An Investigation Into an Effective Method of Automatically Analysing Oracle Applications to Count Function Points

J. L. Wong

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AN INVESTIGATION INTO AN EFFECTIVE METHOD OF AUTOMATICALLY ANALYSING ORACLE APPLICATIONS TO COUNT FUNCTION POINTS

BY

J.L. Wong

A Thesis Submitted in Partial Fulfilment of the Requirements for the Award of

Bachelor of Science (Computer Science) Honours

at the

Faculty of Science, Technology and Engineering

Edith Cowan University

Date of Submission: June 1996
USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.
Abstract

Function Point Analysis (FPA) is a synthetic software estimation metric used for computing the size and complexity of applications. It was first introduced by Allan J. Albrecht during the mid-seventies, as a result of a lengthy research based on applications that were developed using COBOL and PL/1 programming languages.

The purpose of this research is to investigate the possibility, and the most effective method, of automatically performing a Function Point Analysis on Oracle applications that consist of Oracle Forms and Oracle Reports.

The research revealed a seemingly lack of other researches on this topic. As FPA was invented a few years prior to the birth of Oracle, and consequently that of fourth-generation languages, it had to be tailored to suit the fourth-generation language Oracle tools used to develop the Oracle applications. This experiment provided a proof of concept and resulted in a software that achieved its objective of automatically calculating Oracle applications, consisting of Oracle Forms and Oracle Reports, in an a posteriori manner.
I certify that this thesis does not incorporate, without acknowledgment, any material previously submitted for a degree or diploma in any institution of higher education and that, to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where due reference is made in the text.

Signature...

Date...June, 1996...
Acknowledgments

There are a number of people who have contributed to this research and to whom I am deeply grateful. In particular, I thank:

Dr Ken Mullin, my supervisor, for his valuable time in providing the continual guidance, encouragement, support, and feedback. His support has been invaluable.

Dr Thomas O'Neill, the Honours co-ordinator, for assisting with the formalities, getting the honours research rolling, and for being efficient thus reducing any unnecessary delays.

Assoc. Prof. Robert Cross for reviewing and approving the initial thesis proposal and for providing valuable feedback.

Oracle, the world's leading supplier of information management software, for expanding my knowledge in an extremely dynamic field and for providing research material.

My family for bringing me thus far and teaching me the values of life.

My fiance, Ronnie, for his love, motivation, support and for the inspiration to accept challenges.

God and the ever presence of the Holy Spirit.

And to all whom I have met along the way...
In Memory of

DAD
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Chapter 1: INTRODUCTION

This paper documents the outcome of research into the use of Function Point Analysis (FPA) to evaluate those applications that have been developed through the use of a group of tools manufactured by Oracle Corporation. This introduction consists of the theory behind Function Point Analysis (FPA) and its history of usage from the beginning to the present time. Following this account, a review of the current literature relating to the theory of FPA, and its practices, especially as related to Oracle applications is surveyed. The next section concentrates on the preparation of an effective method to automatically analyse Oracle applications using FPA. This will involve an analytical discussion of the possible methods for implementing the automated analyser and the issues relating to this implementation. Finally, the results of the implementation will be presented, and an appropriate conclusion will be drawn from these results.

Function Point Analysis

Function Point Analysis (FPA) is a synthetic software estimation metric used for computing the size and complexity of applications. It is a measure of the functionality of an application, as perceived by the user. Since its birth to the IT industry, FPA has been successfully adopted by a number of large organisations (Heemstra, 1991) who varied the metric slightly to better suit their environment. The popularity of FPA has continued to grow steadily since the seventies and has become the predominant estimation method used in the IT industry. There are now many large databases of completed projects and their function point counts. (Weaver, 1989)
FPA was first introduced by Allan J. Albrecht (IBM, 1975) during the mid-seventies, as a result of lengthy research on applications that were developed using COBOL and PL/1 programming languages (Ferens, 1992). The inspiration for his research was to originate an alternative method to the traditional Source Lines of Code (SLOC) metric which was prevalent, but seemingly inadequate, at the time. FPA was to be used as a more substantial metric to estimate the cost and effort required to complete an application.

Using the original FPA metric, the estimate of the cost and effort required for software development was derived from a calculation of the number of function points associated with the application to be sized. This function point value was calculated based on two groups of parameters that were deemed from the user's perspective to be influential on the estimate:

1. The application attributes and
2. The environmental factors

The five attributes relating to the program to be estimated, which have been identified by Albrecht are:

- the number of external input types (EI)
- the number of external output types (EO)
- the number of external inquiry types (EQ)
- the number of internal logical files (ILF) and
- the number of external interface files (EIF).

This first equation assumes that all the attributes have an “average” rating and is computed as follows:

\[ \text{BFP} = 4\text{EI} + 5\text{EO} + 10\text{ILF} + 7\text{EIF} + 4\text{EQ} \]
where BFP is the "Basic Function Points". (Behrens as cited by Ferens)

To refine the estimation technique further, Albrecht proposed two areas of enhancements. Firstly, each item belonging to an attribute is classified as having "low", "average", or "high" complexity and then an appropriate weighting is assigned. For example, when examining the External Input component, the level of complexity would be determined using the following table:

<table>
<thead>
<tr>
<th>DET (# columns)</th>
<th>FTR (# tables)</th>
<th>1-4</th>
<th>5-15</th>
<th>16+</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

Table 1

Note that the Data Element Type (DET) refers to the number of attributes/columns used by the module and the File Type Referenced (FTR) is "counted for each entity, table or file" used by the module. (Oracle, 1995)

The table shows that an EI module with five to fifteen data element types has a low level of complexity if it contains zero to one file type referenced, an average level of complexity if it contains two FTR, and high complexity if it contains more than three FTR. In relation to Oracle applications, the number of FTR maps to a count of the number of relevant tables, and the number of DETs maps to the associated table columns referenced. A detailed discussion is provided in the next chapter.
Using the complexity rating, the weighting for each of these application components can be obtained by referring to the following table (Ferens, 1992),

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Low</th>
<th>Average</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs (EI)</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Outputs (EO)</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Data Files (ILF)</td>
<td>7</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Interfaces (EIF)</td>
<td>5</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Inquiries (EQ)</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2

This results in the “Unadjusted Function Points” (UFP).

Once the environmental factors are applied to the UFP, the final adjusted function points (FP) will be obtained. The adjusted function points is obtained by summing up the ratings of the environmental factors, totalling to fourteen different characteristics, which results in a value known as the “total degree of influence” (TDI).

The fourteen characteristics comprising the group of environmental factors, with definitions provided by Dreger (1989, pp.63-4), are listed as follows:

1. Data Communications - “means that data or control information used in the application is sent or received over data communication facilities - including not only various networks, concentrators, multiplexers, and private lines, but also the terminals locally connected. Online systems will always have at least some data communication influence.”

2. Distributed Data/Processing - “indicates the application uses data stored, accessed, or processed on a storage or processing system other than the one used in the main program
routines. Note that presence of this factor increases the data communications influence previously defined."

3. Performance Objectives - "influence system design, development, implementation, and support when specific, user-approved demands for exceptionally high throughput or fast response times have been made."

4. Heavily-Used Configuration - "this factor is especially important to a user already lacking computer capacity but unable to purchase or acquire more hardware or upgraded software."

5. Transaction Rate - "a high transaction rate can occur when the network consists of many data entry or inquiry terminals, when each screen transmitted contains a lot of input information, or when the frequency of screen transmission is high."

6. On-Line Data Entry - "(including control and security functions) are always more difficult to accommodate than similar batch systems; hardware, application software, and operating system software are all affected by the additional requirements of an on-line system."

7. End-Use Efficiency - "human-factor features...designed to increase the level of "user-friendliness" and include such things as conventional data entry (requiring multiple sequenced screens), help screens, "next format" fields, paging capabilities, more descriptive documentation (including user manuals and "learner-friendly" training materials), second-language input/output screens and messages, and additional edit, error, and exception handling routines."

8. On-Line Update - "as are on-line inquiry and data entry more difficult than batch, so is on-line update of files and data sets more difficult because of the short turnaround time and its widespread effects on all system design components."
9. Complex Processing - "refers to the situation in which an application requires substantially
greater than average difficult in input or output processing; in logic file, or numeric
manipulation; or in exception handling routines."

10. Reusability - "refers to the situation in which some of an application's routines,
subroutines, or other procedures have been designed or written with uses in mind other
than just the program under evaluation."

11. Conversion/Installation Ease - "increases the difficulty of application development but
reduces the number and severity of problems in testing and implementation."

12. Operational Ease - "is not the same as end user efficiency." The purpose of this factor is
"to provide effective but easy startup, backup, error recovery, and shutdown procedures,
and to minimize such manual activities as mounting tapes or special forms, handling
paper, or responding to requests for information at the operator console."

13. Multiple Site Use - "when the application has been specifically designed, developed, and
supported for installation at multiple sites, for multiple organizations, additional co-
ordination, review, and approval is required even if no site-unique code needs to be
written."

14. Facilitate Change - "when the application has been specifically designed, developed, and
supported to facilitate change, it requires increased attention to and planning for future
maintenance and modification needs."

Based on the degree of influence that one expects from each of the characteristics, a rating of 0
(no influence) to 5 (highly influential), with an average influence rating of 3, is performed,
preferably by the system user. Dreger (1989) suggests the inclusion only of those factors that:

- clearly benefit the user,
are specifically approved by the user, and influence to a measurable degree the design, development, implementation, or support of an application."

