Function type into EI, EO, or EQ. The following tables list the rules that must be applied:

Elementary Process Counting Rules	Does the Rule Apply?
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.	

The answer to both questions must be **'YES'** for the Transactional Function to be an Elementary Process.

Primary Intent	
EI	To maintain an ILF or alter the behavior of the system.
EO	To present information to a user. It presents data that is calculated or derived, it updates 1 or more ILFs, or it alters the behavior of the system.
EQ	To present information to a user. It presents only data that is retrieved from 1 or more ILFs or EIFs.

Use the description that best matches the primary intent of the Transactional Function type to determine whether it is an EI, EO or EQ. This can be determined by careful and accurate interpretation of the user requirements for the function.

Example: Hard Copy Report Output

User Requirements

The user of the Human Resources System requires a listing of employee job assignments.

The report is generated by retrieving:

- An assignment from the job assignment ILF
- Additional information from the employee and job ILFs.

The report control ILF is referenced to determine how to generate the report.

Example Report

The following Job with Employees Report lists jobs and the employees assigned to them.

```
HRS006                      Human Resource System                        Page 1
                            Jobs with Employees                    Date 99.99.99


     Job Number   Job Name                Employee SSN  Employee Name
      9999        xxxxxxxxxx             xxx-xx-xxxx   xxxxxxxxxxxxxxx
                                         xxx-xx-xxxx   xxxxxxxxxxxxxxx
                                         xxx-xx-xxxx   xxxxxxxxxxxxxxx


      9999        xxxxxxxxxx             xxx-xx-xxxx   xxxxxxxxxxxxxxx

      9999        xxxxxxxxxx             xxx-xx-xxxx   xxxxxxxxxxxxxxx
                                         xxx-xx-xxxx   xxxxxxxxxxxxxxx



                  Total Jobs 9999
```

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EO?	Yes. The report contains a calculated field.

Step 3. Validate against the EO Counting Rules

EO Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The report data crosses the 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.	Yes. No other EO has been identified that performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
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 total number of jobs is a calculated field.
• The processing logic of the elementary process maintains at least one ILF.	Not applicable.
• The processing logic of the elementary process creates derived data.	Not applicable.

Conclusion: There is 1 EO for the Jobs with Employees Report.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Yes. The following ILFs are read: Employee Job Job assignment Report control.
Count one FTR for each ILF maintained during the processing of the elementary process.	No ILFs are maintained.
Count only one FTR for each ILF that is both maintained and read during the elementary process.	Not applicable.

Conclusion: The FTR count is 4.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	All fields are user recognizable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Total jobs, Job number, Job name, Employee SSN, Employee name are reported. Count each only once.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 5.

Complexity

4 FTRs and 5 DETs	Complexity is Average

Step 5. Determine the Contribution

Contribution is 1 Average Complexity EO	5 FP

Example: Online Reporting

User Requirements The user requires a report of employees in descending sequence by the duration of their current job assignments. This report is displayed online and contains derived data (for example, the job assignment duration).

Example Screen The following Employees by Assignment Duration screen layout lists employees by duration.

.

```
                              EMPLOYEES BY ASSIGNMENT DURATION

 Rows 1 to 18 of 1,316                                              MM/DD/YY

 Employee          Employee           Job          Job              Assignment
  SSN               Name               Number       Name              Duration

 xxx-xx-xxxx       xxxxxxxxxx         9999         xxxxxxxxxx       99 mos.
 xxx-xx-xxxx       xxxxxxxxxx         9999         xxxxxxxxxx       99 mos.

                   Employees over 24 mos. 9999

                   Employees over 12 mos. 9999




F1=Help F7=Scroll up F8=Scroll down F16=End
```

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EO?	Yes. The report contains calculated data.

Step 3. Validate against the EO Counting Rules

EO Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. Employee data leaves the 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.	Yes. No other EO has been identified that performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
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.	Yes
• The processing logic of the elementary process maintains at least one ILF.	Not applicable.
• The processing logic of the elementary process creates derived data.	Yes.

Conclusion: There is 1 EO for the Employee By Assignment Duration Report.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	The Employee, Job and Job assignment ILFs are read.
Count one FTR for each ILF maintained during the processing of the elementary process.	No ILFs are maintained.
Count only one FTR for each ILF that is both maintained and read during the elementary process.	Not applicable.

Conclusion: The FTR count is 3.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Totals of employees over 24 mos. and 12 mos., Employee SSN, Employee name, Job number, Job name, and Assignment duration are repeated. Count each only once.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 7.

Complexity

3 FTRs and 7 DETs.	Complexity is Average

Step 5. Determine the Contribution

Contribution is 1 Average Complexity EO	5 FP

Example: Transaction Sent to Another Application

User Requirements

When the Human Resources System adds employee dependent data, the user requires that this information is sent to the Benefits application to keep benefits records consistent. This information is sent to Benefits daily.

Construction Requirements

If dependent data is added, that information is formatted properly on the output transaction file.

When implementing a solution, it was decided to include a header and trailer record with the benefits information. These records are used by Benefits to ensure that nothing technically was incorrect when transmitting the file.

Example Record Layout

The following employee dependent record layout contains information about dependent additions and changes.

```
  12345678901234567890123456789012345678901234567890123456789012345678901234567890
0           1         2         3         4         5         6         7         8
1 H|FILE NAME  |DATE  |
2 D|EMP SSN  |DEP SSN  |DEPENDENT NAME     |DEPBDAY|
3 T|TOTAL REC|
4
5
6
7
9
0
1
2
3
4
5
6
7
9
0
1
2
3
4
```

Field Descriptions

The following table includes descriptions for each field on the record.

Record Type	Position	Description
Header	1	Record type H
	2-13	File name
	14-19	Date created
Dependent	1	Record type D
	2-10	Employee social security number
	11-19	Dependent social security number
	20-39	Dependent name
	40-45	Dependent birth date
Trailer	1	Record type T
	2-10	Total number of records

Step 1. Identify the Elementary Process - Header

Does the Transactional Function meet the requirements of an Elementary Process?	No. The header contains no user meaningful data.

Step 1. Identify the Elementary Process - Trailer

Does the Transactional Function meet the requirements of an Elementary Process?	No. The trailer contains no user meaningful data.

Step 1. Identify the Elementary Process - Dependent

Does the Transactional Function meet the requirements of an Elementary Process?	Yes. The dependent section of the transaction file satisfies the requirement for an EP.

Step 2. Determine the Primary Intent, and Classify - Dependent

Does the Transactional Function satisfy the Primary Intent of an EO?	Unsure, must review EO rules.

Step 3. Validate against the EO Counting Rules to the dependent section

EO Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The output transaction file contains the data being transfered to the Benefits application.
For the identified process, <u>one</u> 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.	Yes. No other EO has been identified that performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
For the identified process, <u>one</u> of the following three statements must apply:	
• The processing logic of the elementary process contains at least one mathematical formula or calculation.	No.
• The processing logic of the elementary process maintains at least one ILF.	No.
• The processing logic of the elementary process creates derived data.	No.

Conclusion: This function does not qualify as an EO; it would be counted as an EQ (not analyzed here).

Example: Error/Confirmation Messages

User Requirements Users require message feedback when job information is maintained. More specifically, users require messages to indicate any edit or validation errors or to indicate that the process completed successfully.

Example Screen The following Job screen shows a confirmation message (bottom of screen).

```
Action:_   7=Prior  8=Following
                                       Job Data

Job number:       RD15379305

Job name:         May Issue - Print Covers

Pay grade:        JRNY05A


Line No           Job Description
  01              Print Covers 4-Up, Lacquer Finish.
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

F1=Help  F7=Scroll up  F8=Scroll down  F12=Cancel
Processing Completed Successfully
```

Enter: returns to calling screen. F12: returns to calling screen.
F1: shows screen or field level help. Action 7: shows prior job data, if present.
F7: scrolls up 10 job description lines. Action 8: shows following job data, if present.
F8: scrolls down 10 job description lines.

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	No. The output of an error message is not an EP. It is a DET on the EI.

No further analysis is required.

Example: Notification Message

User Requirements The user requires automatic notification when an employee has completed 12 months in a job assignment. This indicates that a performance review should be completed.

Example Window The following Performance Review Notification window describes the notification message.

Performance Review Notification

Date: xx/xx/xx **Time: hh.mm**

Employee: xxx-xx-xxxx **x________________x**

Has completed 12 months in assignment:

Job: xxxx **x______________________x**

And should be scheduled for a performance review immediately.

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EO?	Yes. The 12 Month completion date is calculated.

Step 3. Validate against the EO Counting Rules

EO Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The notification data cross the boundary.
For the identified process, <u>one</u> 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.	Yes. No other EO performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
For the identified process, <u>one</u> of the following three statements must apply:	
• The processing logic of the elementary process contains at least one mathematical formula or calculation.	12 month completion date is calculated.
• The processing logic of the elementary process maintains at least one ILF.	Not applicable.
• The processing logic of the elementary process creates derived data.	Not applicable.

Conclusion: The notification message is an EO.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Employee, Job, Job assignment.
Count one FTR for each ILF maintained during the processing of the elementary process.	Not applicable.
Count only one FTR for each ILF that is both maintained and read during the elementary process.	Not applicable.

Conclusion: The FTR count is 3.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Employee social security number, Employee name, Job number, Job name.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 4.

Complexity

3 FTR and 4 DETs.	Complexity is Low

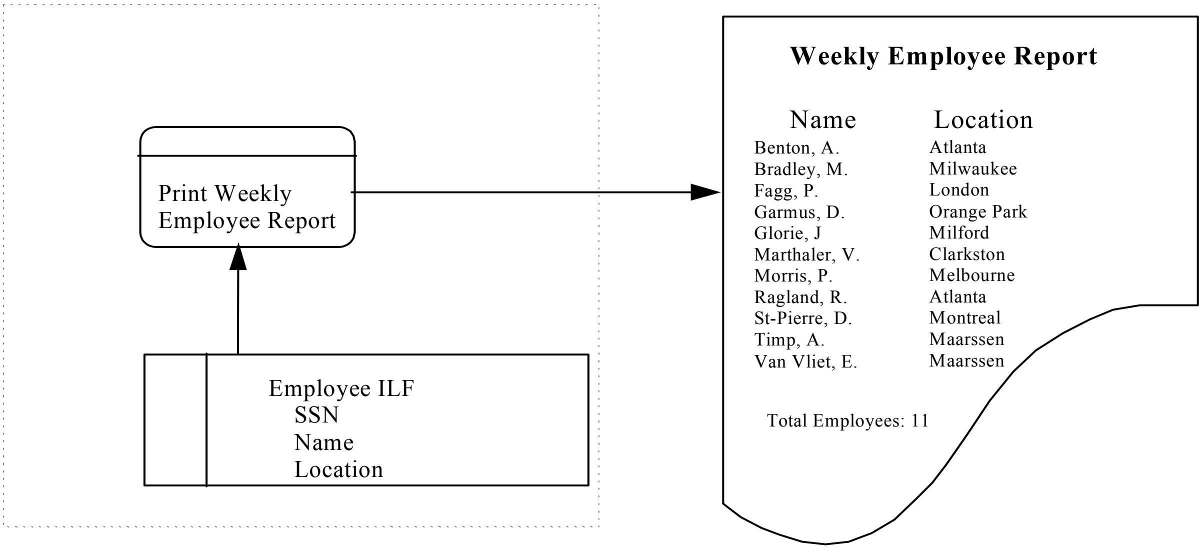
Step 5. Determine the Contribution

Contribution is 1 Low Complexity EO	4 FP

Example: EO Triggered without Data Crossing the Boundary

User Requirement: Users require that the application print the Weekly Employee Report automatically every Sunday night at 11:00 p.m. The report contains details for each employee plus a total of the employees.

Data Model The following diagram shows the data flow for this example.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EO?	Yes. The report contains a calculated field.

Step 3. Validate against the EO Counting Rules

EO Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The report data crosses the 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.	Yes. No other EO performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
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.	Yes. Total employees is calculated.
• The processing logic of the elementary process maintains at least one ILF.	Not applicable.
• The processing logic of the elementary process creates derived data.	Not applicable.

Conclusion: The weekly employee report is an EO.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Employee.
Count one FTR for each ILF maintained during the processing of the elementary process.	No ILF is maintained.
Count only one FTR for each ILF that is both maintained and read during the elementary process.	Not applicable.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Name, Location,Total Employees.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 3.

Complexity

1 FTR and 3 DETs.	Complexity is Low

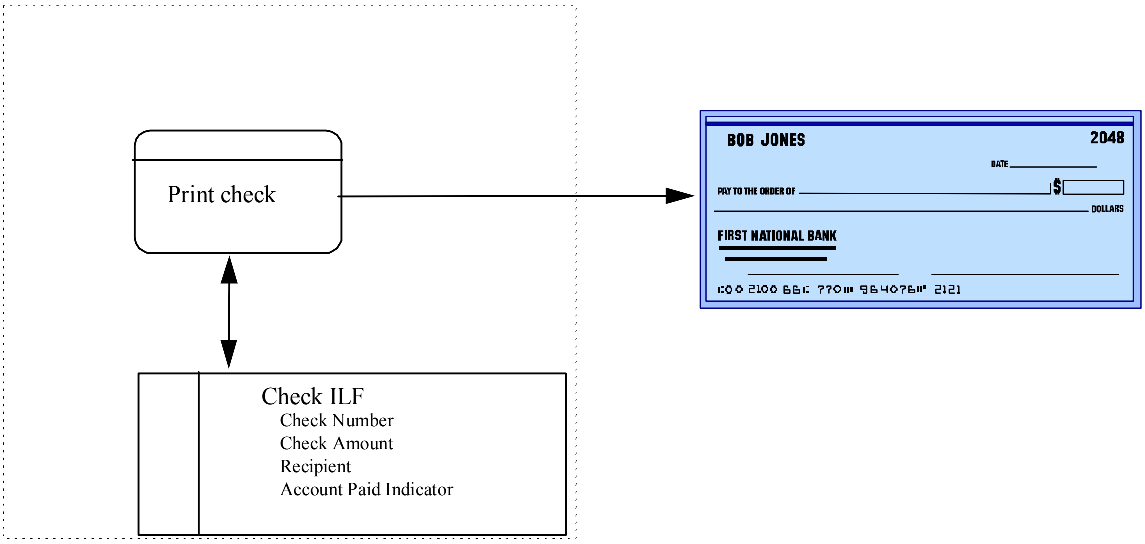
Step 5. Determine the Contribution

Contribution is 1 Low Complexity EO	4 FP

Example: Primary Function of an EO

User Requirements Print a check and, as a result, mark the account as paid. All data printed on the check was already stored in the check file.

The following diagram shows the data flow for this example.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EO?	Yes. The primary intent is to print a check. The maintenance of the ILF is secondary.

Step 3. Validate against the EO Counting Rules

EO Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The check information crosses the boundary.
For the identified process, <u>one</u> 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.	Yes. No other EO performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
For the identified process, <u>one</u> of the following three statements must apply:	
• The processing logic of the elementary process contains at least one mathematical formula or calculation.	Not applicable.
• The processing logic of the elementary process maintains at least one ILF.	Yes. The check ILF is updated.
• The processing logic of the elementary process creates derived data.	Not applicable.

Conclusion: There is 1 EO.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	The check ILF is read.
Count one FTR for each ILF maintained during the processing of the elementary process.	The check file is maintained.
Count only one FTR for each ILF that is both maintained and read during the elementary process.	The check ILF is read and maintained, count only once.

Conclusion: FTR count is 1.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Check number, Check amount, Recipient. The Account paid indicator is not counted as it does not cross the boundary. The date is neither stored or printed.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 3.

Complexity

1 FTR and 3 DETs.	Complexity is Low

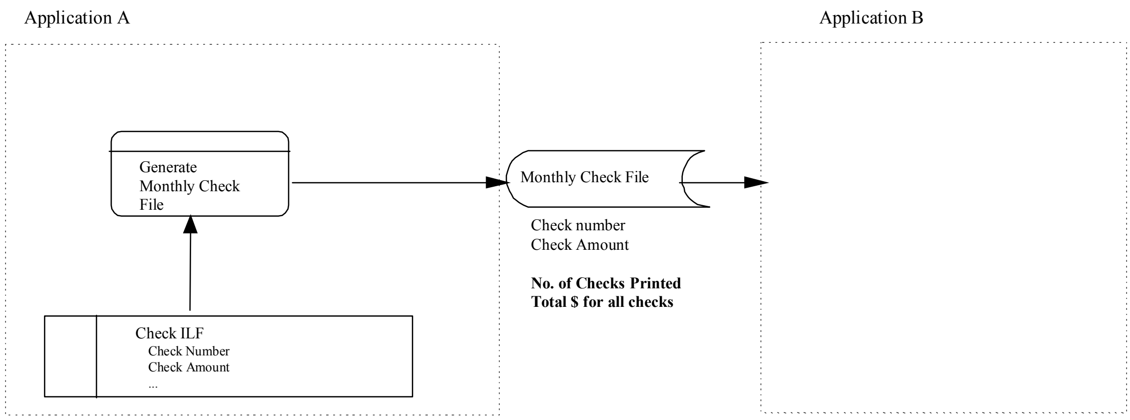
Step 5. Determine the Contribution

Contribution is 1 Low Complexity EO	4 FP

Example: EO Transaction File

User Requirements At the end of the month, generate a transaction file and send it to Application B. The check numbers and amounts are included on the file with a computed count of the checks processed and the total amount of all of the checks printed for the month.

Data Model The following diagram shows the data flow for this example.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EO?	Yes. The primary intent is to generate a transaction file. It includes calculated fields.

Step 3. Validate against the EO Counting Rules

EO Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. Transaction data exits the application.
For the identified process, <u>one</u> 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.	Yes. No other EO performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
For the identified process, <u>one</u> of the following three statements must apply:	
• The processing logic of the elementary process contains at least one mathematical formula or calculation.	Yes. The number of checks and the total value are calculated.
• The processing logic of the elementary process maintains at least one ILF.	Not applicable.
• The processing logic of the elementary process creates derived data.	Not applicable.

Conclusion: There is 1 EO.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	The Check ILF is read.
Count one FTR for each ILF maintained during the processing of the elementary process.	Not applicable.
Count only one FTR for each ILF that is both maintained and read during the elementary process.	Not applicable.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Check number, Amount, No. of checks printed, Total $ for all checks.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 4.

Complexity

1 FTR and 4 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EO	4 FP

Summary of EOs, FTRs and DETs Counted

This section gives a summary of the EOs, FTRs, and DETs counted before calculating the complexity and contribution to the unadjusted function point count.

Summary of EOs Counted

The following table shows the EOs counted for the HR application. It also lists the data that was not counted.

EOs Counted	Not Counted
Jobs with Employees Report	New dependent transactions to benefits
Employees by Assignment Duration Report	error/confirmation messages
Performance Review Notification	
Weekly Employee Report	
Printed Check	
Check Transaction File	

Summary FTR/DET Count

The FTR and DET counts are recorded in the following table.

External Output	FTRs	DETs
Jobs with Employees Report	4	5
Employees by Assignment Duration Report	3	7
Performance Review Notification	3	4
Weekly Employee Report	1	3
Printed Check	1	3
Check Transaction File	1	4

External Output Complexity and Contribution

This last section of the EO examples shows the final steps to determine EO complexity and contribution to the unadjusted function point count.

The final steps are as follows:

1. Rate the EO complexity.
2. Translate the complexity to unadjusted function points.
3. Calculate the external outputs' contribution to the total unadjusted function point count.

Rate EO Complexity

The following ***complexity matrix*** rates the EO complexity.

	1 to 5 DETs	**6 to 19 DETs**	**20 or more DETs**
0 to 1 FTR	Low	Low	Average
2 to 3 FTRs	Low	Average	High
4 or more FTRs	Average	High	High

Legend:

FTR = File Type Referenced (Combination of input and output side)

DET = Data Element Type (Combination of input and output side)

The following table shows the functional complexity for each EO.

External Output	**FTRs**	**DETs**	**Functional Complexity**
Jobs with Employees Report	4	5	Average
Employees by Assignment Duration Report	3	7	Average
Performance Review Notification	3	4	Low
Weekly Employee Report	1	3	Low
Printed Check	1	3	Low
Check Transaction File	1	4	Low

Translate EOs

The following table translates the external outputs' functional complexity to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	4
Average	5
High	7

The complexity is recorded in the table in the following section.

Calculate EO Contribution

The following table shows the total contribution for the EO function type.

Function Type	Functional Complexity			Complexity Totals	Function Types Totals
EO	4	Low	X 4 =	16	
	2	Average	X 5 =	10	
	0	High	X 7 =	0	
					26

This total will be recorded on a table that lists all the function types. The final total for all function types is the unadjusted function point count.

The Appendix includes a table to record the totals for all the function types.

EQ Counting Examples

Introduction

This section uses a Human Resources (HR) application to illustrate procedures to count external inquiries. In addition to this section, examples are in the Case Studies included in the complementary IFPUG documentation.

Contents

This section includes the following examples:

Shared Rules for All Transactional Function Types

The process to analyze all the examples follows the process described earlier in this chapter. Steps of the process are concerned with applying the rules for identifying Elementary Processes, the Primary Intent and the classification of the Transactional Function type into EI, EO, or EQ. The following tables list the rules that must be applied:

Elementary Process Counting Rules	Does the Rule Apply?
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.	

The answer to both questions must be **'YES'** for the Transactional Function to be an Elementary Process.

Primary Intent	
EI	To maintain an ILF or alter the behavior of the system.
EO	To present information to a user.
	It presents data that is calculated or derived, it updates 1 or more ILFs, or it alters the behavior of the system.
EQ	To present information to a user.
	It presents only data that is retrieved from 1 or more ILFs or EIFs.

Use the description that best matches the primary intent of the Transactional Function type to determine whether it is an EI, EO or EQ. This can be determined by careful and accurate interpretation of the user requirements for the function.

Summary Descriptions of EQ Counting Examples

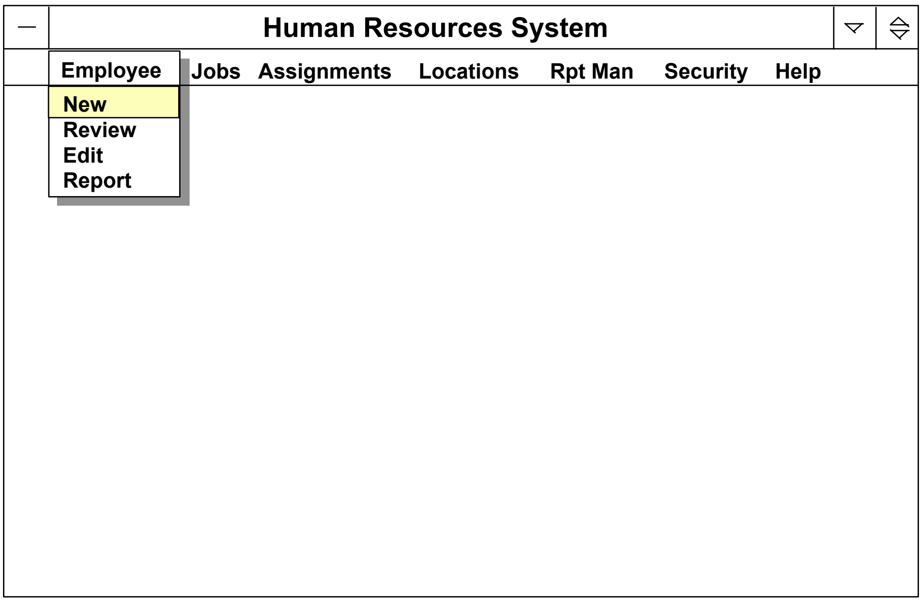
The examples for EQs are listed and described in the following table.

Example	Summary Description	Page
Application Menus	This example shows why navigational menus or other navigational aids are not counted as EQs.	7-126
List of Retrieved Data	This example illustrates the count for a list.	7-128
Drop-Down List Box	This example shows how a drop-down list box is counted.	7-133
Field Level Help–First Occurrence	This example illustrates how field level help is counted for the first occurrence.	7-137
Field Level Help–Second Occurrence	Counting a second instance of field level help is shown in this example.	7-141
Implied Inquiry	This example shows the function point count when data retrieval is not explicitly stated but it is implied.	7-144
EQ Triggered without Data Crossing the Boundary	This example illustrates the count for data retrieval and display triggered internally by time.	7-147
Transaction Sent to Another Application	This example illustrates the count of data sent to another application via a file.	7-150

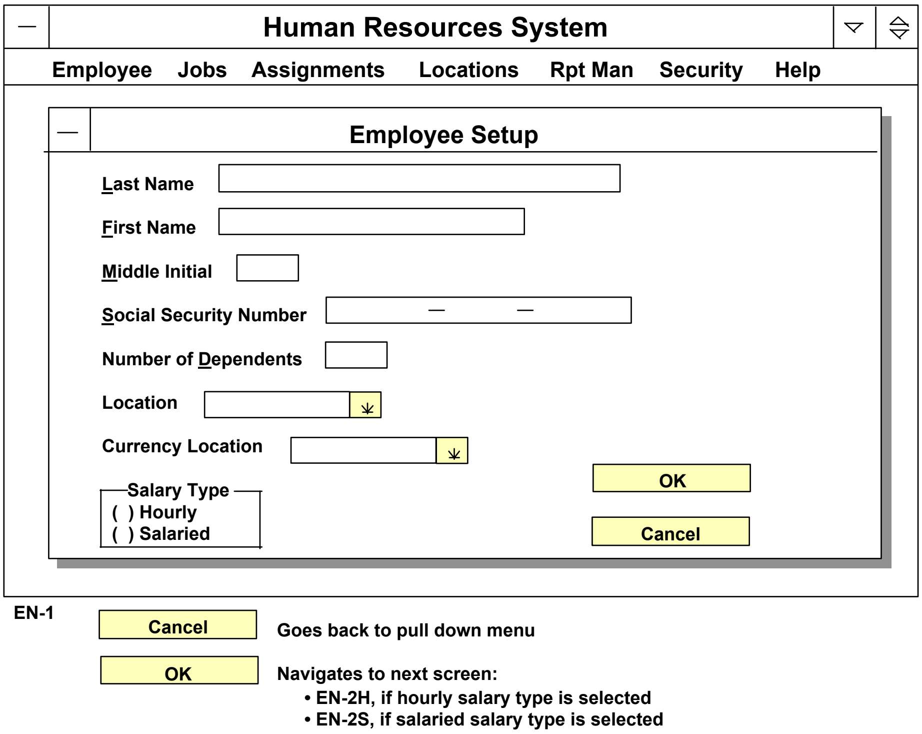
Example: Application Menus

User Requirements The Human Resources application requires navigation menus and aids.

Counting Process The following diagram shows the Employee drop-down menu on the Human Resources System main menu. This is the input request.



When the user selects New on the Employee drop-down menu, the following empty Employee Setup window is displayed.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	No. Selection from a menu of options does not include any data meaningful to the user.

Conclusion: There is no elementary process.

Example: List of Retrieved Data

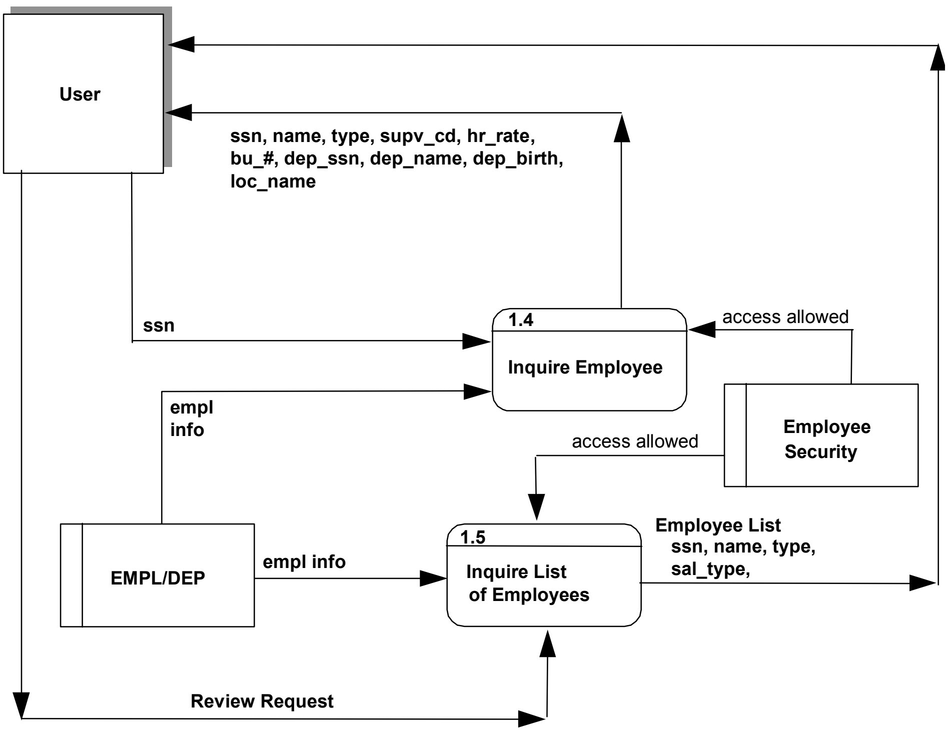
User Requirements

The user has the following requirements:

- View a list of employees.