Once the ratings of the fourteen characteristics have been summed to derive the TDI, the following equation is used to compute the adjusted function points. Note that the TDI can alter the UFP by up to 35% in either direction.

\[ FP = UFP \times (0.65 + 0.01 \times TDI) \]

Function points were derived as a means of assessing the functionality of an application. Subsequent research (Ferens et al., 1992; Kansala & Kitchenham, 1993) showed the measure to correlate well with the effort required to develop the application, provided development environment and individual skills were similar. Thus FP are a useful measure of effort as well as functionality.

**Research Objective**

The objective of this research is to investigate how FPA can be tailored to count the number of function points in given Oracle applications that have been developed using Oracle Forms and/or Oracle Reports. Once the investigation has been completed, and a clear plan has been devised, an application will be developed for the automatic calculation of function points for a given Oracle application. The resulting application will serve as a highly useful tool for its users. In particular, it

- Will eliminate "laborious hand counting of function points." (Internet: Funenet)
• Will provide a consistent means of estimating the size of different Oracle applications. (Low, 1990)
• Will be independent of the technology that has been used for its development.
• Will enable lecturers to assess the effort that went into student Oracle projects.

Note that to satisfy the final point, the resulting application will be required to execute a function point analysis in an “a posteriori,” that is, after the system development phase. (Hignite, Johnson, Foster, 1993).

Upon completion, this will be one of the few pieces of research that focuses on the usage of FPA to automatically count the number of function points in an Oracle application.

**Problem Question**

The research question pertaining to this project is as follows:

What is a most effective way of automatically counting the function points in an Oracle application consisting of forms and reports?
Prior to the invention of Function Point Analysis (FPA), the primary software estimation metric used was the Source Lines of Code (SLOC) metric. The major drawback with this metric is that it does not measure software productivity, which the standard economic definition describes as, "Goods or services produced per unit of labor and expense." Relating to this economic definition, the SLOC metric fails to measure software productivity due to the following reasons (Jones, p.45):

1) Lines of code are neither 'goods' nor 'services'. Thus, measuring the lines of code does not provide a good measurement of software productivity.

2) Lines of code are not the primary deliverable for customers. Customers are not concerned with the number of lines that comprise a completed piece of software, nor are they interested in the programming language used for the source code. In fact, if a piece of software could be developed in a higher-level language, thus generating less code in the final product to provide cost reduction benefits, it would serve as a preferred option, from the customer's point of view.

The deficiency in the SLOC metric inspired the emergence of the Function Point metric. The function point computation is based on those components deemed as important, or of interest, to the customers, and qualify as a quantifying characteristic of the term 'goods' that exists in the economic definition of productivity.

Since its emergence, a number of research projects have been conducted on FPA, focussing on the comparison to SLOC, with favourable outcomes. As an example, research performed by
Kremer (1987), revealed that the two function point models used, ESTIMACS and an Albrecht-derived model, produced estimates that were much more accurate than the two SLOC-based models, PRICE-S and SLIM. The research was based on the comparison of the estimated figures with the actual effort of fifteen, mostly COBOL, applications.

This observation is supported by similar research, conducted by Low & Jeffery (1990), on COBOL and PL/1 business programs which indicated that the function point metric was a more consistent size estimator than the SLOC metric. The function points counted correlated with the effort. This makes FPA a good estimating tool. (Ferens, 1992)

Although many authors, such as (Yau, 1995), (Tsoi, 1995), and (Heemstra, 1991), agree that FPA is widely used and is also a successful method (Betteridge, 1993) for software estimation, a number of significant issues and possible areas of improvement also exist and should be addressed. These areas include:

1) The need for an easier method of defining and counting the application components. One of the major obstacles associated with counting the number of function points within a program is the identification and calculation of the number of inputs, outputs, data files, inquiries, and interface files. A variation of the original Albrecht's FPA is Mark II Function Points which was developed by Symons (Symons, 1988). It attempts to simplify the original method of FPA by using only three of the program attributes, namely the inputs, the outputs, and the entity references of each logical transaction (Betteridge, 1992). Ferens explains that the absent attributes can be neglected since the "external interfaces and inquiries are treated as inputs or outputs, and internal files are 'replaced' by a measure of entity types referenced by transactions."
2) A need to ascertain the accuracy of estimation models using function points. Rask, Laamanen, and Lyytinen (1993, p.661) stated that “the quality of a cost estimate is a function of how it compares with the actual result.” The observation made by Ferens (p.635) on Kremer's study involving the application of the function point models ESTIMACS and an Albrecht-derived model on fifteen (mostly COBOL) programs revealed that “for even the most accurate model, ESTIMACS, the estimates averaged 85% higher than actual levels of effort.” However, Ferens’ own study of applying three FP models, the SPANS (Tecolote Software Program Acquisition Network Simulation) model by Tecelote Research Inc., the Checkpoint model by Software Productivity Research, and the Costar model by Softstar Systems, to estimate thirty-six (mostly COBOL) business programs appeared to indicate that the “calibration of models, or adjusting models to a particular environment, appears to be a worthwhile endeavour if greater accuracy is sought.” This is confirmed by Betteridge's (1992) study which compared the results derived from an FPA method, with the managers’ estimates and the actual expenditure. Betteridge (1992) concluded that “the results give some cause for optimism in the use of the function point model that was used (Mark II).”

3) FPA requires an assessor, commonly the main user(s), to rate a set of 14 general system characteristics. These characteristics, including Reusability, Facilitate Change, Performance, are all subjective elements. Even though these subjective elements are used in FPA, the result given does not show the statistical confidence interval, that is the assessor’s confidence level of the general system characteristics being rated subjectively. To overcome this inability to assess the confidence level of the estimate, Tsoi & Yau (1995) introduced fuzzy logic to the FPA model, that is, a “fuzzified FPA” (FFPA).
The FFPA method, proposed by Tsoi et al (1995), is based on the traditional FPA. The contrast lies in the determination of the Technical Complexity Factor which is derived from an evaluation of the ratings given to the fourteen general system characteristics.

The fourteen general system characteristics are rated not only on a score of 0 (no influence) to 5 (Highly influential), as exists in the traditional FPA, but also on the assessor’s linguistic degree of certainty rating of Almost Certain, Very Likely, Probably, Unlikely, and Extreme Unlikely. For example, an FFPA assessor may give an estimate of “Very Likely 3” to the Performance system characteristic and “Unlikely 1” to the Reusability system characteristic.

For each of the estimates given by an FFPA assessor, an Fuzzified score for General System Characteristics (GSC) can be obtained by referring to the following table (Tsoi et al, 1995).

<table>
<thead>
<tr>
<th>Score 0</th>
<th>Score 1</th>
<th>Score 2</th>
<th>Score 3</th>
<th>Score 4</th>
<th>Score 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Likely</td>
<td>from 0 to 0.25</td>
<td>from 0.75 to 1.25</td>
<td>from 1.75 to 2.25</td>
<td>from 2.75 to 3.25</td>
<td>from 3.75 to 4.25</td>
</tr>
<tr>
<td>Probably</td>
<td>from 0 to 0.5</td>
<td>from 0.5 to 1.5</td>
<td>from 1.5 to 2.5</td>
<td>from 2.5 to 3.5</td>
<td>from 3.5 to 4.5</td>
</tr>
<tr>
<td>Unlikely</td>
<td>from 0.75 to 5</td>
<td>from 0 to 1.75; from 1.75 to 5</td>
<td>from 0 to 2.25; from 3.75 to 5</td>
<td>from 0 to 3.25; from 4.75 to 5</td>
<td>from 0 to 4.25;</td>
</tr>
<tr>
<td>Extreme Unlikely</td>
<td>from 1 to 5</td>
<td>from 2; from 3 to 5</td>
<td>from 0 to 1; from 3 to 5</td>
<td>from 0 to 2; from 4 to 5</td>
<td>from 0 to 3; from 4 to 4</td>
</tr>
</tbody>
</table>

Table 3: Fuzzified Score for GSC

The final Fuzzified FPA count will consist of a range of values, to reflect the confidence level. The following is an example given by Tsoi et al (1995) to illustrate the calculation performed using FFPA to derive the FP count:
TCF (FPA) = 0.65 + (0.01 * 48) = 1.13
TCF\text{min}(\text{Fuzzified FPA}) = 0.65 + (0.01 * 44) = 1.09
TCF\text{max}(\text{Fuzzified FPA}) = 0.65 + (0.01 * 51.5) = 1.165

Function Point Computed (FP):
FP (FPA) = 211 * 1.13 = 238.43
FP\text{min}(\text{Fuzzified FPA}) = 211 * 1.09 = 230
FP\text{max}(\text{Fuzzified FPA}) = 211 * 1.165 = 245.815

As Tsoi et al (1995) explains, "it has been expected that the FPA result falls in the range of the FFPA result, from 230 to 245.815. There is around 8% difference of DI (Degree of Influence) between the two models."

Tsoi et al (1995) concludes that the estimates provided by this Fuzzified version of FPA "have been found more informative than the conventional FPA" and that "the range of estimates allows the project management to conduct contingency planning more effectively."

4) Estimation of fourth generation (4G) applications. Since FPA was invented prior to the existence of 4G languages, there may be possible areas of improvement to accommodate for 4G applications. An investigation carried out by Van Wonderen (1991) revealed that "improvements are necessary, particularly for the estimation of interactive 4th-generation language applications." This issue is particularly relevant to this research, as the applications to be automatically function point counted are developed using Oracle Forms and/or Oracle Reports which are considered to be 4G development tools. The issues relating to the usage of FPA to 4GLs and Oracle applications will be covered in a later chapter.

5) FPA is not readily adaptable to real-time, scientific environments. Jones (p.76), as cited by (Alford, 1991), explains that FPA "is not widely used for real time systems, military systems, or any other kind of software where algorithmic complexity is high and data complexity is low." Inspired by this, Jones proposed an adaptation of function points, known as Feature Points, to allow for the real-time environment. Feature Points uses the
five attributes proposed by Albrecht. The differences between the two metric concepts lie in the different weightings assigned to the internal file attribute, and also in the new attribute, *algorithmic complexity* (A), introduced in Feature Points. The new equation for the *Basic Feature Points* (BFEA) is

\[ BFEA = 4EI + 5EO + 7ILF + 7EIF + 4EQ + 3A \]

compared to  \[ BFP = 4EI + 5EO + 10ILF + 7EIF + 4EQ \]
(as shown previously)

Note: 7 + 3 = 10 i.e. Points of algorithmic complexity weighted same as ILFs.

**FPA and Oracle**

The literature research to date has not revealed any studies on the use of FPA models on Oracle applications. To achieve the objective of this project, it would be necessary to investigate how the definitions of the function point parameters, and the function point counting rules apply to Oracle applications. Once this has been established, it would be a natural progression to automate the function point computation for Oracle applications.
Chapter 3: METHODOLOGY OF RESEARCH

The research into a most effective way of automatically counting the number of function points in any given Oracle application followed this method:

1. Investigate how FP counting can be applied to Oracle applications, including whether this has been achieved elsewhere.

2. Analyse the structure of Oracle forms & reports to determine how the application components can be counted.

3. Determine the best automated method to do this counting.

4. Design an automatic method of analysing this structure to count inputs, outputs, inquiries, data files, and interfaces.

5. Set up the development environment.

6. Develop the software.

The remainder of the thesis follows this methodology.
Chapter 4: FP COUNTING IN RELATION TO ORACLE APPLICATIONS

An extensive literature search, with sources ranging from libraries to the Internet World-Wide Web, revealed a deficiency in previous researches, let alone the production of software, on the automatic counting of function points in Oracle applications. In fact, the only enlightening literature discovered that related to this subject was from an Oracle manual, titled QMS Project Management. This is a Quality Management Systems manual produced for project managers intending to develop quality systems. The manual contains a chapter on estimating projects, which contains a section on FPA. The automatic function point counting software resulting from this investigation was developed based mainly on the function point theory presented in this manual. This theory closely follows the IFPUG standard.

Steps to manually calculate Function Points in Oracle applications.

STEP 1. Generate a full text description of the Oracle Forms or Oracle Reports application - the Module Documentation.

FOR ORACLE FORMS APPLICATIONS:

a. Start up Oracle Forms Designer 4.5
b. File | Open then specify the name of the application eg. emp.fmb
c. File | Administration | Form Doc

FOR ORACLE REPORTS APPLICATIONS:

a. Start up Oracle Reports Designer 4.5
b. File | Open then specify the name of the application eg. dept.rpt
c. File | Administration | Report Doc
The text version, e.g. emp.txt & dept.txt, should now be generated. This text file is then parsed for the application attributes (steps 2-5).

STEP 2. For each form or report module, count the number of base tables referenced.

Oracle (1994) defines a base table as one that is "associated with a specific database table or view." Base tables are associated with base table blocks within Oracle Forms.

STEP 3. For each form or report module, count the number of base table columns referenced.

Oracle (1994) explains that the base table columns "correspond directly to columns in the block's base table." They should correspond to a base table elected in the previous step.

STEP 4. Count the number of accumulated non-base tables referenced in the application.

Non-base tables are commonly referenced in select statements, such as those belonging to a record group (forms) or belonging to queries (reports). A SQL select statement may contain references to more than one table. Caution must be exercised in counting the number of tables referenced as, for example, select statements can be nested within each other.

STEP 5. Count the number of accumulated non-base columns referenced in the application.

This is similar to the count of the number of non-base tables referenced, as detected in the previous step. This involves a count of the number of associated columns referenced and can be an intricate process. Consideration must be made for such instances as nested calls to built-in functions. For example, select nvl(round(max(salary), 2), 0) from...

STEP 6. Determine the complexity rating for each component. (Hignite et al, 1993)

External Input: For each non-query-only form module, determine the complexity rating by applying the number of base tables and their columns, derived in Step 2 and Step 3, to the following table (Oracle, 1995)
<table>
<thead>
<tr>
<th># base table columns</th>
<th>1-4</th>
<th>5 - 15</th>
<th>16+</th>
</tr>
</thead>
<tbody>
<tr>
<td># base tables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>3+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 4

External Output: For each report module, determine the complexity rating by applying the number of base tables and their columns, derived in Step 2 and Step 3, to the following table (Oracle, 1995)

<table>
<thead>
<tr>
<th># base table columns</th>
<th>1-5</th>
<th>6 - 19</th>
<th>20+</th>
</tr>
</thead>
<tbody>
<tr>
<td># base tables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2 - 3</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>4+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 5

External Inquiry: For each query-only form module, determine the complexity rating by applying the number of base tables and their columns, derived in Step 2 and Step 3, to the following table (Oracle, 1995)

<table>
<thead>
<tr>
<th># base table columns</th>
<th>1-4</th>
<th>5 - 15</th>
<th>16+</th>
</tr>
</thead>
<tbody>
<tr>
<td># base tables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>3+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 6
Internal Logical Files: An internal entity/table is one that is maintained by the application through creation/deletion/update. Determine the complexity rating by applying the number of tables and their columns, derived in Step 4 and Step 5, to the following table (Oracle, 1995)

<table>
<thead>
<tr>
<th># columns referenced</th>
<th># tables referenced</th>
<th>1-19</th>
<th>20-50</th>
<th>51+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>2-5</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>6+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

Table 7

External Interface Files: An external entity/table is one that is used by the application through retrieval. Determine the complexity rating by applying the number of tables and their columns, derived in Step 4 and Step 5, to the following table (Oracle, 1995)

<table>
<thead>
<tr>
<th># columns referenced</th>
<th># tables referenced</th>
<th>1-19</th>
<th>20-50</th>
<th>51+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>2-5</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>6+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

Table 8

Step 7. Determine the total number of Unadjusted function points.

The complexity ratings derived from the above steps are then converted into function points by applying the ratings to this table. (IFPUG, 1990)
Step 8. Calculate the Total Degree of Influence (TDI).

The TDI calculation is based on the summation of the fourteen general system characteristics, commonly elected by the system users. A rating (Oracle, 1995) of

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Average</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>EI</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>EO</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>EQ</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>ILF</td>
<td>7</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>EIF</td>
<td>5</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 9

is applied to each of the fourteen characteristics. The fourteen characteristics that relate to the general functionality of the application is as follows:

1. Data Communications
2. Distributed Data/Processing
3. Performance Objectives
4. Heavily-Used Configuration
5. Transaction Rate
6. On-Line Data Entry
7. End-Use Efficiency
8. On-Line Update
9. Complex Processing
10. Reusability
11. Conversion/Installation Ease
12. Operational Ease
13. Multiple Site Use
14. Facilitate Change

Step 9. Calculate the Technical Complexity Factor (TCF).

Use the following formula (Hignite et al, 1993) to compute the TCF:

\[
TCF = (TDI \times 0.01) + 0.65
\]

Step 10. Calculate the Total Function Points (TFP).

Finally, the total FP count can be derived by applying the following formula (Hignite et al):

\[
TFP = TCF \times \text{Unadjusted function points}
\]

Once a method of manually counting the number of function points for any forms/reports-based Oracle application was identified, the next challenge was to automate this process. An evaluation of these methods are discussed in the next section.
Chapter 5: FP COUNTING IN RELATION TO ORACLE APPLICATIONS

ISSUES

Since FPA was invented prior to the existence of 4G languages, there are a number of issues relating to the use of FPA to estimate Oracle applications that have been developed using Oracle Forms and/or Oracle Reports which are considered to be 4G development tools. These include

- The distinction between an input screen and an inquiry screen
- Categorisation of the List of Values (LOV) feature
- The determination of Internal Logical Files and External Interface Files.

The Input/Inquiry distinction

The IFPUG definition, as provided by Oracle (1995), states that an external input is one that "processes data or control information which enters the application's external boundary." When applied to 4GL applications, specifically to those developed using Oracle Forms, an external input could be referred to a screen developed using Oracle Forms, since a screen allows the input of data. One of the advantages of using Oracle Forms to develop screens for user inputs is that, by default, the data inquiry facilities are also provided by the input screen. This is where the complication of applying FPA to Oracle applications arise. How does one distinguish between an external input and an external inquiry in Oracle applications?

While FPA draws a distinction between external inputs and external inquiries, this is not necessary for Oracle Forms applications since both the input and inquiry features are typically
included in the same screen. To cater for these differences when using FPA to estimate Oracle applications, one can categorise an input/query screen as either:

- an external input only
- an external inquiry only or
- both an external input and an external inquiry

The preferred option to be used is entirely based on the individual estimator's preferences. The automatic calculation of function points in Oracle applications prototype software developed in conjunction with this documentation defines an input/query screen as an external input only. The explanation for this follows.

Although a screen developed using Oracle Forms allows both input and inquiry features by default, these features can also be toggled to be enabled or disabled. Thus, a screen can be either:

- an input only screen
- an inquiry only screen
- an input/inquiry screen or
- a non-input/non-inquiry screen.