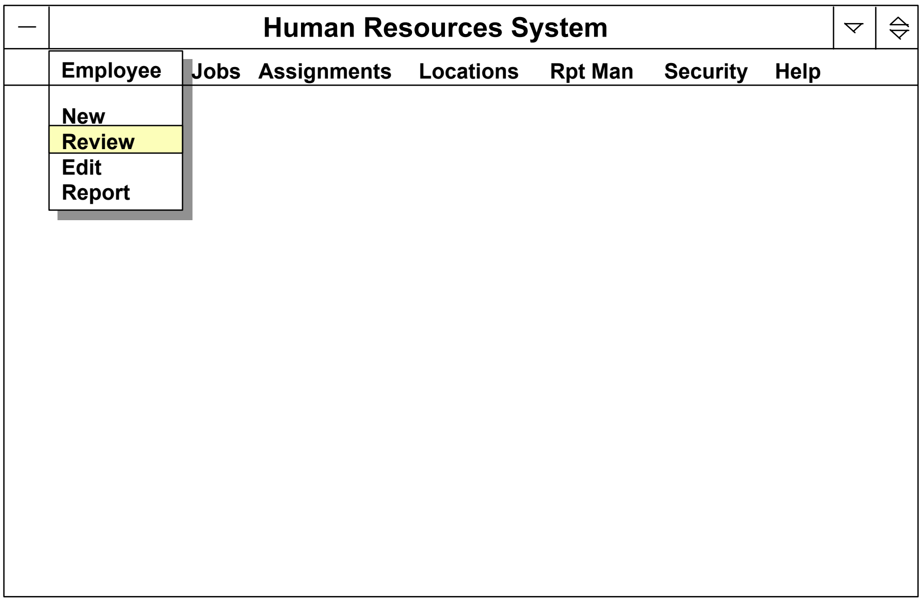
This example focuses on viewing a list of employees in the Human Resources application.

The following diagram shows the data flow for this example.

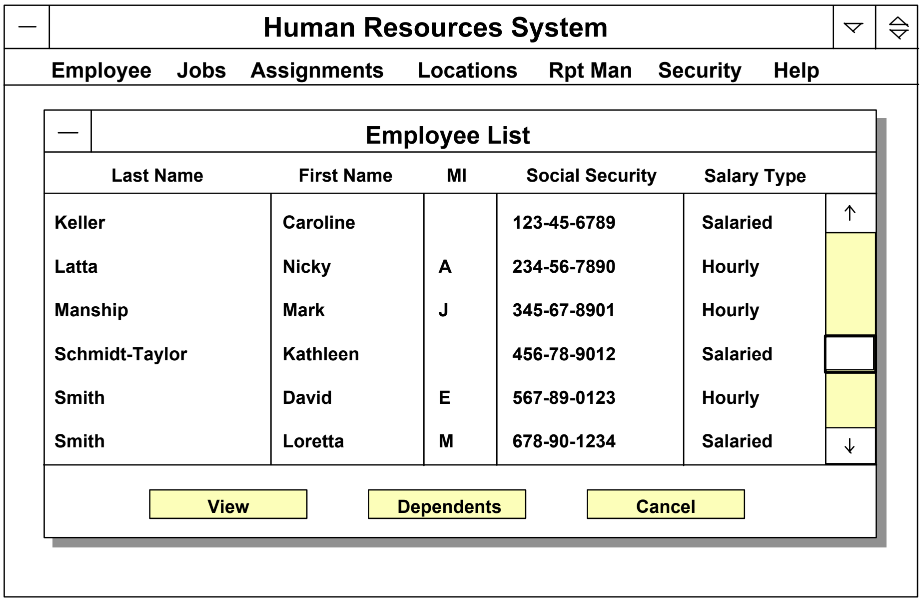


Counting Process

The following diagram shows the drop-down menu for employee. The Review field and the enter key make up the input side of this example.



When the user selects Review on the Employee drop-down menu, the following window displays with a list of employees.



EI-1

View	Initiates display of data on EI-2
Dependents	Initiates list displayed on EI-4
Cancel	Returns to pull down menu

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EQ?	Yes. The primary intent is to present data. Only retrieved data is involved.

Step 3. Validate against the EQ Counting Rules

EQ Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The employee data crosses the 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.	Yes. No other EQ performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
The processing logic of the elementary process retrieves data or control information from an ILF or EIF.	Yes. Employee data is retrieved.
The processing logic of the elementary process does not maintain an ILF.	Yes.
The processing logic of the elementary process does not contain a mathematical formula or calculation.	Yes.
The processing logic of the elementary process does not create derived data.	Yes.

Conclusion: 1 EQ is counted.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Yes. Employee.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	The following are repeated, they are counted only once. (Last Name + First Name + MI), SSN, Salary type.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Yes, the review field/enter key.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 4. The name is considered together as one DET.

Complexity

1 FTR and 4 DETs.	Complexity is Low

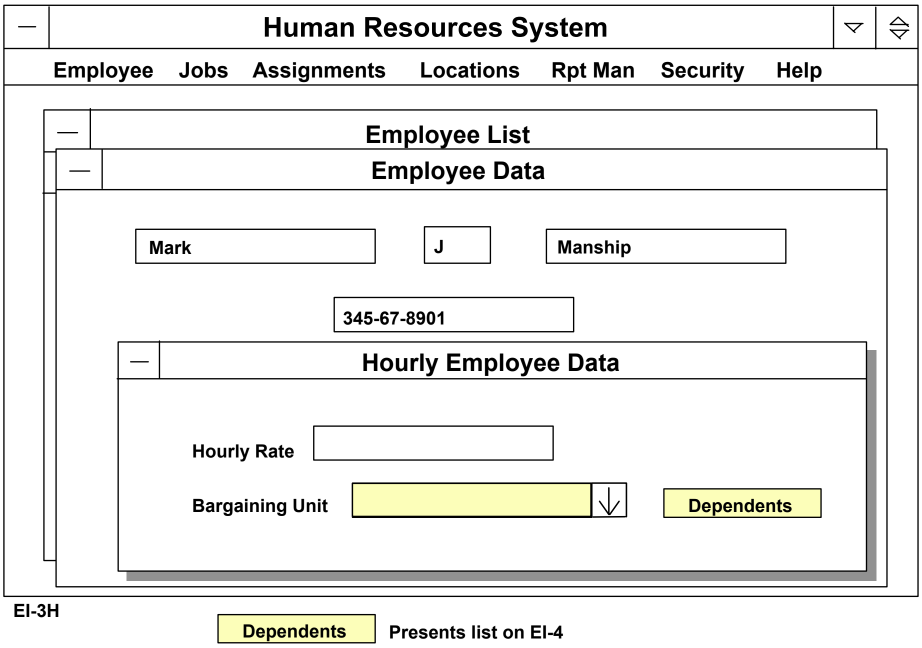
Step 5. Determine the Contribution

Contribution is 1 Low Complexity EQ	3 FP

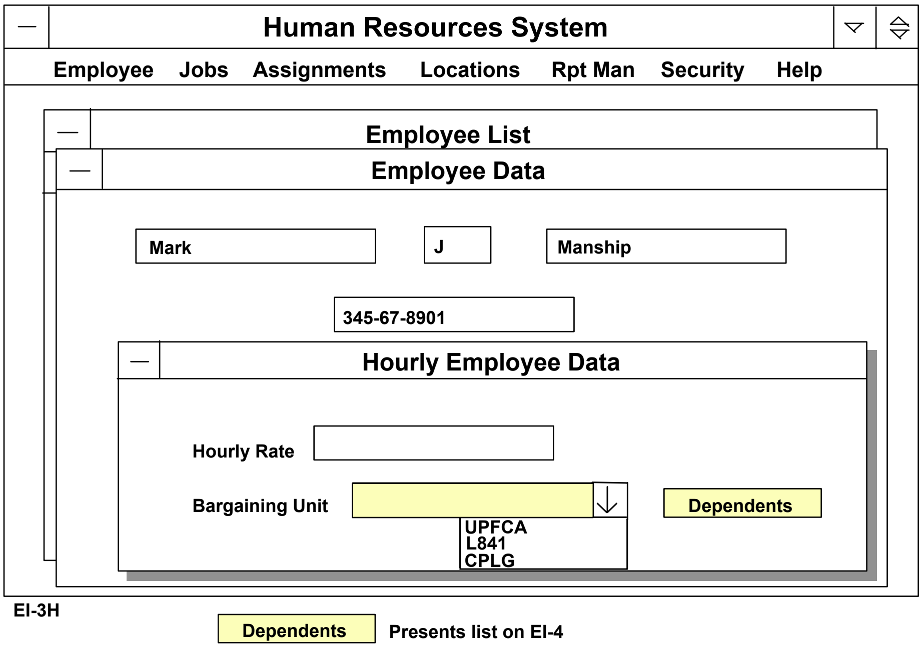
Example: Drop-Down List Box

User Requirements The user requires the ability to view a list of bargaining units added to the Human Resources System by a user.

Counting Process The following diagram shows the Hourly Employee Data window with the Bargaining Unit field.



When the user selects the arrow, the following drop-down list box appears.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EQ?	Yes. The primary intent is to is to present information. Only retrieved data is involved.

Step 3. Validate against the EQ Counting Rules

EQ Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The list of bargaining units is displayed.
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.	Yes. There is no other EQ that performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
The processing logic of the elementary process retrieves data or control information from an ILF or EIF.	Yes.
The processing logic of the elementary process does not maintain an ILF.	Yes.
The processing logic of the elementary process does not contain a mathematical formula or calculation.	Yes.
The processing logic of the elementary process does not create derived data.	Yes.

Conclusion: There is 1 EQ.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Bargaining unit.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Bargaining Unit.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Yes, the down arrow.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The total DET count is 2.

Complexity

1 FTR and 2 DETs.	Complexity is Low

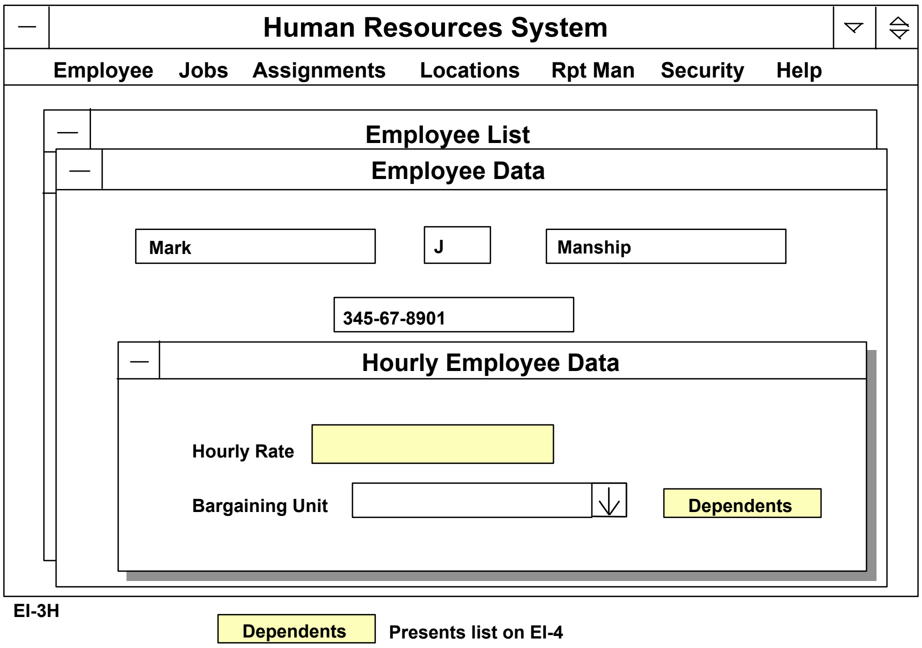
Step 5. Determine the Contribution

Contribution is 1 Low Complexity EQ	3 FP

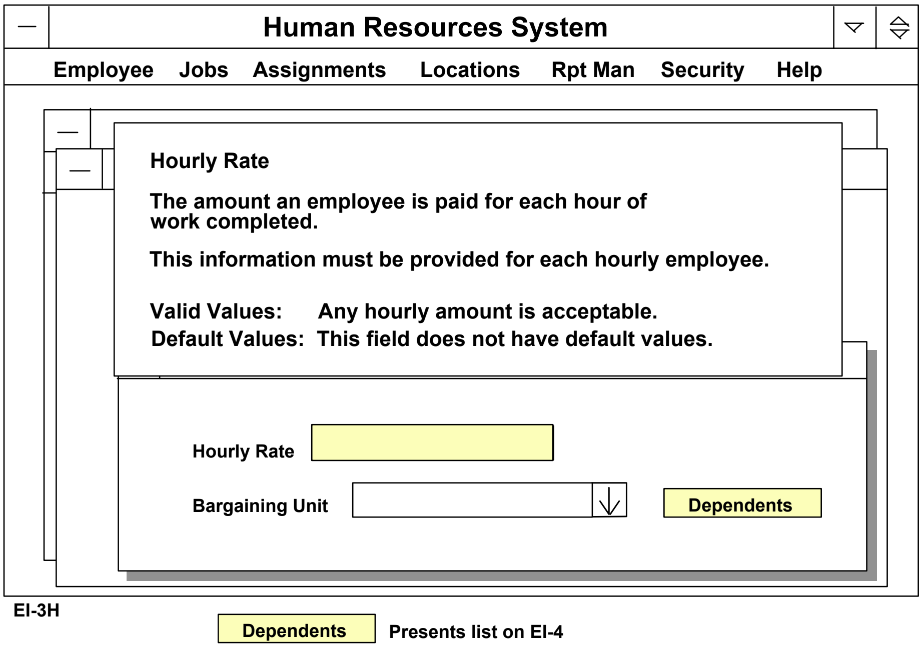
Example: Field Level Help–First Occurrence

User Requirements During construction of the Human Resources System, a requirement for online field level help was added. The help facility is provided by a separate application. The Help application provides help to the Human Resources, Currency, Fixed Assets, and Benefits applications.