To distinguish between an external input and an external inquiry, an Oracle Forms screen is only deemed to be an external inquiry if it is a query-only form. Based on this logical definition, the above selection of screens is categorised as follows:
<table>
<thead>
<tr>
<th>Screen Type</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input only screen</td>
<td>External input</td>
</tr>
<tr>
<td>Inquiry only screen</td>
<td>External inquiry</td>
</tr>
<tr>
<td>Input / inquiry screen</td>
<td>External input</td>
</tr>
<tr>
<td>Non-input / non-inquiry screen</td>
<td>neither.</td>
</tr>
</tbody>
</table>

Table 10

When parsing the Oracle Forms text file, the automatic parser should search for the

<table>
<thead>
<tr>
<th>Insert Allowed</th>
<th>Query Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>True/False</td>
<td>True/False</td>
</tr>
</tbody>
</table>

properties listed under the block(s) associated with the input/inquiry screen to determine the input/inquiry status. This will allow the classification of the screen as an external input or an external inquiry.

**Categorisation of LOVs**

A screen developed using Oracle Forms may contain one or more instances of a List of Values (LOV) to facilitate the ease of input. These are commonly known as “look-up tables.” A LOV may be based on a record group which may query one or more database tables. An example of the use of an LOV is the entry of a postcode value belonging to an address section of a personal details screen. Rather than relying on the user to remember the postcode values for all suburbs, the postcode field may be implemented to use a LOV which queries the postcode database table to return a list of all of the suburbs and their associated postcodes. Once a suburb and its associated postcode is selected, the postcode field will be populated with the selected value.
If a LOV is based on a record group that queries one or more database tables, it should be classified as an external inquiry. This is a sensible assumption as a user is likely to perceive this LOV as a query.

When parsing the Module Documentation of the Oracle Forms/Reports, the automatic parser should search for the LOV property to ensure that an LOV is attached to a text item. This property would have a value of <null> if an LOV was not attached to it. An example illustrating an item with the postcode_lov attached is:

```
LOV postcode_lov
```

Once it has been established that an LOV is attached to a text item, the next step would be to ensure that the LOV attached is based on a record group. To do this, the parser should search for the properties, under the LOV section. Once this has been established, the parser can search for the Record Group Query property under the record group section to obtain the query statement used for this record group. For example,

```
Record groups
Name Postcode_query
...
 Record Group Query select distinct code, suburb from postcodes
```
These steps will allow the estimator to determine whether an LOV is based on a query of one or more database tables and if so, the database tables and columns that are used. This information will allow the estimator to determine the complexity rating for the external inquiry.

Internal Logical Files & External Interface Files

Oracle (1995) describes an internal logical file as an “entity which is maintained by the application, in other words: the CRUD matrix contains at least one C, U, or D for this entity”, and an external interface file is defined as “an external entity .. with an R in the CRUD matrix.” The CRUD matrix refers to the Create, Retrieve, Update, and Delete functionality. Based on these definitions, it may be worthwhile to note that the internal logical files (ILF) and the external interface files (EIF) are applied to the entire application. Therefore, the complexity rating should be applied to the accumulation of these entities for the entire application rather than for each separate module.

The automatic calculation of function points in Oracle applications prototype software developed in conjunction with this documentation defines the base tables as external entities. A base table is typically associated with a block within a screen.

As for the internal entities, the software parses the application text file for keywords: create, update, and delete to determine the existence of internal entities. The existence of such entities are rare in typical Oracle applications.
The accumulated count of internal and external entities are used to determine the complexity ratings for the ILF and the EIF.

In conclusion, it is important to note that although the customisations made by an estimator for the application of FPA to a 4GL application, such as Oracle, is crucial, it may not be as significant as the consistent usage of the same method for all of the applications to be estimated.
Chapter 6: ANALYSE THE STRUCTURE OF ORACLE FORMS & REPORTS

An Oracle application typically consists of a number of input screens, to allow user interaction with the data within database tables, and the facility to generate reports through the retrieval of data from the database tables. For example, an order entry system application may consist of order input/inquiry screens and order reporting facilities. Each of the components of an Oracle application are discussed in detail to provide a general overview of the concepts behind forms, tables and reports.

Forms

An input/inquiry screen within an Oracle application is typically designed using the Oracle Forms Designer development tool. When using Oracle Forms Designer to create an input screen, an inquiry facility is provided "free" to the same screen without additional effort required to update the form design.

A form is a logical collection of blocks, items, triggers and procedures. A block is a logical collection of fields in a form. It may correspond to, at the most, one table. A database table on which a block is based upon is known as a base table. Those items that are based upon these base tables are known as a base table items.

An item field is an area that is capable of accepting and displaying data. To facilitate the entry of data, an item field can appear in one of a number of different forms, including list items,
radio buttons, checkboxes, text items that allow data inputs, and display items that do not allow data inputs. The data displayed can correspond to a column in a database table.

A List of Values (LOV) is another way of assisting users to enter data in an item field. An LOV is a look-up table that consists of a query to a database table. An LOV may be associated with a text item. An example of the use of an LOV is for entering the customer code within an Invoice screen. Instead of relying on the user to memorise the customer codes for all existing customers, an input/inquiry screen may attach an LOV to the customer code item. This LOV may be based on a query that retrieves the customer codes and names for every customer in the database table.

Triggers and procedures within forms contain programming logic that may include read/write to database tables. The logic within these components can be written in PL/SQL. (Oracle, 1986)

Reports

Oracle Reports Designer is typically used for the reporting components of Oracle applications. To specify the data definitions within Oracle Reports Designer, a data model is created. A data model consists of the following data definition objects: queries, groups, columns, parameters and links.

Report queries consists of SQL SELECT statements written to fetch data from database table(s). An analysis of the report queries will reveal the tables and columns that have been referenced by a report. Once a query has been specified, groups and columns will be created
to reflect the query. Groups contain columns and are used primarily to create breaks in a report.

Links are used to specify parent-child relationships between one SELECT statement and one or more other SELECT statements.

Parameters are variables to which a user can assign values at runtime. The two types of report parameters are system parameters and user-defined parameters. It is the user-defined parameters that are relevant to the counting of function points since they may contain SQL SELECT statements to fetch data from database tables. (Oracle, 1988)
Chapter 7: LIST & EVALUATE POSSIBLE AUTOMATIC COUNTING

METHODS

There is more than one way of implementing the automatic counting of the number of function points within an Oracle application. This section will highlight three of the more likely methods of achieving this and will provide a logical evaluation of these methods. These methods are:

• Using Designer/2000 (Oracle's CASE tool)
• Using SQL*Plus
• Parsing the Module Documentation.

METHOD 1: Using Designer/2000 (CASE)

Designer/2000, the most recent version of the Oracle CASE software, is capable of generating a number of reports, based on the parameters given. A group of these reports are based on Function Point Analyses. A sample of the printouts of these FPA reports is provided in Appendix A, and they are listed as follows:

Mkl FPA Analysis Level - CDFPA1A
Mkl FPA Design Level - CDFPA1D
FPA Analysis Level (DFDs & Event Models) - CDFPA2A
FPA MkII (Design1) - CDFPAD1
FPA MkII (Design2) - CDFPAD2
Area Metric - CDMETRIC
Advantages

These reports provide a detailed analysis of the application system requested by the user, for the purpose of function point analysis. The technique of counting the number of function points is controlled by Designer/2000 and is stored internally. This automatic computation of function points saves the user time which would have been expended on grasping the workings of Function Point Analysis and also on manually counting the function points for each individual module to be estimated. Since the same method is automatically applied by Designer/2000 to compute the number of function points in any given Oracle module, the results obtained are expected to be consistent.

Disadvantages

It appears that to take advantage of this utility, the Oracle application to be analysed must be designed and generated by Designer/2000, and stored in the database. This may pose an unnecessary obstacle if the applications were developed as a direct usage of Developer/2000, or more specifically, Oracle Forms Designer and Oracle Reports Designer. In this case, however, the Reverse Engineering utility provided by Designer/2000 may serve as a viable option.

The Reverse Engineering utility attempts to capture the data/functional design of an Oracle application in the CASE tool. When reverse engineering a forms module using Module Data Diagrammer, the blocks within the forms are translated to entities, the items to attributes, and the relationships (defined through the presence of the foreign key constraints) are translated to the relationships between entities. This process will result in a data diagram displaying the entities, their attributes, and the relationships between entities. In addition to this, the
properties of each of the elements within this data diagram provide further information that are relevant to the element highlighted. For example, the properties of an attribute contain information including whether it is updateable, and whether it is queryable. The data diagram produced will assist in function point counting.

The main obstacle with the use of Designer/2000 to generate FPA reports is the requirement of the Designer/2000 software, which in turn, demands an increase in the hardware requirements. It cannot be done easily, or definitively.

Conclusion: viable but difficult.

METHOD 2: Using SQL*Plus

Prior to the development of an Oracle application, the usual practice asserts the creation and population of tables in the database first. This is normally achieved through the execution of a Data Definition Language SQL script. By parsing this SQL script, or querying the database after the creation of the tables, one would be able to retrieve such information as the number of tables and columns that exist in the database. For example, the script

```
select table_name from user_tables;
```

would list all of the tables that exist in this database.

Advantages

This appears to be a simple method of collecting information, such as a count of the number of tables and columns, to assist the performance of a FPA. The simplicity is partly due to the
ease of data collection using SQL, and also partly due to the sole requirement of the standard SQL*Plus product which is a common product for Oracle developers.

**Disadvantages**

However, upon further examination, one should be convinced that this method provides insufficient data.

Firstly, the mere creation or existence of a table in the database does not guarantee its usage by the application to be function point analysed. A table in the database may not be referenced by the application to be analysed at all. There appears to be a lack of an easy solution to differentiating between those tables that are, and those that are not, relevant to the function point analysis of an application.

Furthermore, one cannot distinguish whether a table in the database that is referenced by an application is referenced as a base table for a block or referenced by a radio group in a `select` statement.

Conclusion: not viable.

**METHOD 3: Parsing the text files of Oracle Forms & Oracle Reports**

The conversion of an Oracle Forms or Oracle Reports binary file to its text equivalent, Module Documentation, is a simple process that can be achieved by following the instructions provided in the first step of the previous chapter.
Advantages

The Module Documentation (MD) covers detailed information regarding the forms/reports module. Relating to FPA, the MD incorporates all of the necessary information to perform a function point calculation. This information includes the base tables and their columns that are referenced by the module, trigger texts, and SQL code for record groups and for other components. By parsing this text file, a function point count can be achieved automatically.

Disadvantages

The issues relating to the method are:

- Software requirement
- Large text file size
- Truncation of the MD

A detailed discussion is provided in a later chapter.

Conclusion: Viable and do-able.

CHOICE of Method

It appears that the third method, parsing of the Modular Documentation, is the most suitable method to use for automatically computing the number of function points in Oracle applications.
Determination of a Suitable Language for Parsing

An optimal parser for these Oracle-generated text files should be able to deliver the following characteristics:

- **Backtracking:** The parser should be able to scan in both directions, that is, forwards and backwards. An example of the use of backtracking is to get the name of a base table column. To do this, the parser must firstly search for an item with the "base table item" property set to true. Once this is found, the parser will be required to reverse its direction to resolve the name of the item by searching for the "name" property.

- **Data Structure:** One of the more significant data structures that the parser should possess is the array structure. The parser should be able to keep track of the accumulated number of base tables and base table columns detected for each and every form and report text file parsed, and also keep track of the complexity ratings for each of the form/report module.

- **Reporting facility:** At the end of the parsing phase, the parser should be able to produce a report that presents the results in a clear, logical, and presentable form to the analyst.

- **Availability:** Ideally, the parser end-product should be an automatic estimator that is easily attainable by analysts. An Oracle analyst should be able to access the automatic estimator and execute the parser straight away, reducing the unnecessary wasted time on installations, compatibility checks and other pre-installation procedures.

For this research, Microsoft Word Basic has been chosen as the prototype language to implement the parser for the automatic calculation of function points in Oracle applications. The main objective of the prototype is to provide a "proof of concept" for the ideas presented in this document. The use of Microsoft Word Basic achieves this and also meets the above requirements for an effective parser for this research.
CHAPTER 8: DESIGN AN AUTOMATIC COUNTING METHOD

- ISSUES WITH IMPLEMENTATION

By using the third method discussed in the previous section, the automatic function point counting software could be implemented successfully. However, there are a number of issues that should be considered. A comprehensive discussion of these issues is given in this section.

Software Requirement

A basic requirement of the implementation of the method under discussion is the following software: Oracle Forms Designer, Oracle Reports Designer, and Microsoft Word. The first two application tools are required for the automatic generation of the module text documents, and Microsoft Word is required to view the generated text documents, to parse the text files, and to generate a report of the results of the automatic function point analysis.

These three pieces software are all within reasonable expectations. If an application has been developed using the Oracle Forms Designer and Oracle Reports Designer development tools then these tools may still be available at the time of function point analysis. As for Microsoft Word, this software was deliberately chosen to perform the analysis work, due to its popularity with personal computer users.
Large File Size

An important consideration when generating a text document of a binary Oracle Forms or Reports file is that the generated document can be relatively large. For example, generating a simple binary forms file of size 32KBytes can result in a text document of ten times its original size, in this case 231KBytes, which equates to approximately 78 pages when viewed using Microsoft Word size 10 font.

The automatic function point computation software developed appears to parse the large text files within a reasonable amount of time. For example, on a 486DX2-66MHz laptop with eight megabytes of RAM, a very large forms text file opened in Microsoft Word size 10 font, spanning 263 pages, consisting of 14,425 lines and 43,213 words, was parsed by the software in approximately two-and-a-half minutes.

Since an Oracle application will consist of many form and report modules to be parsed separately, the total time taken to automatically count the number of function points may become quite significant. This potential problem was conceived at the design phase of the software development and a method was incorporated into the software in an attempt to alleviate this symptom. The software prompts the user for the names of all of the application module text files, stores these file names in an array, and then parses all of the modules together. This way, the user is not required to be present to continually feed the next module into the parser.

The large text files resulting from the document generation facility in Oracle Designer appears to be unavoidable. Consequently, the time taken to parse these text files will inevitably be
lengthened. To alleviate this problem, one can only alleviate the symptoms. By incorporating the method mentioned, the time requirement on the user's behalf is reduced.

*Truncation of Generated Document*

Another disadvantage to be highlighted is the occasional truncation of those lines of code, mainly those within trigger texts, within a module that exceed their limitation. This may result when using the document generation facility provided by Oracle Forms Designer and Oracle Reports Designer.

One way of avoiding the truncation of trigger texts would be to generate a *.jmt* extension of the text file instead of generating a *.txt* extension. This facility is also provided in the development tools, however, this format of the text file does not include the other information, such as that relating to base tables, which is required to perform a function point count.

The prototype function point counting software is developed based on the assumption that the occurrence of the right-truncation of lines, for any given Oracle application, will not be frequent enough to produce a significant variation to the final function point count achieved.
Chapter 9: DESIGN AN AUTOMATIC COUNTING METHOD

THE COMPLEXITY DETERMINATION PROCESS FOR ORACLE APPLICATIONS

The derivation of the Unadjusted Function Point count depends on the complexity rating of the five components: External Interface File, Internal Logical File, External Input, External Output, External Inquiry. A discussion of the accommodation of the IFPUG definitions and method for an Oracle application is provided in this section. This is to assist the implementation of the automatic counting software for Oracle applications.

External Inputs (EI)

The IFPUG definition of an External Input is defined as one that "processes data or control information which enters the application's external boundary." When tailored to Oracle applications, an EI becomes "a ... module of which the CRUD (Create, Retrieve, Update, Delete) usage contains a C, U, D." (Oracle, 1995) An obvious example of an EI is an Oracle Form module that is not query-only.

The IFPUG complexity rating of an EI is dependent on the number of File Types Referenced (FTR) and the number of Data Element Types (DET).

An IFPUG version of a FTR is "counted for each Internal Logical File maintained or referenced and each External Interface file referenced during the processing of the External Input." This can be tailored to Oracle applications to be defined as one that "is counted for
each table used by the module.” and the DET is the number of associated attributes.

(Oracle, 1995).

<table>
<thead>
<tr>
<th># base table columns</th>
<th>1-4</th>
<th>5-15</th>
<th>16+</th>
</tr>
</thead>
<tbody>
<tr>
<td># base tables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>3+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 11

**External Outputs (EO)**

The IFPUG definition of an External Output is defined as one that “processes data or control information that exits the application’s external boundary.” When tailored to Oracle applications, an EO becomes “a .. module of which the CRUD (Create, Retrieve, Update, Delete) usage contains only R’s.” (Oracle, 1995) An obvious example of an EO is an Oracle Report.

The complexity rating of an EO is dependent on the number of File Type Referenced (FTR) and the number of Data Element Types (DET), both of which are explained in the External Inputs section.

<table>
<thead>
<tr>
<th># base table columns</th>
<th>1-5</th>
<th>6 - 19</th>
<th>20+</th>
</tr>
</thead>
<tbody>
<tr>
<td># base tables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2 - 3</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>4+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 12
External Inquiry (EQ)

Oracle (1995) defines an External Inquiry as one that "requires input parameters, usually a unique identifier, and produces output with a fixed volume, usually with a fixed volume, usually one record." Following the concept presented by Oracle (1995), the implementation of the automatic function point counting software classifies query-only forms as external inquiries, instead of external outputs, since it "is usually not explicitly specified by the user."

The complexity rating of an EQ is dependent on the number of File Type Referenced (FTR) and the number of Data Element Types (DET), both of which are explained in the External Inputs section.

<table>
<thead>
<tr>
<th># base table columns</th>
<th>1-4</th>
<th>5 - 15</th>
<th>16+</th>
</tr>
</thead>
<tbody>
<tr>
<td># base tables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>3+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 13

Internal Logical Files (ILF)

A formal definition of the Internal Logical Files, provided by Engineering Information, Inc (1996), is "a user identifiable group of logically related data or control information maintained within the boundary of the application being counted." In addition to this definition, the counting rules in relation to ILF are also provided. These rules specify that the following rules "must apply for the group of data/control information to be counted as an ILF:

It is a logical, or user identifiable, group of data that fulfils specific user requirements.

It is maintained within the application boundary.

It is modified, or maintained, through an elementary process of the application.
It has not been counted as an EIF for this application.” (Engineering Information, 1996)

When related to an Oracle applications, an internal entity, or table, is one that “is maintained by the application, in other words: the CRUD matrix contains at least one C, U or D for this entity (or table).”

The complexity rating of an ILF is dependent on the number of Record Types (RET) and the number of Data Element Types (DET). Oracle (1995) explains that “an entity or a table can have only one record definition: RET=1” and that the “DET is the number of attributes.”

<table>
<thead>
<tr>
<th># columns referenced</th>
<th>1-19</th>
<th>20-50</th>
<th>51+</th>
</tr>
</thead>
<tbody>
<tr>
<td># tables referenced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2-5</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>6+</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 14

**External Interface Files (EIF)**

A formal definition of the External Interface Files, provided by Engineering Information, Inc (1996), is “a user identifiable group of logically related data or control information referenced by the application being counted, but maintained within the boundary of another application.”