Counting Process The following diagram shows the Employee Data window.



When the user presses **F1** while the cursor is on the hourly rate field, a box displays the help text as shown in the following diagram.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EQ?	Yes. The primary intent is to present information. Only retrieved data is involved.

Step 3. Validate against the EQ Counting Rules

EQ Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. Help information crosses the 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.	Yes. No other EQ performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
The processing logic of the elementary process retrieves data or control information from an ILF or EIF.	Yes.
The processing logic of the elementary process does not maintain an ILF.	Yes.
The processing logic of the elementary process does not contain a mathematical formula or calculation.	Yes.
The processing logic of the elementary process does not create derived data.	Yes.

Conclusion: This is 1 EQ.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Help.

Conclusion: The FTR count is 1.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Window ID, Field ID.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Help message, Default value, Valid values.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Yes. The F1 key.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 6.

Complexity

1 FTR and 6 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EQ	3 FP

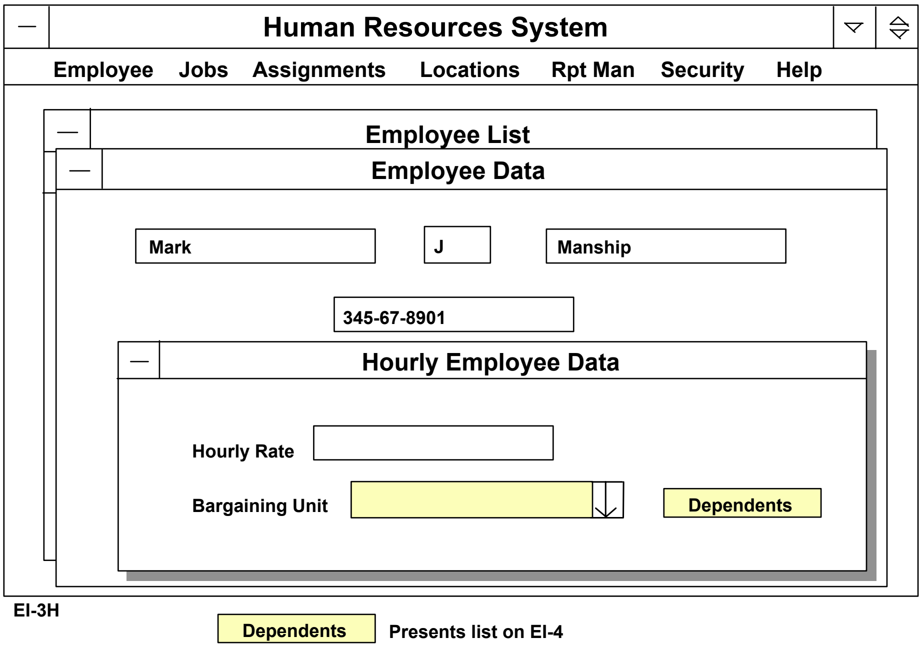
Example: Field Level Help–Second Occurrence

User Requirements

During construction of the Human Resources System, a requirement for online field level help was added. The online help is for the add, delete, and change processes for the Human Resources information. The help facility is provided by a separate application. The Help application provides help to the Human Resources, Currency, Fixed Assets, and Benefits applications.

Counting Process

The following diagram shows the Employee Data window.



The user places the cursor on the field for which help is desired, and presses **F1** to view help about that field.

Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EQ?	Yes. The primary intent is to present information. Only retrieved data is involved.

Step 3. Validate against the EQ Counting Rules

EQ Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. Help information crosses the 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.	No. The processing logic to present field level help for this field has been identified previously.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
The processing logic of the elementary process retrieves data or control information from an ILF or EIF.	Not applicable.
The processing logic of the elementary process does not maintain an ILF.	Not applicable.
The processing logic of the elementary process does not contain a mathematical formula or calculation.	Not applicable.
The processing logic of the elementary process does not create derived data.	Not applicable.

Conclusion: Although this is an Elementary Process, it is not counted because it is not a unique function in this application. Field level help has already been counted.

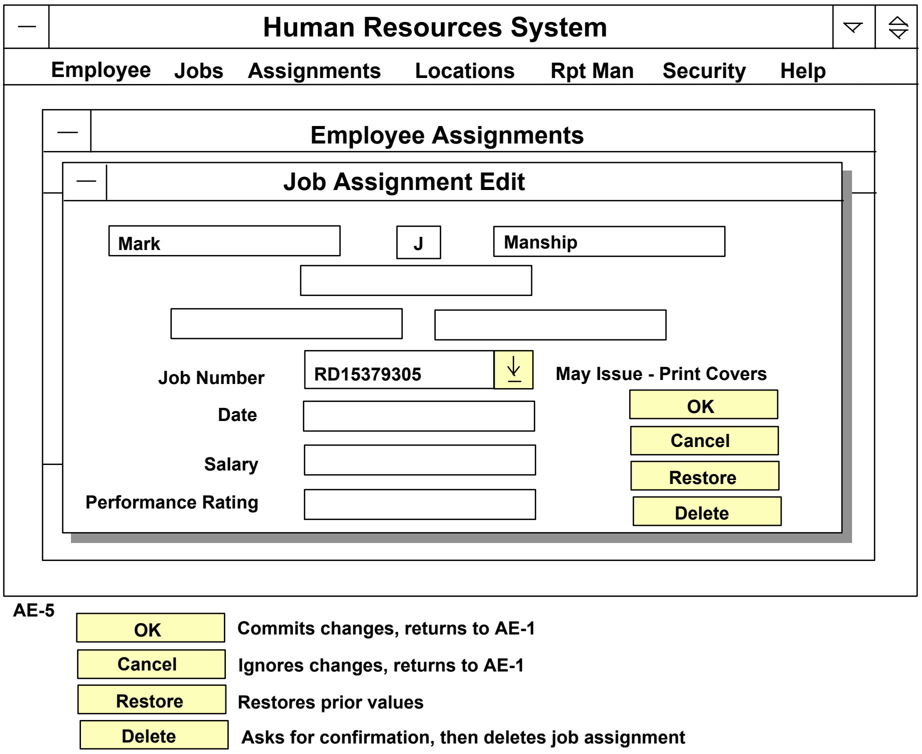
Example: Implied Inquiry

User Requirements

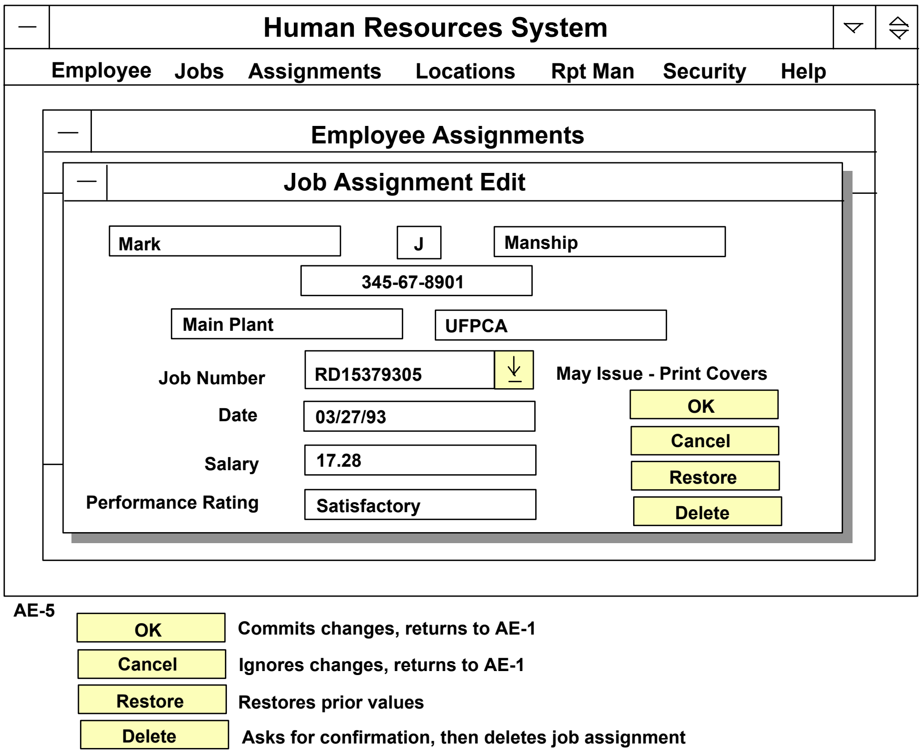
The user requires the ability to view assignment information. Although it is not explicitly stated, it is implied that job information must be retrieved before it can be changed. It is not efficient for the user to enter changes to the job assignment information without first viewing the existing information. This is the implied inquiry.

Counting Process

The following diagram shows the Job Assignment Edit window with only the employee name and job number.



When the user enters employee name and job number, the job information appears as shown in the following diagram.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EQ?	Yes. The primary intent is to present information. Only retrieved data is involved.

Step 3. Validate against the EQ Counting Rules

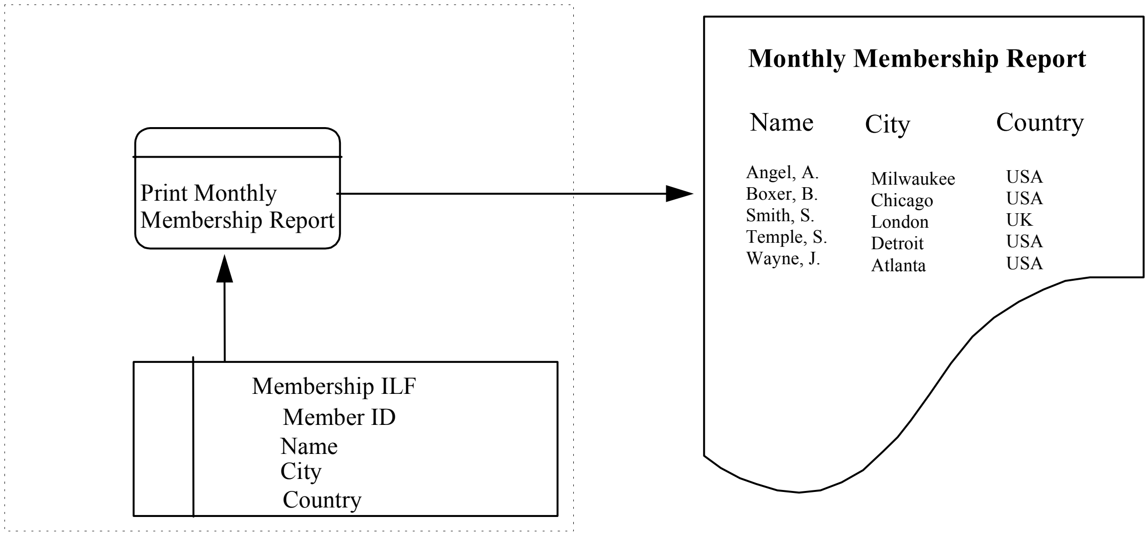
EQ Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. Job information is displayed.
For the identified process, one of the following three statements must apply:	
• Processing logic is unique from the processing logic performed by other external outputs or external inquiries for the application.	No. There is an existing EQ, which provides a view of the same information.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
The processing logic of the elementary process retrieves data or control information from an ILF or EIF.	Not applicable.
The processing logic of the elementary process does not maintain an ILF.	Not applicable.
The processing logic of the elementary process does not contain a mathematical formula or calculation.	Not applicable.
The processing logic of the elementary process does not create derived data.	Not applicable.

Conclusion: Although the function is an elementary process, it is not counted because it is not unique within this application. An identical display has previously been counted.

Example: EQ Triggered without Data Crossing the Boundary

User Requirements The user requires that the application print the Monthly Membership Report automatically every month.

The following diagram shows the data flow for this example.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EQ?	Yes. The primary intent is to present information. Only retrieved data is involved.

Step 3. Validate against the EQ Counting Rules

EQ Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. The monthly membership data crosses the 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.	Yes. No other EQ performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
The processing logic of the elementary process retrieves data or control information from an ILF or EIF.	Yes.
The processing logic of the elementary process does not maintain an ILF.	Yes.
The processing logic of the elementary process does not contain a mathematical formula or calculation.	Yes.
The processing logic of the elementary process does not create derived data.	Yes.

Conclusion: There is 1 EQ. Note, an EQ can be triggered without data crossing the boundary. In this example, the transaction is triggered by a time event within the application boundary.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Membership.

Conclusion: The total FTR count is 1.

For DETs, look at each field on the window and determine which DET counting rules apply.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Name, city, country.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 3.

Complexity

1 FTR and 3 DETs.	Complexity is Low

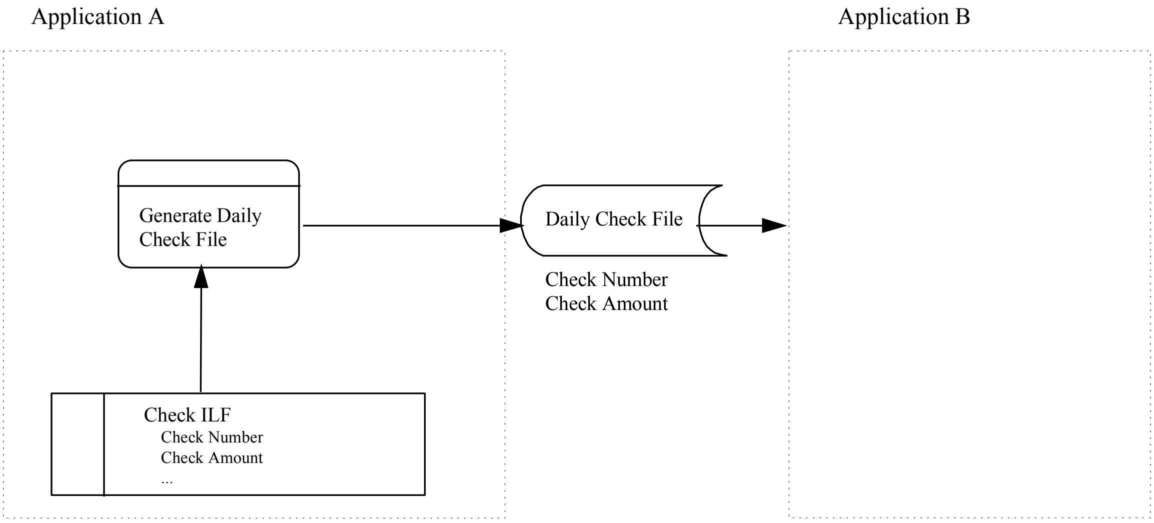
Step 5. Determine the Contribution

Contribution is 1 Low Complexity EQ	3 FP

Example: Data Sent to Another Application

User Requirements At the end of each day, send a transaction file to Application B listing the check numbers and the amount of each check printed for the day.