In addition to this definition, the counting rules in relation to EIF are also provided. These rules specify that the following rules “must apply for the group of data/control information to be counted as an EIF:

- It is a logical, or user identifiable, group of data that fulfils specific user requirements.
- It is referenced by, and external to, the application being counted.
It is not maintained by the application being counted.” (Engineering Information, 1996)

When related to an Oracle applications, an external entity, or table, is one that only appears with a Retrieved in the CRUD matrix.

The complexity rating of an EIF is dependent on the number of Record Types (RET) and the number of Data Element Types (DET), both of which are explained in the Internal Logical File section.

<table>
<thead>
<tr>
<th># columns referenced</th>
<th># tables referenced</th>
<th>1-19</th>
<th>20-50</th>
<th>51+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>2-5</td>
<td>1</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>6+</td>
<td>2</td>
<td>Average</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 15
Chapter 10: DESIGN AN AUTOMATIC COUNTING METHOD

- THE PARSING PROCESS

The principal component of the implementation of the automatic function point counting software is the parsing of the module text files. The module text files are parsed to collect such information as the number of base tables referenced, the number of base table columns referenced, the number on non-base tables referenced and the number of non-base table columns referenced which are required to determine the complexity rating for the components stated in the previous section, and consequently, obtain the Unadjusted Function Point count.

Base Tables Referenced

When parsing a module text file to search for the base tables referenced, the automatic function point counting software searches for the keywords Base Table. Once these two words are found, the parser examines the subsequent word to check whether it is a base table name. If it is, the name is stored, otherwise, the parser ignores the subsequent word and continues its search. An example of a base table appears as follows:

Base Table EMPLOYMENTS

The following two lines, however, would be ignored by the parser:

Base Table <Null>
Base Table Item False
**Base Table Columns Referenced**

When parsing a module text file to search for the base table columns referenced, the automatic function point counting software searches for the keywords *Base Table Item True*. Once these keywords have been found, the parser reverses its search direction to seek the name of the base table column. An example of a base table item appearing in the module text file is:

<table>
<thead>
<tr>
<th>Name</th>
<th>CEASE_DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>&lt;Null&gt;</td>
</tr>
<tr>
<td>Item Type</td>
<td>Text Item</td>
</tr>
<tr>
<td>Canvas</td>
<td>CG$PAGE_1</td>
</tr>
<tr>
<td>Displayed</td>
<td>True</td>
</tr>
<tr>
<td>X Position</td>
<td>84</td>
</tr>
<tr>
<td>Y Position</td>
<td>22</td>
</tr>
<tr>
<td>Navigable</td>
<td>True</td>
</tr>
<tr>
<td>Next Navigation Item</td>
<td>&lt;Null&gt;</td>
</tr>
<tr>
<td>Previous Navigation Item</td>
<td>&lt;Null&gt;</td>
</tr>
<tr>
<td><strong>Base Table Item</strong></td>
<td>True</td>
</tr>
<tr>
<td>Primary Key</td>
<td>False</td>
</tr>
<tr>
<td>Insert Allowed</td>
<td>False</td>
</tr>
<tr>
<td>Query Allowed</td>
<td>False</td>
</tr>
<tr>
<td>Query Length</td>
<td>12</td>
</tr>
<tr>
<td>Case Insensitive Query</td>
<td>False</td>
</tr>
</tbody>
</table>

**Non-Base Tables and Columns Referenced**

The non-base tables and columns referenced can appear in triggers, record groups, report queries, and many other tables. The automatic function point counting software searches for those tables and columns that appear in *create, select, update, and delete* statements. Of these statements, the *select* statement seems to be the most common. For this reason, a detailed discussion of the parsing of the *select* statement is accommodated here.

The *SQL Language Quick Reference* (1992) defines a *select* statement as one that "queries one or more tables or views. (The *select* statement) returns rows and columns of data. (The *select*
statement) may be used as statement or as a subquery in another statement." The syntax for the select statement is provided in the Appendix.

One of the more significant challenges of the select statement is the flexibility provided by the SQL language. There are many variations to a select statement. The parsing of a select statement includes considerations such as nested select statements, those statements with references to functions consisting of a variable number of parameters, the possible spreading of the statement over an unpredictable number of lines, and the combination of any or all of these.

For a nested select statement, consider the following example:

```sql
SELECT roster_dec_hrs_fi
    INTO temp_number
FROM rosters a
WHERE a.id_number = :control.person_id_number
AND a.pers_pos_no = :control.pers_pos_no
AND a.rec_status != 'x'
AND a.commence_date = (SELECT max(commence_date)
    FROM rosters
    WHERE a.id_number = :control.person_id_number
    AND a.pers_pos_no = :control.pers_pos_no
    AND a.rec_status != 'x'
    AND nvl(a.delete_flag, 'n') != 'y');
```

The parser scans such nested statements separately to determine the table and column names. In this example, the parser identifies `rosters` as the only table referenced, and `roster_dec_hrs_fn, commence_date` as the columns referenced.

The above example also illustrates references to functions. Function references can also be nested, and may contain any number of parameters. Consider the following:

```sql
SELECT substr(ltrim(rtrim(nvl(region_inst, main_inst))), 1, 6) FROM institutions;
```
This seemingly simple statement contains references to the functions:

- `substr` consisting of three parameters,
- `ltrim` consisting of one parameter,
- `rtrim` consisting of one parameter,
- `nvl` consisting of one parameter.

With such statements, the automatic function point counting parser examines the open- and close- brackets to distinguish the columns referenced from the functions. In this example, the parser correctly identifies `region_inst, main_inst` as the columns referenced and `institutions` as the table referenced.

To illustrate the spreading of a `select` statement over a variable number of lines, consider the simple SQL statement:

```
SELECT id_number, name, age FROM employments;
```

This same statement can also be legally coded in the following format:

1) `SELECT id_number, name, age
   FROM employments;`

2) `SELECT
   id_number,
   name,
   age FROM employments;`

3) `SELECT
   id_number,
   name,
   age FROM employments;`

The above illustrates only a sample of a seemingly infinite number of variations to the same statement! All of these statements are identified by the parser as consisting of the table `employments, and the columns id_number, name, age.`
Enhancements

To extend the automatic function point counting prototype to a more comprehensive software, possible enhancements may be incorporated. These areas include reducing the parsing time and fine-tuning the parser.

The parsing time may be improved by upgrading the hardware or improving the parsing method. The current parser scans the Module Documentation more than once to count the number of base tables & columns, and non-base tables & columns. The parsing time may be reduced by limiting the parser to scan the Module Documentation once only.

This automatic Oracle applications estimator prototype can be fine-tuned since it provides a list of the names of the tables, their associated columns, the base tables and their associated columns. The names of the objects that have been detected by the software can be compared with the object names manually detected to determine and tune the accuracy of the parser. For example, occasionally, the software may display an object name that is, in fact, not an object, but a reserved word. This can be turned so that the reserved word will be ignored.
Data Flow Modelling is used as part of the design of the automatic calculation of function points in Oracle applications software. As stated by Oracle (1992b), upon which this model is based, the objective of this data flow model is "to ensure that functions are supplied with the necessary data in order to provide the information intended and also to identify the sources of the requisite data and the destinations for the information produced."
Automatically calculate the number of function points in Oracle applications.

1. Determine the complexity of the application modules.

2. Calculate the unadjusted function point count (UFP).

3. Rate the system characteristics for the application.

4. Calculate the function point count (FP).

5. Generate function point analysis report.
Chapter 12: RESULTS & CONCLUSIONS

The investigation part of this research has revealed very little previous work on the application of Function Point Analysis to Oracle applications. The most useful literature on this topic appears to be the QMS Project Management manual from Oracle Corporation. To date, no literature appears to be available on the automatic calculation of function points in Oracle applications.

This investigation also revealed that automatic function point analysis can be performed in a number of ways. Upon evaluation, it was concluded that the parsing of the module text documents generated by Oracle Developer/2000 would be the most suitable for an a posteriori evaluation of Oracle applications.

Software was developed that incorporated a number of the features discussed, to enable it to perform a comprehensive analysis, and automatic count of the number of function points for any Oracle application developed using Oracle Forms Designer, and Oracle Reports Designer. The successful implementation of this software appears to be the first of its kind. For this reason, it represents a worthwhile proof of concept for automatically counting function points for Oracle applications.

The automatic function point counting software produces a detailed report on the results of the automatic function point analysis at the end of its execution. This report presents the results in a very logical manner, following the format presented by Hignite et al (1993), to show the
calculations leading to the derivation of the final function point count. Since the report is
produced as a Microsoft Word document, it can be easily printed at the user's discretion.
A complex form with 5 base tables, 55 base table columns and referencing 16 other non-base
tables and 20 non-base table columns was parsed in approximately five minutes. Its Module
Documentation, with a size of 761 KBytes, spanned 14 425 lines over 263 pages.

The overall success rate of the automatic estimator reveals a proof of concept that provides the
grounds for the possible launch of further researches in this area. This research and the
development of the associated software is a worthwhile source of the proof of the concept. It
is the first version produced, and for this reason, several possible areas of improvements may
be incorporated in future researches to enhance the software.

Oracle is the second largest software company world-wide and there are many Oracle
applications and Oracle users in the IT industry. For this reason, it is expected that the
automatic function point counting of Oracle applications software should be beneficial in
many project estimation exercises.
REFERENCES


17. Oracle (1988). Building Reports with Oracle Reports 2.0 *Oracle Corporation*
19. Oracle (1992b). Oracle Education Services Course Notes: Analysis Techniques *Oracle Corporation*

Appendix A: FPA reports generated by Designer/2000

The FPA reports can be obtained from Designer/2000 by following these simple steps:

2. Within RON, select from the menu: Tools | Repository Reports (RR)
3. Within RR, expand in the object navigator: Reports | Function Point Analysis

A copy of each of the following FPA reports are included in this section.

- Mkl FPA Analysis Level - CDFPA1A
- FPA Analysis Level (DFDs & Event Models) - CDFPAA2
- FPA MkII (Design1) - CDFPAD1
- FPA MkII (Design2) - CDFPAD2
- Area Metric - CDMETRIC

A printout sample copy of the Mkl FPA Design Level report has been intentionally excluded as its layout is an exact replica of the Mkl FPA Analysis Level layout.
Report : FPA (IFPUG) - Analysis Level
Filename
Run by OWNER1
Report Date 16-MAY-96 03:06pm
Total Pages : 6

Parameter Values

Application System : TEST
Application Version : 1
Function Label : TEST
Help Inquiries : 1
For Application System : TEST
Version : 1
Starting at Function : TEST

Maintain a person and their jobs

Unadjusted Function Point Count

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Functional Complexity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>Average</td>
</tr>
<tr>
<td>ILF</td>
<td>Internal Logical Files</td>
<td>1 * 7 = 7</td>
<td>0 * 10 = 0</td>
</tr>
<tr>
<td></td>
<td>No. of Entities created, updated or deleted by one</td>
<td>With &lt; 51</td>
<td>With &gt; 50</td>
</tr>
<tr>
<td>EIP</td>
<td>External Interface Files</td>
<td>1 * 5 = 5</td>
<td>0 * 7 = 0</td>
</tr>
<tr>
<td></td>
<td>No. of Entities read but not created, updated or</td>
<td>With &lt; 51</td>
<td>With &gt; 50</td>
</tr>
<tr>
<td>EI</td>
<td>External Inputs</td>
<td>3 * 3 = 9</td>
<td>0 * 4 = 0</td>
</tr>
<tr>
<td></td>
<td>No. of Entity Create, Update and Delete Usages</td>
<td>With &lt; 15</td>
<td>With &gt; 14</td>
</tr>
<tr>
<td>EO</td>
<td>External Outputs</td>
<td>0 * 4 = 0</td>
<td>0 * 5 = 0</td>
</tr>
<tr>
<td></td>
<td>No. of Entity Read Usages by a Leaf Function where</td>
<td>With &lt; 20</td>
<td>With &gt; 19</td>
</tr>
<tr>
<td></td>
<td>there is no Create, Update or Delete usage of any</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Designers/2000 Report : cdfpa3a
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Functional Complexity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ</td>
<td><strong>External Inquiries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Entity Function Usages counting 1 for any combination of Create, Read, Update and Delete involving 1 Entity and 1 Function (excluding read)</td>
<td><strong>Low</strong></td>
<td><strong>Average</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 * 3 = 6</td>
<td>0 * 4 = 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With &lt; 15</td>
<td>With &gt; 14</td>
</tr>
<tr>
<td></td>
<td>No. of low complexity External Inquiries for Help (e.g. 1 for full screen help throughout the)</td>
<td>1 * 3 = 3</td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td><strong>Function Count</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Unadjusted Function Points</strong></td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

Designer/2000 Report: cdfpala
### General System Characteristics

<table>
<thead>
<tr>
<th>ID</th>
<th>Characteristic</th>
<th>Degree of Influence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Data Communications</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Distributed Functions</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Performance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>No. Of Functions</td>
</tr>
<tr>
<td></td>
<td>0 PER</td>
<td>1</td>
</tr>
<tr>
<td>C4</td>
<td>Heavily Used Configuration</td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>Transaction Rate</td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>Online Data Entry</td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td>End User Efficiency</td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td>Online Update</td>
<td></td>
</tr>
<tr>
<td>C9</td>
<td>Complex Processing</td>
<td></td>
</tr>
<tr>
<td>C10</td>
<td>Reusability</td>
<td></td>
</tr>
<tr>
<td>C11</td>
<td>Installation Ease</td>
<td></td>
</tr>
<tr>
<td>C12</td>
<td>Operational Ease</td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>Characteristic</td>
<td>Degree of Influence*</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>C13</td>
<td>Multiple Sites</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Business Units to</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C14</td>
<td>Facilitate Change</td>
<td></td>
</tr>
<tr>
<td>TDI</td>
<td>Total Degree of Influence</td>
<td></td>
</tr>
</tbody>
</table>

* Degree of Influence Values:
- Not present or no influence = 0
- Insignificant influence = 1
- Moderate influence = 2
- Average influence = 3
- Significant influence = 4
- Strong influence, throughout = 5

Value Adjustment Factor (VAF) = \((\text{TDI} \times 0.01) + 0.65\) = 
Function Point Count (FP) = \(\text{FC} \times \text{VAF}\) = 

Designer/2000 Report: cdfpala
Designer/2000

FPA (IFPUG) - Analysis Level

End of Report
Designer/2000

Report : MKII FPA Information
Filename
Run by : OWNER1
Report Date : 16-MAY-96
Total Pages : 5

Parameter Values

Application System : TEST
Version : 1
Based at the Analysis Level (where DFD's and Event Models have been used)

For Application System: TEST
Version: 1

Information Processing Logic Size

Input

No. of dataflow contents on each dataflow which exists between an external entity and a function included as a logical transaction (No. of attribute types input)

Processing

No. of functions triggered by an event of type time (Logical transactions triggered by reaching a specific point in time)

No. of functions where exists a dataflow from an external entity (Logical transactions triggered by external)

Logical Transactions

No. of distinct entities included in dataflows between datastores and functions included as logical transactions (No. of entity types referenced)

Output

No. of dataflow contents on each dataflow which exists between a function included as a logical transaction and an external entity (No. of attribute types output)

Information Processing Logic Size in Unadjusted Function Points

Designer/2000 Report: cdfpaa2
Technical Complexity Characteristics

1. Data Communications
2. Distributed Functions
3. Performance

<table>
<thead>
<tr>
<th>Frequency</th>
<th>No. Of Functions</th>
</tr>
</thead>
</table>

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
   (No. Of Business Units to Functions included as Logical Transaction Usages)
   0
14. Facilitate Change
15. Interface Requirements Of Other Applications
   (Number of Functions included as Logical Transactions which are Master Functions in other Applications)
   0
16. Security, Privacy, Audit
17. User Training Needs
18. Third Party Use
19. Documentation

20. Site Specific

Total Degree of Influence

Technical Complexity Adjustment

\(0.65 + C \times \text{Total Degree of Influence}\)

where \(C\) may take value of 0.005

Size of System in MKII Function Points

\(\text{Size of System in MKII Function Points} = \text{Information Processing Logic Size} \times \text{Technical Complexity Adjustment}\)
Designer/2000

MKII PPA Information

End of Report
Report : MKII FPA - Design Level 1
Filename
Run by : OWNER1
Report Date : 16-MAY-96
Total Pages : 6

Parameter Values
Application System : TEST
Version : 1
Include Shared Modules : True
Module Type : %
Language : %
Based at the Design Level

For Application System: TEST
Version: 1

Information Processing Logic Size

<table>
<thead>
<tr>
<th>Module Type</th>
<th>SCREEN</th>
<th>Language: Oracle Forms</th>
</tr>
</thead>
</table>

**INPUT - Number of attribute types input**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of select column usages</td>
<td>48</td>
</tr>
<tr>
<td>No. of select detailed column usages</td>
<td>45</td>
</tr>
<tr>
<td>No. of Input parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of modified parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>

**PROCESS**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Modules</td>
<td>4</td>
</tr>
<tr>
<td>No. of tables/Views - No. of entity types referenced</td>
<td>6</td>
</tr>
<tr>
<td>No. of look-up links between table usages</td>
<td>0</td>
</tr>
<tr>
<td>No. of base links between table usages</td>
<td>6</td>
</tr>
</tbody>
</table>

**OUTPUT - Number of attribute types output**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of column usages in create/update/nullify</td>
<td>48</td>
</tr>
<tr>
<td>No. of detailed column usages in create/update/nullify</td>
<td>48</td>
</tr>
<tr>
<td>No. of output parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of modified parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>

TOTAL 66.67
Information Processing Logic Size

Module Type PACKAGE Language: PL/SQL

INPUT - Number of attribute types input

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of select column usages</td>
<td>0</td>
</tr>
<tr>
<td>No. of select detailed column usages</td>
<td>0</td>
</tr>
<tr>
<td>No. of Input parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of modified parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>

PROCESSING

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>%TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Modules</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>No. of tables/Views - No. of entity types referenced</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No. of look-up links between table usages</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No. of base links between table usages</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

OUTPUT - Number of attribute types output

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of column usages in create/update/nullify</td>
<td>0</td>
</tr>
<tr>
<td>No. of detailed column usages in create/update/nullify</td>
<td>0</td>
</tr>
<tr>
<td>No. of output parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of modified parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>
## Information Processing Logic Size

**Module Type**: PROCEDURE  
**Language**: PL/SQL

### INPUT - Number of attribute types input

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of select column usages</td>
<td>0</td>
</tr>
<tr>
<td>No. of select detailed column usages</td>
<td>0</td>
</tr>
<tr>
<td>No. of Input parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of modified parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>