The following diagram shows the data flow for this example.



Step 1. Identify the Elementary Process

Does the Transactional Function meet the requirements of an Elementary Process?	Yes.

Step 2. Determine the Primary Intent, and Classify

Does the Transactional Function satisfy the Primary Intent of an EQ?	Yes. The primary intent is to present information. Only retrieved data is displayed.

Step 3. Validate against the EQ Counting Rules

EQ Counting Rules	Does the Rule Apply?
The function sends data or control information external to the application boundary.	Yes. Data crosses the boundary as a data file of transactions.
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.	Yes. No other EQ performs this function.
• The set of data elements identified is different from the sets identified for other external outputs and external inquiries in the application.	Not applicable.
• The ILFs or EIFs referenced are different from the files referenced by other external outputs and external inquiries in the application.	Not applicable.
The processing logic of the elementary process retrieves data or control information from an ILF or EIF.	Yes.
The processing logic of the elementary process does not maintain an ILF.	Yes.
The processing logic of the elementary process does not contain a mathematical formula or calculation.	Yes.
The processing logic of the elementary process does not create derived data.	Yes.

Conclusion: There is 1 EQ.

Step 4. Determine the Complexity

FTR Counting Rule	Does the Rule Apply?
Count one FTR for each ILF or EIF read during the processing of the elementary process.	Check.

Conclusion: The total FTR count is 1.

DET Counting Rules	Does the Rule Apply?
Count one DET for each user recognizable, non-repeated field that enters the application boundary and is required to specify when, what and/or how the data is to be retrieved or generated by the elementary process.	Not applicable.
Count one DET for each user recognizable, non-repeated field that exits the boundary.	Check Number, Amount.
If a DET both enters and exits the boundary, count it only once for the elementary process.	Not applicable.
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.	Not applicable.
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.	Not applicable.
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.	Not applicable.
Do not count literals as DETs.	
Do not count paging variables or system-generated stamps.	

Conclusion: The DET count is 2.

Complexity

1 FTR and 2 DETs.	Complexity is Low

Step 5. Determine the Contribution

Contribution is 1 Low Complexity EQ	3 FP

Summary of EQs, FTRs and DETs Counted

This section gives a summary of the EQs, FTRs, and DETs counted before calculating the complexity and contribution to the unadjusted function point count.

Summary of EQs Counted

The following table shows the EQs counted for the HR application. It also lists the data that was not counted.

EQs Counted	Not Counted
List of retrieved data Drop-down list box Field level help first occurrence Monthly Membership Report Check Transaction File	Application menus Second occurrence of field help Implied inquiry (previously counted)

Summary FTR/DET Count

The FTR and DET counts are recorded in the following table.

External Inquiry	FTRs	DETs
List of retrieved data	1	4
Drop-down list box	1	2
Field level help first occurrence	1	6
Weekly Membership Report	1	3
Check Transaction File	1	2

External Inquiries Complexity and Contribution

This last section of the EQ examples shows the final steps to determine EQ complexity and contribution to the unadjusted function point count.

The final steps are as follows:

1. Rate the EQ complexity.
2. Translate the complexity to unadjusted function points.
3. Calculate the external inquiries' contribution to the total unadjusted function point count.

Rate EQ Complexity

The following ***complexity matrix*** rates the EQ complexity.

	0 to 5 DETs	**6 to 19 DETs**	**20 or more DETs**
0 to 1 FTR	Low	Low	Average
2 to 3 FTRs	Low	Average	High
4 or more FTRs	Average	High	High

Legend:

FTR = File Type Referenced (Combination of input and output side)

DET = Data Element Type (Combination of input and output side)

Functional Complexity: The following table shows the functional complexity for each EQ.

External Inquiry	FTRs	DETs	Functional Complexity
List of retrieved data	1	4	Low
Drop-down list box	1	2	Low
Field level help	1	6	Low
Weekly Membership Report	1	3	Low
Daily Check File	1	2	Low

Translate EQs

The following table translates the external inquiries' functional complexity to unadjusted function points.

Functional Complexity Rating	Unadjusted Function Points
Low	3
Average	4
High	6

The complexity is recorded in the table in the following section.

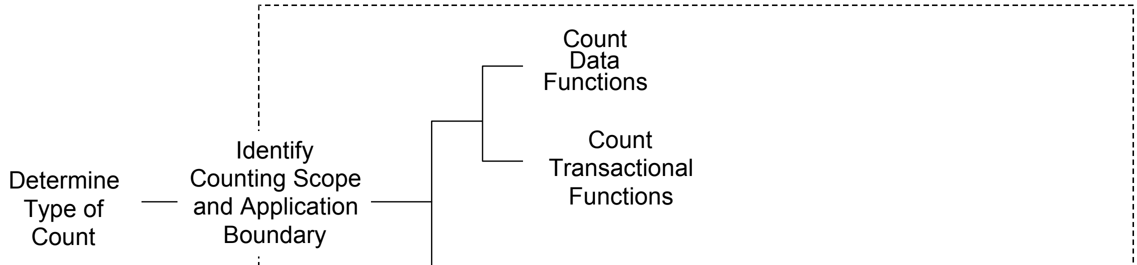
Calculate EQ Contribution

The following table shows the total contribution for the EQ function type.

Function Type	Functional Complexity			Complexity Totals	Function Types Totals
EQ	5	Low	X 3 =	15	
		Average	X 4 =		
		High	X 6 =		
					15

This total will be recorded on a table that lists all the function types. The final total for all function types is the unadjusted function point count.

The Appendix includes a table to record the totals for all the function types.



8 Determine Value Adjustment Factor (Optional)

Introduction This chapter explains the value adjustment factor for the function point count.

Contents This chapter includes the following sections:

Continued on next page

Value Adjustment Factor Determination

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

The 14 general system characteristics are summarized into the value adjustment factor. When applied, the value adjustment factor adjusts the unadjusted function point count +/-35 percent to produce the adjusted function point count.

Note that the VAF determination is an *optional* step in the function point counting process. This step may be omitted, and unadjusted function points may be used to measure the size of a software application or project.

Procedures to Determine the VAF

The following steps outline the procedures to determine the value adjustment factor.

Step	Action
1	Evaluate each of the 14 general system characteristics on a scale from zero to five to determine the degree of influence (DI).
2	Add the degrees of influence for all 14 general system characteristics to produce the total degree of influence (TDI).
3	Insert the TDI into the following equation to produce the value adjustment factor. VAF = (TDI * 0.01) + 0.65 For example, the following value adjustment factor is calculated if there are three degrees of influence for each of the 14 GSC descriptions (3*14). VAF = (42 * 0.01) + 0.65 VAF = 1.07

A table to facilitate the calculation is included in the Appendix.

General System Characteristics

The *general system characteristics* are a set of 14 questions that evaluate the overall complexity of the application.

The 14 general system characteristics are:

1. Data Communications
2. Distributed Data Processing
3. Performance
4. Heavily Used Configuration
5. Transaction Rate
6. Online Data Entry
7. End-User Efficiency
8. Online Update
9. Complex Processing
10. Reusability
11. Installation Ease
12. Operational Ease
13. Multiple Sites
14. Facilitate Change

Degrees of Influence

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

- 0 Not present, or no influence
- 1 Incidental influence
- 2 Moderate influence
- 3 Average influence
- 4 Significant influence
- 5 Strong influence throughout

Each of the following general system characteristic descriptions includes guidelines to determine the degree of influence. The remaining sections in this chapter explain the guidelines for each general system characteristic.

Guidelines to Determine Degree of Influence

This section presents the guidelines to determine the degree of influence for each general system characteristic.

The *Score As* in the tables in this section are guides. If none of the guideline descriptions fits the application exactly, a judgment must be made to determine which degree of influence is the most appropriate for the application.

1. Data Communications

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

The *data* and *control* information used in the application are sent or received over communication facilities. Terminals connected locally to the control unit are considered to use communication facilities. Protocol is a set of conventions which permit the transfer or exchange of information between two systems or devices. All data communication links require some type of protocol.

Score As	Descriptions to Determine Degree of Influence
0	Application is pure batch processing or a stand-alone PC.
1	Application is batch but has remote data entry *or* remote printing.
2	Application is batch but has remote data entry *and* remote printing.
3	Application includes online data collection or TP (teleprocessing) front end to a batch process or query system.
4	Application is more than a front-end, but supports only one type of TP communications protocol.
5	Application is more than a front-end, and supports more than one type of TP communications protocol.

2. Distributed Data Processing

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

Distributed data or processing functions are a characteristic of the application within the application boundary.

Score As	Descriptions To Determine Degree of Influence
0	Application does not aid the transfer of data or processing functions between components of the system.
1	Application prepares data for user processing on another component of the system such as PC spreadsheets and PC DBMS.
2	Data is prepared for transfer, then is transferred and processed on another component of the system (not for end-user processing).
3	Distributed processing and data transfer are online and in one direction only.
4	Distributed processing and data transfer are online and in both directions.
5	Processing functions are dynamically performed on the most appropriate component of the system.

3. Performance

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

Application performance objectives, stated or approved by the user, *in either* response or throughput, influence (or will influence) the design, development, installation, and support of the application.

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

4. Heavily Used Configuration

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

A heavily used operational configuration, requiring special design considerations, is a characteristic of the application. For example, the user wants to run the application on existing or committed equipment that will be heavily used.

Score As	Descriptions To Determine Degree of Influence
0	No explicit or implicit operational restrictions are included.
1	Operational restrictions do exist, but are less restrictive than a typical application. No special effort is needed to meet the restrictions.
2	Some security or timing considerations are included.
3	Specific processor requirements for a specific piece of the application are included.
4	Stated operation restrictions require special constraints on the application in the central processor or a dedicated processor.
5	In addition, there are special constraints on the application in the distributed components of the system.

5. Transaction Rate

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

The transaction rate is high and it influences the design, development, installation, and support of the application.

Score As	Descriptions To Determine Degree of Influence
0	No peak transaction period is anticipated.
1	Peak transaction period (e.g., monthly, quarterly, seasonally, annually) is anticipated.
2	Weekly peak transaction period is anticipated.
3	Daily peak transaction period is anticipated.
4	High transaction rate(s) stated by the user in the application requirements or service level agreements are high enough to require performance analysis tasks in the design phase.
5	High transaction rate(s) stated by the user in the application requirements or service level agreements are high enough to require performance analysis tasks and, in addition, require the use of performance analysis tools in the design, development, and/or installation phases.

6. Online Data Entry

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

Online data entry and control functions are provided in the application.

Score As	Descriptions To Determine Degree of Influence
0	All transactions are processed in batch mode.
1	1% to 7% of transactions are interactive data entry.
2	8% to 15% of transactions are interactive data entry.
3	16% to 23% of transactions are interactive data entry.
4	24% to 30% of transactions are interactive data entry.
5	More than 30% of transactions are interactive data entry.

7. End-User Efficiency

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

The online functions provided emphasize a design for end-user efficiency. The design includes:

- Navigational aids (for example, function keys, jumps, dynamically generated menus)
- Menus
- Online help and documents
- Automated cursor movement
- Scrolling
- Remote printing via online transactions
- Pre-assigned function keys
- Batch jobs submitted from online transactions
- Cursor selection of screen data
- Heavy use of reverse video, highlighting, colors underlining, and other indicators
- Hard copy user documentation of online transactions
- Mouse interface
- Pop-up windows
- As few screens as possible to accomplish a business function
- Bilingual support (supports two languages; count as four items)
- Multilingual support (supports more than two languages; count as six items)

Score As	Descriptions To Determine Degree of Influence
0	None of the above.
1	One to three of the above.
2	Four to five of the above.
3	Six or more of the above, but there are no specific user requirements related to efficiency.
4	Six or more of the above, and stated requirements for end-user efficiency are strong enough to require design tasks for human factors to be included (for example, minimize key strokes, maximize defaults, use of templates).
5	Six or more of the above, and stated requirements for end-user efficiency are strong enough to require use of special tools and processes to demonstrate that the objectives have been achieved.

8. Online Update

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

The application provides online update for the internal logical files.

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

9. Complex Processing

Complex processing describes the degree to which processing logic influenced the development of the application.

The following components are present:

- Sensitive control (for example, special audit processing) and/or application specific security processing
- Extensive logical processing
- Extensive mathematical processing
- Much exception processing resulting in incomplete transactions that must be processed again (for example, incomplete ATM transactions caused by TP interruption, missing data values, or failed validations)
- Complex processing to handle multiple input/output possibilities (for example, multimedia, or device independence)

Score As	Descriptions To Determine Degree of Influence
0	None of the above.
1	Any one of the above.
2	Any two of the above.
3	Any three of the above.
4	Any four of the above.
5	All five of the above.

10. Reusability

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

Score As	Descriptions To Determine Degree of Influence
0	No reusable code.
1	Reusable code is used within the application.
2	Less than 10% of the application considered more than one user's needs.
3	Ten percent (10%) or more of the application considered more than one user's needs.
4	The application was specifically packaged and/or documented to ease re-use, and the application is customized by the user at source code level.
5	The application was specifically packaged and/or documented to ease re-use, and the application is customized for use by means of user parameter maintenance.

11. Installation Ease

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

Conversion and installation ease are characteristics of the application. A conversion and installation plan and/or conversion tools were provided and tested during the system test phase.

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

12. Operational Ease

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

Operational ease is a characteristic of the application. The application minimizes the need for manual activities, such as tape mounts, paper handling, and direct on-location manual intervention.

Score As	Descriptions To Determine Degree of Influence
0	No special operational considerations other than the normal back-up procedures were stated by the user.
1 - 4	One, some, or all of the following items apply to the application. Select all that apply. Each item has a point value of one, except as noted otherwise. • Effective start-up, back-up, and recovery processes were provided, but operator intervention is required. • Effective start-up, back-up, and recovery processes were provided, but no operator intervention is required (count as two items). • The application minimizes the need for tape mounts. • The application minimizes the need for paper handling.
5	The application is designed for unattended operation. Unattended operation means *no operator intervention* is required to operate the system other than to start up or shut down the application. Automatic error recovery is a feature of the application.

13. Multiple Sites

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

The application has been specifically designed, developed, and supported to be installed at multiple sites for multiple organizations.

Score As	Descriptions To Determine Degree of Influence
0	User requirements do not require considering the needs of more than one user/installation site.
1	Needs of multiple sites were considered in the design, and the application is designed to operate only under identical hardware and software environments.
2	Needs of multiple sites were considered in the design, and the application is designed to operate only *under similar* hardware and/or software environments.
3	Needs of multiple sites were considered in the design, and the application is designed to operate *under different* hardware and/or software environments.
4	Documentation and support plan are provided and tested to support the application at multiple sites and the application is as described by 1 or 2.
5	Documentation and support plan are provided and tested to support the application at multiple sites and the application is as described by 3.

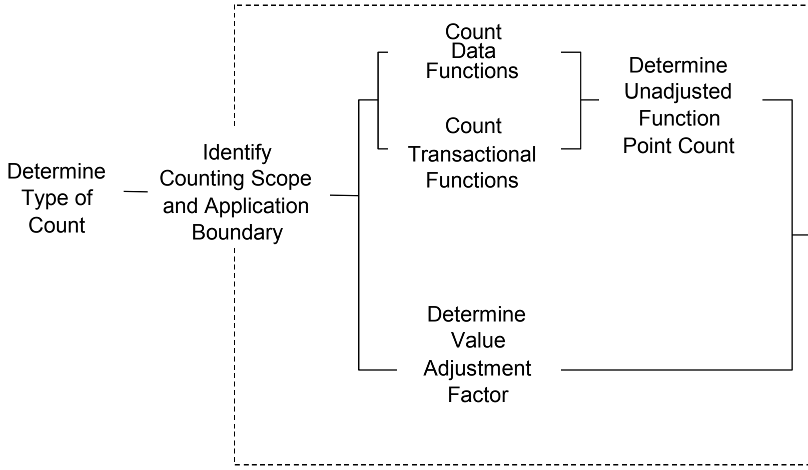
14. Facilitate Change

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

The following characteristics can apply for the application:

- Flexible query and report facility is provided that can handle simple requests; for example, and/or logic applied to only one internal logical file (count as one item).
- Flexible query and report facility is provided that can handle requests of average complexity, for example, and/or logic applied to more than one internal logical file (count as two items).
- Flexible query and report facility is provided that can handle complex requests, for example, and/or logic combinations on one or more internal logical files (count as three items).
- Business control data is kept in tables that are maintained by the user with online interactive processes, but changes take effect only on the next business day.
- Business control data is kept in tables that are maintained by the user with online interactive processes, and the changes take effect immediately (count as two items.

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



9 Calculate Adjusted Function Point Count

Introduction

This chapter presents the formulas to complete the last step for function point analysis. It includes formulas to calculate the three types of function point counts—development project, enhancement project, and application.

Contents

This chapter includes the following sections:

Continued on next page

Review of Steps for Function Point Analysis

The following list includes the function point analysis steps introduced in Chapter 2, Overview of Function Point Analysis.

Step	Action
1	Determine the type of function point count (Chapter 4).
2	Identify the counting boundary (Chapter 5).
3	Determine the unadjusted function point count a. Count data functions (Chapter 6). b. Count transactional functions (Chapter 7).
4	Determine the value adjustment factor (Chapter 8). Note that this is an optional step, and that unadjusted function points may be used.
5	Calculate the adjusted function points (Chapter 9).

The remaining sections in this chapter present the formulas to complete the final step to calculate the function point count. Example calculations are included for each of the three types of function points counts:

- Development project
- Enhancement project
- Application

The formulas in this chapter may be used whether or not the value adjustment factor has been calculated. VAF is the value adjustment factor (if the value adjustment factor was not calculated, VAF is 1.00 then the result of the calculation is functional size, reported with units of 'unadjusted function points'. If the VAF is calculated then the result is reported with units of 'adjusted function points').

Development Project Function Point Calculation

The development project function point calculation consists of three components of functionality:

- Application functionality included in the user requirements for the project
- Conversion functionality included in the user requirements for the project
- Application value adjustment factor

Application Functionality

Application functionality consists of functions used after software installation to satisfy the ongoing business needs of the user.

Conversion Functionality

Conversion functionality consists of functions provided only at installation to convert data and/or provide other user-specified conversion requirements, such as special conversion reports.

For example, if a Human Resources (HR) software application was in use and a new HR application is installed, the users may require that information about employees be converted and loaded into the new application. The user-specified conversion requirement is to transfer the current employee data into the new HR system.

Application Value Adjustment Factor

The value adjustment factor, if used, is determined by using the 14 general system characteristics to rate the application functional complexity. Refer to Chapter 8 for details.

Function Point Formula

Use the following formula to calculate the development project function point count.

DFP = (UFP + CFP) * VAF

Where:

DFP is the development project function point count

UFP is the unadjusted function point count for the functions that will be available after installation

CFP is the unadjusted function points added by the conversion unadjusted function point count

VAF is the value adjustment factor (if the value adjustment factor was not calculated, VAF is 1.00 then the result of the calculation is functional size, reported with units of 'unadjusted function points'. If the VAF is calculated then the result is reported with units of 'adjusted function points').

Note: After software installation, the application function point count is calculated using components of the development project function point count. See Application Function Point Calculation on page 9-17.

Example: Development Project Function Point Count

This section shows an example count for a sample development project. The project includes both application and conversion functionality.

Note: The examples in Chapters 6 and 7 explain why each function in this example is counted.

Application Functionality

The following tables show the application functionality counted for a development project.

Data Functions	RETs	DETs	Functional Complexity
Internal Logical Files			
• Job information	2	5	Low
• Suspended jobs	2	6	Low
• Report definition	1	4	Low
• Employee information	1	6	Low
External Interface Files			
• Location information	1	6	Low
• Conversion information	1	2	Low
• Window help information	1	2	Low
• Field help information	1	5	Low

Transactional Functions	FTRs	DETs	Functional Complexity
External Inputs			
Assignment report definition	1	5	Low
Add job information (screen input)	1	7	Low
Add job information (batch input)	2	6	Average
Correct suspended jobs	1	7	Low
Employee job assignment	3	7	High
EI with screen output –1	2	11	Average
EI with screen output –2	1	6	Low
External Outputs			
Jobs with employees report	4	5	Average
Employees by assignment duration report	3	7	Average
Performance review notification	3	4	Low
Weekly employees report	1	3	Low
Printed check	1	3	Low
Check transaction file	1	4	Low
External Inquiries			
List of retrieved data	1	4	Low
Drop-down list box	1	2	Low
Field level help	1	6	Low
Weekly membership report	1	3	Low
Daily check file	1	2	Low

Conversion Functionality

The following table shows the conversion functionality for the development project.

Transactional Function	FTRs	DETs	Functional Complexity
External Input			
Employee migration	1	11	Low

Application Contribution to the Unadjusted Function Point Count

The following table shows the contribution of the application functionality to the unadjusted function point count.

Function Type	Functional Complexity		Complexity Totals		Function Type Totals
ILFs	4	Low	X 7 =	28	
	0	Average	X 10 =	0	
	0	High	X 15 =	0	
					28
EIFs	4	Low	X 5 =	20	
	0	Average	X 7 =	0	
	0	High	X 10 =	0	
					20
EIs	4	Low	X 3 =	12	
	2	Average	X 4 =	8	
	1	High	X 6 =	6	
					26
EOs	4	Low	X 4 =	16	
	2	Average	X 5 =	10	
	0	High	X 7 =	0	
					26
EQs	5	Low	X 3 =	15	
	0	Average	X 4 =	0	
	0	High	X 6 =	0	
					15
	Unadjusted Function Point Count				115

Conversion Contribution to the Unadjusted Function Point Count

The following table shows the contribution of the conversion functionality to the unadjusted function point count.

Function Type	Functional Complexity			Complexity Totals	Function Type Totals
EIs	1	Low	X 3 =	3	
	0	Average	X 4 =	0	
	0	High	X 6 =	0	
		Unadjusted Function Point Count			3

Final Calculation

Using the complexity and contribution counts for this example, the development project count is shown below. The value adjustment factor for this example is 1.05. (The formula was explained on page 9-5.)

DFP = (UFP + CFP) * VAF

DFP = (115 + 3) * 1.05

DFP = 123.9 or 124

Enhancement Project Function Point Calculation

The enhancement project function point calculation consists of three components of functionality:

- Application functionality included in the user requirements for the project
- Conversion functionality included in the user requirements for the project
- Application value adjustment factor

Application Functionality

Application functionality consists of:

- Function points identified from the functionality that is added by the enhancements
- Function points counted because existing functionality is changed during the enhancement project
- Function points counted for functionality deleted during the enhancement project

Conversion Functionality

The conversion functionality consists of function points delivered because of any conversion functionality required by the user.

Value Adjustment Factor

The two value adjustment factors are the:

- Application value adjustment factor before the enhancement project begins
- Application value adjustment factor after the enhancement project is complete

Note that if the value adjustment factors were not calculated, each will be assumed to be 1.00.

VAF is the value adjustment factor (if the value adjustment factor was not calculated, VAF is 1.00 then the result of the calculation is functional size, reported with units of 'unadjusted function points'. If the VAF is calculated then the result is reported with units of 'adjusted function points').

Function Point Formula

Use the following formula to calculate the enhancement project function point count.

Note: Data conversion requirements *are included* in this count.

EFP = [(ADD + CHGA + CFP) * VAFA] + (DEL* VAFB)

Where:

EFP is the enhancement project function point count.

ADD is the unadjusted function point count of those functions that were or will be added by the enhancement project.

CHGA is the unadjusted function point count of those functions that were or will be modified by the enhancement project. This number reflects the size of the functions *after* the modifications.

CFP is the function point count of those functions added by the conversion

VAFA is the value adjustment factor of the application *after* the enhancement project is complete. (If VAFA was not calculated, it will be assumed to be 1.00.)

DEL is the unadjusted function point count of those functions that were or will be deleted by the enhancement project.

VAFB is the value adjustment factor of the application *before* the enhancement project begins. (If VAFB was not calculated, it will be assumed to be 1.00.)

Note: VAF is the value adjustment factor (if the value adjustment factor was not calculated, VAF is 1.00 then the result of the calculation is functional size, reported with units of 'unadjusted function points'. If the VAF is calculated then the result is reported with units of 'adjusted function points').

Note: When an enhancement project is installed, the application function point count must be updated to reflect changes in the application's functionality.

Example: Enhancement Project Count

This section shows an example for a sample enhancement project. The requirements for the enhancement project include the following changes:

- The user no longer needs to add a job online, therefore, that functionality is to be or was removed.
- The user needs to receive an additional report about jobs that includes totals.
- Additional DETs are required to add jobs in batch and correct suspended transactions. A reference to security is also added for the add job transaction.

Application Functionality

The following paragraphs explain the application functionality counted for the example enhancement project. Functionality is described as added, changed, or deleted.

Added Functionality

The following table shows the functional complexity for the added functionality counted when the project was completed.

Note: Providing a new report was an additional external output.

Transactional Functions	FTRs	DETs	Functional Complexity
External Output			
Job report	1	15	Low

Changed Functionality

The following table shows the functional complexity for the changed functionality, as the functions will exist after the enhancement project is completed.

Note: The complexity for adding a job was increased because of the additional file type referenced. The complexity for correcting suspended transactions remained low.

Transactional Functions	FTRs	DETs	Functional Complexity
External Input			
Add job information (batch input)	3	8	High
Correct suspended transaction	1	8	Low

Deleted Functionality

The following table shows the functional complexity for deleted functionality identified at the end of the project.

Transactional Functions	FTRs	DETs	Functional Complexity
External Inputs			
Add job information (screen input)	1	7	Low

Application Contribution to the Unadjusted Function Point Count

The following paragraphs explain the application functionality contribution to the total unadjusted function point count.

Added Functionality

The following table shows the contribution to the unadjusted function point count for the added functionality identified at the end of the project.

Function Type	Functional Complexity			Complexity Totals	Function Type Totals
EOs	1	Low	X 4 =	4	
	0	Average	X 5 =	0	
	0	High	X 7 =	0	
					4

Changed Functionality

The following table shows the contribution to the unadjusted function point count for the changed functionality as it will exist after the enhancement project is complete.

Function Type	Functional Complexity		Complexity Totals		Function Type Totals
EIs	1	Low	X 3 =	3	
	0	Average	X 4 =	0	
	1	High	X 6 =	6	
					9

Deleted Functionality

The following table shows the contribution to the unadjusted function point count for the deleted functionality.

Function Type	Functional Complexity		Complexity Totals		Function Type Totals
EIs	1	Low	X 3 =	3	
	0	Average	X 4 =	0	
	0	High	X 6 =	0	
					3

Final Calculation

The application value adjustment factor was 1.05 before the project began. The value adjustment factor remained the same after the project was completed.

Using the complexity and contribution counts for this example, the enhancement project function point count is shown below. (The formula was explained on page 9-11.)

EFP = [(ADD + CHGA + CFP) * VAFA] + (DEL* VAFB)

EFP = [(4 + 9 + 0) * 1.05] + (3 * 1.05)

EFP = 16.8 or 17

Application Function Point Calculation

This section provides the formulas to calculate the application function point count. There are two variations of this formula:

- Formula to establish the initial function point count for an application
- Formula to re-establish the function point count for an application after an enhancement project has changed the application functionality

Formula to Establish the Initial Count

Use the formula in this section to establish the initial function point count for an application. Initially, the user is receiving new functionality. There are no changes to the existing functionality or deletions of obsolete or unneeded functionality. The application function point count *does not* include conversion requirements.

AFP = ADD * VAF

Where:

AFP is the initial application function point count.

ADD is the unadjusted function point count of those functions that were installed by the development project.

VAF is the value adjustment factor (if the value adjustment factor was not calculated, VAF is 1.00 then the result of the calculation is functional size, reported with units of 'unadjusted function points'. If the VAF is calculated then the result is reported with units of 'adjusted function points').

Formula to Reflect Enhancement Projects

When an enhancement project is installed, the existing application function point count must be updated to reflect modifications to the application. The functionality for the application can be altered in one or more ways:

- Added (new) functionality increases the size of the application
- Changed functionality increases, decreases, or has no effect on the size of the application
- Deleted functionality decreases the application size
- Changes to the value adjustment factor adds, subtracts, or has no effect on the function point count but does affect the adjusted function point count

Note: Because conversion functionality does not affect the application function point count, any conversion functionality associated with an enhancement project is omitted entirely from the application function point calculation.

Note: VAF is the value adjustment factor (if the value adjustment factor was not calculated, VAF is 1.00 then the result of the calculation is functional size, reported with units of 'unadjusted function points'. If the VAF is calculated then the result is reported with units of 'adjusted function points').

Use the following formula to calculate the application function point count after an enhancement project:

AFP = [(UFPB + ADD + CHGA) - (CHGB + DEL)] * VAFA

Where:

AFP is the application's adjusted function point count.

UFPB is the application's unadjusted function point count *before* the enhancement project begins.

Note: If this count is unavailable, it can be calculated using the formula UFBP = AFPB/VAFB; where AFPB is the adjusted application function point count before the enhancement project. VAFB is the value adjustment factor of the application before the enhancement project.

ADD is the unadjusted function point count of those functions that were added by the enhancement project.

CHGA is the unadjusted function point count of those functions that were changed by the enhancement project. This number reflects the size of the functions *after* the changes.

CHGB is the unadjusted function point count of those functions that were changed by the enhancement project. This number reflects the size of the functions *before* the changes were made.

DEL is the unadjusted function point count of those functions that were deleted by the enhancement project.

VAFA is the value adjustment factor of the application *after* the enhancement project is complete. (If VAFA was not calculated, it will be assumed to be 1.00.)

Example: Application Count

This section shows an example for the initial count and the count that reflects an enhancement project. Numbers for these counts are from the application count on page 9-8 and the enhancement count on page 9-11.

Initial Count

The initial application project count is shown below. The value adjustment factor is 1.05. (The formula was explained on page 9-17.)

AFP = ADD * VAF

AFP = 115 * 1.05

AFP = 120.75 or 121

Note: Only the size of the application functionality installed for the user is included in the initial count.

Count After Enhancement

The application project function point count to reflect enhancements is shown below. The value adjustment factor is 1.05. (The formula was explained on page 9-18.)

AFP = [(UFPB + ADD + CHGA) - (CHGB + DEL)]* VAFA

AFP = [(115 + 4 + 9) - (9 + 3)]* 1.05

AFP = 121.8 or 122

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Appendix A: Calculation Tables

Introduction Appendix A includes tables to facilitate counting function points.

Contents This appendix includes the following tables:

Unadjusted Function Point Count Calculation Table

The following table is provided to facilitate the calculation of the contribution to the unadjusted function point count.

Function Type	Functional Complexity			Complexity Totals	Function Type Totals
ILFs	______	Low	X 7 =	______	
	______	Average	X 10 =	______	
	______	High	X 15 =	______	
					______________
EIFs	______	Low	X 5 =	______	
	______	Average	X 7 =	______	
	______	High	X 10 =	______	
					______________
EIs	______	Low	X 3 =	______	
	______	Average	X 4 =	______	
	______	High	X 6 =	______	
					______________
EOs	______	Low	X 4 =	______	
	______	Average	X 5 =	______	
	______	High	X 7 =	______	
					______________
EQs	______	Low	X 3 =	______	
	______	Average	X 4 =	______	
	______	High	X 6 =	______	
					______________
	Total Unadjusted Function Point Count				______________

Value Adjustment Factor Calculation Table

The following table is provided to facilitate the calculation of the value adjustment factor.

General System Characteristics (GSCs)	Degree of Influence (DI) 0 - 5
1. Data Communications	___________
2. Distributed Data Processing	___________
3. Performance	___________
4. Heavily Used Configuration	___________
5. Transaction Rate	___________
6. Online Data Entry	___________
7. End-User Efficiency	___________
8. Online Update	___________
9. Complex Processing	___________
10. Reusability	___________
11. Installation Ease	___________
12. Operational Ease	___________
13. Multiple Sites	___________
14. Facilitate Change	___________
Total Degree of Influence (TDI)	___________
Value Adjustment Factor (VAF)	___________
	VAF = (TDI * 0.01) + 0.65

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Appendix B: The Change from CPM 4.0 to 4.1

Introduction

This appendix includes information about the changes, clarifications, and enhancements in CPM 4.1, the decision making process, and recommendations to users of the new manual.

Contents

This chapter includes the following:

Introduction

Since the release of IFPUG Counting Practices Manual (CPM) 4.0 in January 1994, the Counting Practices Committee (CPC) has received requests from the membership to clarify existing rules or to include topics the members felt were not adequately covered by CPM 4.0 including:

- the identification of elementary processes,
- the identification of external inputs (EIs), external outputs (EOs), and external inquiries (EQs), and
- counting Data Element Types (DETs) for transactional and data function types.

In creating CPM 4.1, following the CPM revision process, the CPC has reviewed all requests for support and, where appropriate, new rules have been promulgated, and existing rules clarified. Also, new hints and examples have been included to aid understanding.

When revising the CPM, the CPC process is as follows:

1. The issue is submitted to the CPC by the membership.
2. The issue is assigned to CPC members for research.
3. The CPC reviews and discusses the issue.
4. The CPC presents the proposed solution to the membership.
5. An impact study is initiated.
6. The final decision is made.
7. The IFPUG membership is informed of the decision through MetricViews and IFPUG conference presentations.
8. Changes become effective in a new CPM.
9. Case Studies are revised to reflect the new CPM.

The CPC believes that CPM 4.1's expanded and clarified definitions, examples, and hints will insure more consistent results between Certified Function Point Specialists.

Major Functional Change Areas in CPM 4.1

The major functional change areas in CPM 4.1 are:

- New chapter - Guidance on counting function points from the "user's view"
- Guidance on establishing the application boundary
- Guidance on identifying elementary process
- Identification of DETs for data function types (Internal Logical Files (ILFs)/External Interface Files (EIFs)) and transactional function types (EI/EO/EQ)
- Differentiation between EOs and EQs
- Clarification on control information
- Clarification of shared ILF/EIFs

Version Control

The CPC has chosen to name this version of the IFPUG CPM 4.1 rather than 5.0 for two reasons:

- CPM 4.1 is not a major change from the Albrecht methodology that forms the basis of all previous IFPUG CPMs. It is, for the most part, a refinement and clarification of the previous manual.
- The impact study performed to compare counts using CPM 4.0 and 4.1 showed very little difference in the functional size of the projects when measured using both methods. The count results compared in this study indicated that the counts are comparable and that an adjustment of counts previously done using 4.0 is unnecessary in the majority of cases. Therefore, there was no need to indicate by version number that these counts are not comparable, and there will be no noticeable change to organizations' software assets portfolio

Overview of Changes

Many revisions and enhancements have been made in this new version of the CPM and are listed below by chapter.

Chapter 1: Introduction

This chapter is unchanged.

Chapter 2: Overview of Function Point Analysis

This chapter now introduces the concept of the *primary intent* of a function type to assist in identification of EIs, EOs, and EQs.

Chapter 3: User View

This new chapter presents the concept of the user's role in defining the functional requirements for a project or application by defining *user view* and discussing sizing during the life cycle of an application by phases.

Chapter 4: Determine the Type of Count

This chapter was previously chapter 3 and is unchanged.

Chapter 5: Identify Counting Scope and Application Boundary

This chapter was previously chapter 4, Identify Counting Boundary, and now defines the terms: purpose of the count, counting scope, and application boundary. It includes rules, procedures, and hints to determine boundaries for applications and to establish the scope of the count.

Chapter 6: Count Data Functions

This was previously chapter 5, Count Data Function Types. The important clarifications and revisions to the definitions and rules used to identify Data Element Types (DETs) and File Types References (FTRs) for data function types are:

- When two applications maintain the same ILF/EIF, but each maintain separate portions of the available DETs, only the information being used by each application being counted should be used to size the ILF/EIF. Each application counts the key(s) as DETs, regardless of whether each can maintain those data elements.
- If an application references a logical data file for one portion of the data, yet maintains the logical data file for a different portion of the data, the combination of the DETs that are maintained and referenced will be counted as an ILF. A group of data cannot be counted as both an ILF and EIF by the same application.
- Two different applications being counted can count the same sets of information as having a different number of DETs, depending on the user's view and use of that data.
- A before or after image of a group of 10 fields maintained for audit purposes would count as one DET for the before image (all 10 fields) and one DET for the after image (all 10 fields).

This chapter has also been enhanced by the inclusion of:

- a clearer definition of control data,
- a new definition for *user identifiable*,
- the descriptions of the primary intent of each transactional function type,
- a clarification of DET rules,
- new examples for DET rules,
- new examples for counting ILFs and EIFs, and
- new and enhanced hints.

Chapter 7: Count Transactional Functions

This chapter was previously chapter 6, Count Transactional Function Types. The important clarifications and revisions to the definitions or rules used to identify DETs and or FTRs for transactional function types are:

- For an EI, count one DET for each user recognizable field that enters <u>or exits</u> the application boundary and is required to complete the external input.
- Only count DETs for those fields that enter or exit the boundary of the application.
- Control information can perform as the input side of an EO or EQ. The request specifying what, when, and/or how data is to be retrieved or generated, is part of the elementary process to provide the user data and is not an elementary process itself.
- Do not count fields that are retrieved or derived by the system and stored on an ILF during the elementary process if the field(s) did not cross the application boundary.
- A process can trigger an "internal process" which may result in an update of information. This overall process is either counted as an EI or EO depending on the primary intent of the process, regardless of the number of "internal processes" that may be triggered.
- An EO or EQ can be triggered without data crossing the boundary by a process inside the application boundary.
- An elementary process identified as an EO or EQ may have an input side and an output side.
- To determine the EO complexity and contribution to the unadjusted function point count:

  - identify and count the number of FTRs and DETs for the input side of the EO,
  - identify and count the number of FTRs and DETs for the output side of the EO, and
  - combine the contributors to complexity for the input side and the output side, ignoring duplicates, to determine the overall complexity of the function using the EO complexity matrix.
- To determine the EQ complexity and contribution to the unadjusted function point count:
  - identify and count the number of FTRs and DETs for the input side of the EQ,
  - identify and count the number of FTRs and DETs for the output side of the EQ, and
  - combine the contributors to complexity for the input side and the output side, ignoring duplicates, to determine the overall complexity of the function using the EQ complexity matrix.

NOTE: Previously, both the input side and output side of an EQ were compared and the most complex side was chosen to rate the EQ.

This chapter has also been enhanced by the inclusion of:

- an expanded index of the chapter,
- additional identification rules for elementary processes,
- additional and improved examples to assist in identifying unique elementary processes,
- descriptions of the primary intent of each transactional function type,
- a table summarizing the functions performed by the transactional function types to ease identification,
- a clearer definition of control information,
- a refined definition of *user,*
- a new definition for *user identifiable*,
- an enhanced definition and additional examples of *processing logic*,
- a table summarizing the processing logic of each transactional function type to ease identification, and
- examples of fields that are retrieved or derived by the system and are not counted as DETs.

Chapter 8: Determine Value Adjustment Factor

This chapter was previously chapter 7 and has been enhanced by the addition of the description of each of the General System Characteristics.

Chapter 9: Calculate Final Adjusted Function Point Count

This chapter was previously chapter 8 and is unchanged.

Appendix A: Calculation Tables

This appendix is unchanged.

Appendix B: The Change from CPM 4.0 to 4.1

This new chapter includes the following

- the major functional change areas in CPM 4.1,
- version control information,
- an overview of the changes by chapter,
- the background of the change process,

- the impact study process,
- the impact of the changes on 4.1 users,
- conversion from CPM 4.0 to 4.1, and
- recommendations for users switching from 4.0 to 4.1.

Glossary

The glossary has been updated to include new and changed definitions.

Quick Reference Card

There is a new IFPUG Function Point Quick Reference Card, based on CPM 4.1. This easy to use guide includes:

- Steps in FP Analysis,
- Key Definition of Terms,
- information on counting ILFs, EIFs, EIs, EOs, and EQs,
- Weighted Complexity of Functions,
- General Systems Characteristics,
- Formulas,
- Summary of Functions Performed by EIs, EOs, and EQs, and
- Summary of Processing Logic Used by EIs, EOs, and EQs.

Background

The CPC internal decision making process is governed by a set of CPM characteristics (meta rules) selected and voted on by the IFPUG board and the CPC. Those guiding principles in order of importance are:

1. It should be possible to model the correlation of software size (derived using the CPM) with other attributes (e.g., effort, defects, cost, etc.).
2. The CPM contains a consistent set of rules.
3. Function Point Analysis results are consistent between different counters using the CPM.
4. The CPM provides rules on how to size a functional need that is defined and agreed upon by user(s) and IT.
5. Function Point Analysis results using the CPM can be a contributing factor in estimation.
6. The CPM is an Albrecht based method.
7. Function Point Analysis using the CPM is easy.
8. Function Point Analysis using the CPM is fast.

The Impact Study

As required by the CPC revision process, an impact study with 35 participating IFPUG members was conducted to:

- assure that the content of the new CPM would enable the membership to identify the changes, and to correctly interpret and apply them,
- determine the change in results of function point counts done using CPM 4.0 and 4.1, and
- enable the CPC, based on the change in the results, to recommend to the membership the conversion factors, or procedures, to be applied to the size of existing 4.0 counts to make them compatible with future counts performed using CPM 4.1, if necessary.

To accomplish this goal, a group of IFPUG members who were Certified Function Point Specialists:

- submitted a participant profile detailing their counting experience using CPM 4.0,
- participated in a series of controlled test case exercises, based on the proposed CPM changes, using a draft, experimental version of the new CPM,
- provided comments on the proposed changes in the experimental version of the CPM, and
- submitted a variety of their own projects counted using both CPM 4.0 and 4.1 for comparison, along with project profile information.

The results of the test case exercises administered in September 1997 and April 1998, assured the CPC that the new CPM did enable the participants to identify the changes, and to correctly interpret and apply them.
The CPC then asked the participants to submit their own counted projects, and a project profile for each project submitted, for analysis. Of the projects submitted, 17 qualified for inclusion in the study. The criteria for submitted projects were:

- the projects must have been more that 100 function points according to CPM 4.0,
- the projects must have been new development or enhancement projects (software installation projects were excluded),
- the projects must have been completed, and

- the projects must have been delivered during the past 5 years.

The results of the impact study are summarized below:

Count Code	4.0 Count	4.1 Count	Change	% Change
1	280	247	-33	-11.79%
2	126	103	-23	-18.25%
3	316	296	-20	-6.33%
4	141	137	-4	-2.84%
5	161	154	-7	-4.35%
6	141	141	0	0.00%
7	184	184	0	0.00%
8	160	155	-5	-3.13%
9	359	345	-14	-3.90%
10	244	229	-15	-6.15%
11	237	237	0	0.00%
12	1376	1364	-12	-0.87%
13	209	209	0	0.00%
14	687	686	-1	-0.15%
15	659	606	-53	-8.04%
16	558	551	-7	-1.25%
17	157	157	0	0.00%
Total	**5995**	**5801**	**-194**	**-3.24%**

Conversion from CPM 4.0 to 4.1

Based on the results of the impact study, no conversion of counts previously performed using CPM 4.0 will be required. If your organization feels that the impact sample is not representative of your portfolio, reproduce the impact study locally to determine the difference for your organization using CPM 4.1. The CPC will make the test case exercise package used by the study participants available to the members upon request to the IFPUG office. This exercise can be used as a control to determine the level of understanding of the rule changes. If your data indicates something other than the results of the current impact study data, we request that you submit it to the CPC for inclusion with the study data.

Impact on 4.0 Users Changing to 4.1

The changes in counting practices will result in need for IFPUG committees to review the following documents to assure the conformance of the documents to CPM 4.1:

A. all IFPUG documents related to the CPM,

B. Case Studies 1, 2, 3, and 4, which will begin in 1999, and

C. Management Reporting Guides.

Although certification tests will be updated to reflect the changes, recertification from 4.0 to 4.1 will not be required.

Recommendations

The CPC recommends the following actions for users switching from CPM 4.0 to 4.1:

- Attend the workshop on the new manual the CPC is providing at the IFPUG Spring 1999 Training Sessions.
- Update all in-house developed training materials for conformance.
- Ensure all counters within your organization have been appropriately trained in the differences between 4.0 and 4.1.
- Check all vendor offered training materials for version certification.
- Notify anyone in your organization involved with function point counts of the change and make the new manual available to them.
- Review all counting tools for your users, both automated and manual, for IFPUG 4.0 version certification, if applicable, and modifications to conform to 4.1 counting rules.
- Although an additional certification will not be required for counters for CPM 4.1, the certification tests will be updated for conformance to 4.1 during 1999.
- Specify on the documentation for each function point count done, and with the results, which version of the CPM was used for the count.
- Make sure to specify which version of the IFPUG CPM was used for counting when submitting data for benchmarking either to your own benchmark database, the IFPUG Benchmarking committee, or ISBSG.
- Update all internal guidelines and other local documents related to 4.0 to version 4.1.

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IFPUG Glossary

This is a comprehensive glossary of terms used across IFPUG publications.

Adjusted function point count (AFP). The function point count based on the unadjusted function point count multiplied by the value adjustment factor. The adjusted function point count is calculated using a specific formula for development project, enhancement project, and application. The adjusted function point count is commonly called the function point count.

Albrecht 1984. Original document of the function point concept, written by Allan J. Albrecht in November 1984. Also known as "313" from its document number.

Application. A cohesive collection of automated procedures and data supporting a business objective. It consists of one or more components, modules, or subsystems. Frequently used synonymously with System, Application System, and Information System.

Application area. A general term for a grouping of applications that handle a specific business area. It corresponds to an administrative level for management purposes.

Application area level. The management level responsible for managing maintenance activities as well as new development or major enhancement projects for one or more applications.

Application Boundary. The application boundary indicates the border between the software being measured and the user.

Application function point count. A count that provides a measure of the current functionality the application provides to the user. It is also referred to as a baseline or installed function point count.

Application manager. A person responsible for managing projects and support activities for one or more application areas.

Asset. (1) A capital asset of the enterprise. (2) An advantage or resource.

Associative entity type. An entity type that contains attributes which further describe a many-to-many relationship between two other entity types. See also Entity type.

Attribute. See Project/application attribute and Data attribute.

Attributive entity type. An entity type that further describes one or more attributes of another entity type. See also Entity.

Baseline function point count. See Application function point count.

Budget. A planned sequence of expenditures over time with monetary costs assigned to specific tasks or jobs. Often used also to refer to work effort as well as, or instead of, money.

Capital expenditure. A form of spending in which an enterprise trades money (capital) for acquisition of tangible objects such as furniture, computers, and the like.

Complex processing GSC. One of the 14 general system characteristics describing the degree to which processing logic influences the development of the application.

Contribution. The function type's (ILF, EIF, EI, EO, EQ) contribution to the unadjusted function point count.

Control information. Control Information is data that influences an elementary process of the application being counted. It specifies what, when, or how data is to be processed.

Conversion. Those activities associated with mapping data or programs from one format to another, for example, converting an application from COBOL to VS COBOL II. The assumption is that functionality remains the same.

Conversion functionality. For a development project, functions provided to convert data and/or provide other user-specified conversion requirements, such as special conversion reports. For an enhancement project, functions delivered because of any conversion functionality required by the user.

Corporate executive level. The management level responsible for the enterprise, including the Board of Directors.

Counting Practices Committee (CPC). The working committee that maintains the IFPUG Counting Practices Manual.

Counting Scope. The counting scope defines the functionality which will be included in a particular function point count.

Data attribute. A characteristic of an entity. Data attributes are generally analogous to data element types (DETs).

Data communications GSC. One of the 14 general system characteristics describing the degree to which the application communicates directly with the processor.

Data element type (DET). A *data element type* is a unique user recognizable, non-repeated field.

Data functions. The functionality provided to the user to meet internal and external data requirements. Data functions are either internal logical files (ILFs) or external interface files (EIFs).

Defect. A problem which, if not corrected, could cause an application to either fail or to produce incorrect results. The absence of functionality that was specified or required is also considered a defect.

Defect removal. See Repair.

Degree of influence (DI). A numerical indicator of the amount of impact of each of the 14 general system characteristics, ranging from zero to five. These indicators are used to compute the value adjustment factor.

Delivery rate. The productivity measure for creating or enhancing an application. It is expressed by the Project Function Points divided by the Work Effort for the development or enhancement project.

Derived data. Data that requires processing other than or in addition to direct retrieval and validation of information from internal logical files and/or external interface files.

Development. The specification, construction, testing, and delivery of a new information system.

Development project function point count (DFP). A count that measures the functions provided to the users with the first installation of the software delivered when the project is complete.

Distributed data processing GSC. One of the 14 general system characteristics describing the degree to which the application transfers data among components of the application.

Effectiveness. Producing the intended or desired result.

Efficiency. Producing a result with a minimum of extraneous or redundant effort.

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

End-user efficiency GSC. One of the 14 general system characteristics describing the degree of consideration for human factors and ease of use for the user of the application measured.

Enhancement. The modification of an existing application.

Enhancement project function point count (EFP). A count that measures the modifications to the existing application that add, change, or delete user functions delivered when the project is complete.

Entity (or entity type). A fundamental thing of relevance to the user, about which a collection of facts is kept. An association between entities that contains attributes is itself an entity.

Entity subtype. A subdivision of an entity type. A subtype inherits all the attributes and relationships of its parent entity type, and may have additional, unique attributes and relationships. See also Entity type.

External input (EI). An external input (EI) 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. See also External inquiry and External output.

External inquiry (EQ). An external inquiry (EQ) is an elementary process that sends data or control information outside the application boundary. The primary intent of an external inquiry is to present information to a user through the retrieval of data or control information from an ILF or EIF. The processing logic contains no mathematical formulas or calculations, and creates no derived data. No ILF is maintained during the processing, nor is the behavior of the system altered. See also External input and External output.

External interface file (EIF). An external interface file (EIF) is a user identifiable group of logically related data or control information referenced by the application, but maintained within the boundary of another application. The primary intent of an EIF is to hold data referenced through one or more elementary processes within the boundary of the application counted. This means an EIF counted for an application must be in an ILF in another application. See also Internal logical file.

External output (EO). 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 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, or create derived data. An external output may also maintain one or more ILFs and/or alter the behavior of the system. See also External input and External inquiry.

Facilitate change GSC. One of the 14 general system characteristics describing the degree to which the application has been developed for easy modification of processing logic or data structure.

File. For data functions, a logically related group of data, not the physical implementation of those groups of data.

File type referenced (FTR). A *file type referenced* is

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

First normal form. Result of a normalization process that transforms groups of data so they have a unique identifier, one or more attributes, and no repeating attributes.

Foreign key. Data in an ILF or EIF that exists because the user requires a relationship with another ILF or EIF.

Function. The features or capabilities of an application as seen by the user.

Functionality. See Function.

Function point (FP). A measure which represents the functional size of application software.

Function point analysis. A standard method for measuring software development and maintenance from the customer's point of view.

Function point count. The function point measurement of a particular application or project.

Function type. The five basic information services provided to the user of an application and identified in function point analysis. The five function types are external input, external output, external inquiry, internal logical file, and external interface file.

Functional complexity. A specific function type's complexity rating which has a value of low, average, or high. For data function types, the complexity is determined by the number of RETs and DETs. For transactional function types, the complexity is determined by the number of FTRs and DETs.

General system characteristics (GSCs). The *general system characteristics* are a set of 14 questions that evaluate the overall complexity of the application.

Heavily used configuration GSC. One of the 14 general system characteristics describing the degree to which computer resource restrictions influenced the development of the application.

IBM CIS & A Guideline 313. See Albrecht 1984.

IFPUG. The International Function Point Users Group is a membership governed, non-profit organization committed to promoting and supporting function point analysis and other software measurement techniques.

Installation ease GSC. One of the 14 general system characteristics describing the degree to which conversion from previous environments influenced the development of the application.

Installed function point count. See Application function point count.

Internal logical file (ILF). 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. See also External interface file.

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

Maintenance. The effort to keep an application performing according to its specifications, generally without changing its functionality (or function point count). Maintenance includes repair, minor enhancement, conversion, user support and preventive maintenance activities. Activities include defect removal (see repair), hardware or software upgrades (see conversion), optimization or quality improvement (see preventive maintenance), and user support.

Maintenance (support) rate. The productivity measure for maintaining an application. It is expressed as the Work Effort by category of maintenance divided by 1000 Application Function Points in a period of time.

Mandatory subgroup. One of the two types of subgroups for record element types (RETs). Mandatory subgroups mean the user must use one of the subgroups during an elementary process that creates an instance of the data.

Measure. As a noun, a number that assigns relative value. Some examples may include volume, height, function points, or work effort. As a verb, to ascertain or appraise by comparing to a standard.

Measurement. Assigning relative value. Usually, in the improvement process, measures gained from this activity are combined to form metrics.

Media/Medium. A channel of communication or information, for example, a report issued on paper or in microfiche.

Metric. There is no single universal definition of a metric. In the context of this document, a metric is a combination of two or more measures or attributes. Examples include (1) defect density (defects per function point) and (2) delivery rates (function points per hour).

Multiple sites GSC. One of the 14 general system characteristics describing the degree to which the application has been developed for multiple locations and user organizations.

Normalization. The process by which any data structure can be transformed by a database designer into a set of *normalized* relations that have no repeating groups.

Online data entry GSC. One of the 14 general system characteristics describing the degree to which data is entered through interactive transactions.

Online update GSC. One of the 14 general system characteristics describing the degree to which internal logical files are updated online.

Operational ease GSC. One of the 14 general system characteristics describing the degree to which the application attends to operational aspects, such as, start-up, back-up, and recovery processes.

Optional subgroup. *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 or the data.

Organization level. The management level or levels responsible for managing one or more data processing or information systems organizations.

Performance GSC. One of the 14 general system characteristics describing the degree to which response time and throughput performance considerations influenced the application development.

Preventive maintenance. Changes to hardware or software performed to prevent future defects or failures. For example, restructuring programs or data to improve maintainability or to prevent defects.

Process measures. Information captured about the development process.

Processing logic. Any of the requirements specifically requested by the user to complete an elementary process, such as validations, algorithms, or calculations, and reading or maintaining a file.

Product measures. Information captured about the developed software application.

Productivity. The ratio of work product to work effort. See also Delivery rate.

Project. A collection of work tasks with a time frame and a work product to be delivered.

Project/application attribute. Characteristics of a project or an application that may have a significant impact on productivity. Examples include hardware platform, personnel experience, tools, and methodology. The project/application attribute is used to categorize project data during analysis.

Project leader. A person who manages or leads projects. May be a synonym for Project Manager.

Project level. The management level responsible for managing individual new development or major enhancement projects.

Project manager. A person who manages one or more projects or groups of projects.

Purpose of the Count. The purpose of a function point count is to provide an answer to a business problem.

Quality. Quality includes: conformity to user expectations, conformity to user requirements, customer satisfaction, reliability, and level of defects present. Context and policy will decide the best definition for a given situation.

Ratio. In the context of this document, ratio is defined as the result of dividing one measured quantity by another.

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

RECUP. Acronym for Repair/Enhancement/ Conversion/User support/Prevention. See also Maintenance (support) rate.

Relationship. An association of interest between two entities. A relationship does not have attributes and does not count as a RET when counting function points.

Release. A delivered version of an application which may include all or part of an application.

Repair. The correction of defects that have resulted from errors in external design, internal design, or code. Examples are missing functions that do not result in application failure (external design error) or errors resulting in a stop-run situation (code error).

Reusability GSC. One of the 14 general system characteristics describing 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

Scope creep/gallop. Additional functionality that was not specified in the original requirements, but is identified as the scope is being clarified and the functions defined.

Second normal form. Result of a normalization process that transforms groups of data so that each non-key attribute depends on the key attribute(s) of the group of data and all parts of the key attribute(s).

Software Engineering Institute (SEI) Maturity. The ability of an organization to achieve a controlled and measured process as the foundation for continued improvement (Humphrey). The level of experience of an organization or project with a particular tool, resource, technique, or methodology.

Subtypes. See Entity subtypes.

Support. See Maintenance.

System. See Application.

Third normal form. Result of a normalization process that transforms groups of data so that each non-key attribute does not depend on any other non-key attribute.

Total degree of influence (TDI). The sum of the degrees of influence for the fourteen GSCs.

Transaction rate GSC. One of the 14 general system characteristics describing the degree to which the rate of business transactions influenced the development of the application.

Transactional functions. The functionality provided to the user to process data by an application. Transactional functions are defined as external inputs, external outputs, and external inquiries.

Trend. A time analysis showing repeated occurrences of a particular measure or metric.

Unadjusted function point count (UFP). The measure of the functionality provided to the user by the project or application. It is contributed by the measure of two function types—data and transactional.

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

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

User view. A *user view* represents a formal description of the user's business needs in the user's language. Developers translate the user information into information technology language in order to provide a solution.

Value adjustment factor (VAF). The factor that indicates the general functionality provided to the user of the application. The VAF is calculated based on an assessment of the 14 general system characteristics (GSCs) for an application.

Work effort. Labor resources required for the production of a specified output. Here referring to the effort required to develop or maintain an application. Labor resources are usually expressed as work hours.

Work product. The product that is created by information systems work, here the result of a software development effort.

313. See Albrecht 1984.

ICS 35.080

Price based on 338 pages