### PROCESSING

<table>
<thead>
<tr>
<th>Table/View Usage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Modules</td>
<td>1</td>
</tr>
<tr>
<td>No. of tables/views</td>
<td>0</td>
</tr>
<tr>
<td>No. of entity types referenced</td>
<td>0</td>
</tr>
<tr>
<td>No. of look-up links between table usages</td>
<td>0</td>
</tr>
<tr>
<td>No. of base links between table usages</td>
<td>0</td>
</tr>
</tbody>
</table>

### OUTPUT - Number of attribute types output

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of column usages in create/update/nullify</td>
<td>0</td>
</tr>
<tr>
<td>No. of detailed column usages in create/update/nullify</td>
<td>0</td>
</tr>
<tr>
<td>No. of output parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of modified parameters</td>
<td>0</td>
</tr>
<tr>
<td>No. of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>

**%TOTAL**: 16.67
### TOTAL INPUTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of select column usages</td>
<td>48</td>
</tr>
<tr>
<td>Sum of select detailed column usages</td>
<td>45</td>
</tr>
<tr>
<td>Sum of input parameters</td>
<td>0</td>
</tr>
<tr>
<td>Sum of modified parameter</td>
<td>0</td>
</tr>
<tr>
<td>Sum of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>

### TOTAL PROCESSING

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of modules</td>
<td>6</td>
</tr>
<tr>
<td>Sum of tables/view</td>
<td>6</td>
</tr>
<tr>
<td>Sum of look_up links between table usages</td>
<td>0</td>
</tr>
<tr>
<td>Sum of base links between table usages</td>
<td>6</td>
</tr>
</tbody>
</table>

### TOTAL OUTPUTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of column usages in create/update/null</td>
<td>48</td>
</tr>
<tr>
<td>Sum of detailed column usages in create/update/nullify</td>
<td>48</td>
</tr>
<tr>
<td>Sum of output parameters</td>
<td>0</td>
</tr>
<tr>
<td>Sum of modified parameter</td>
<td>0</td>
</tr>
<tr>
<td>Sum of other parameters</td>
<td>0</td>
</tr>
</tbody>
</table>
Designer/2000

Report : MKII FPA - Design Level 2
Filename
Run by : OWNER1
Report Date : 16-MAY-96
Total Pages : 4

Parameter Values
Application System : TEST
Version : 1
Include Shared Modules : True
Module Type :
<table>
<thead>
<tr>
<th>Module Type</th>
<th>Technical Complexity Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Data Communications</td>
<td></td>
</tr>
<tr>
<td>2. Distributed Functions</td>
<td></td>
</tr>
<tr>
<td>No. of nodes (Total in application system) = 0</td>
<td></td>
</tr>
<tr>
<td>No. of node to module usages = 0</td>
<td></td>
</tr>
<tr>
<td>Distinct No. of databases to table/view usages.</td>
<td></td>
</tr>
<tr>
<td>Module Type</td>
<td>Distinct No. of databases</td>
</tr>
<tr>
<td>3. Performance</td>
<td></td>
</tr>
<tr>
<td>4. Heavily used configuration</td>
<td></td>
</tr>
<tr>
<td>5. Transaction Rate</td>
<td></td>
</tr>
<tr>
<td>6. Online Data Entry</td>
<td></td>
</tr>
<tr>
<td>7. End User Efficiency</td>
<td></td>
</tr>
<tr>
<td>8. Online Update</td>
<td></td>
</tr>
<tr>
<td>9. Complex Processing</td>
<td></td>
</tr>
<tr>
<td>Module Complexity</td>
<td>EASY</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$TOTAL</td>
</tr>
<tr>
<td>10. Reusability</td>
<td></td>
</tr>
<tr>
<td>No of modules owned by this Application system/version which are shared with others = 0</td>
<td></td>
</tr>
<tr>
<td>No of Business unit to module usages</td>
<td></td>
</tr>
</tbody>
</table>

Designer/2000 report : cdfpad2
11. Installation Base

12. Operational Ease

13. Multiple Sites

No of access group to module usages = 0

14. Facilitate Change

15. Interface Requirement of other applications

No of modules owned by other application system/versions which are shared with this one = 0

16. Security, privacy and audit

17. User training needs

Average No. of help text lines across tables which have help text
(Total in application system) =

Average number of lines of help text across all the tables that could have help text
(Total in application system) = 0.00

18. Third Party Use

19. Documentation

20. Site Specific
Designer/2000

MKII FPA - Design Level 2

End of Report
Designer/2000

Report : Application System Metrics

Filename :

Run by : OWNER1

Report Date : 16-MAY-96 03:28pm

Total Pages : 3

Parameter Values

Application System : TEST
Version : 1
Shared? : False
1. Area Metric Based on Entity Model

\[ N = (A \times E) + (R \times A) + (R \times E) \]

Where
\( A = \) No. of Attributes,
\( E = \) No. of Entities,
\( R = \) No. of Relationships

\[ N = 20 \]

2. Area Metric Based on Schema Design

\[ D = (T \times C) + (T \times F) + (F \times C) \]

Where
\( T = \) No. of Tables,
\( C = \) No. of Columns which are not Foreign Keys,
\( F = \) No. of Foreign Keys

\[ D = 458 \]

3. Area Metric Based on Comparison of Entity Model and Schema Design

\[ M = \frac{D}{N} \]

\[ M = 22.9 \]
Designer/2000

Application System Metrics

End of Report
Appendix B: The SQL SELECT statement

Oracle (1992) states the syntax of the SQL select statement as follows:

```
SELECT select_list FROM table_list WHERE condition
  
  ALl | DISTINCT

  START WITH condition
  
  CONNECT BY condition

  GROUP BY expr

  HAVING condition

  UNION
  
  SELECT command
  
  UNION ALL
  
  INTERSECT
  
  MINUS

  ORDER BY expr position ASC DESC
  
  FOR UPDATE OF update_list NOWAIT

select_list ::= *
  
  table
  
  view
  
  snapshot

expr c_alias
```
Appendix C: Design of Function Point Counting Software

A layout of the General flow of the function point counting software is illustrated in the following diagram.

1.0 Analyse another module?

   OK

2.0 Module Type:
   * Query-only Form
   * Not Query-only Form
   * Report

   CANCEL

   OK

3.0 Analyse another module?

   CANCEL

   OK

4.0 Open text file

5.0 Parse text file

6.0 Close text file

ALL TEXT FILES PARSED.

7.0 System Characteristics
   Total of fourteen.

8.0 Generate Report

END
## Appendix D: A sample FPA report produced

### FUNCTION POINT CALCULATION REPORT

#### TOTAL UNADJUSTED FUNCTION POINT CALCULATION

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>LOW</th>
<th>AVERAGE</th>
<th>HIGH</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>EI</td>
<td>1 x 3 = 3</td>
<td>0 x 4 = 0</td>
<td>0 x 6 = 0</td>
<td>3</td>
</tr>
<tr>
<td>EO</td>
<td>0 x 4 = 0</td>
<td>0 x 5 = 0</td>
<td>0 x 7 = 0</td>
<td>6</td>
</tr>
<tr>
<td>EQ</td>
<td>0 x 3 = 0</td>
<td>0 x 4 = 0</td>
<td>1 x 6 = 6</td>
<td>6</td>
</tr>
<tr>
<td>ILF</td>
<td>0 x 7 = 0</td>
<td>0 x 10 = 0</td>
<td>0 x 15 = 0</td>
<td>0</td>
</tr>
<tr>
<td>EIF</td>
<td>0 x 5 = 0</td>
<td>0 x 7 = 0</td>
<td>1 x 10 = 10</td>
<td>10</td>
</tr>
</tbody>
</table>

#### TECHNICAL COMPLEXITY CALCULATION

<table>
<thead>
<tr>
<th>GENERAL SYSTEMS</th>
<th>DI</th>
<th>CHARACTERISTIC</th>
<th>DI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Data communications</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distributed Processing</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performance</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy used configuration</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transaction rates</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>On-Line data entry</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End-User efficiency</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Degree of Influence (TDI) = 36
Technical Complexity Factor (TCF) = (TDI * .61) + 0.65
= 1.01

Total Function Points = TCF * TUFP
= 1.01 * 19
= 19.19

**** A LIST OF POSSIBLE BASE TABLES ****
employments
COUNT = 1

**** A LIST OF POSSIBLE TABLES ****
pay_offers
COUNT = 1

**** A LIST OF POSSIBLE BASE TABLE COLUMNS ****
commence_date
COUNT = 1

**** A LIST OF POSSIBLE COLUMNS ****
pay_offer_desc
COUNT = 1
APPENDIX E: Source Code for the Function Point Counting Software

The following is a listing of the macro code that has been created to perform the automatic function point computation. It is based on the model illustrated in Appendix B.

```vba
Dim Shared ModType$(50) 'eg. Reports, Forms (Q-only, not Q-only) R,QO,NQO
Dim Shared ModName$(50) 'name of the module text file
Dim Shared ModCtr 'the number of module text files to be parsed
Dim Shared Analyse
Dim Shared NumIT 'number of external tables referenced by application.
Dim Shared NumCol 'number of external table columns referenced by application.
Dim Shared NumIT 'number of internal tables referenced by application.
Dim Shared NumICol 'number of internal table columns referenced by application.
Dim Shared NumB 'number of base tables.
Dim Shared NumBCol 'number of base table columns referenced.
Dim Shared E0(3) 'external output counter for Low, Av, Hi complexities
Dim Shared E1(3) 'external input counter for Low, Av, Hi complexities
Dim Shared EQ(3) 'external inquiry counter for Low, Av, Hi complexities
Dim Shared ILF(3) 'internal logical counter for Low, Av, Hi complexities
Dim Shared EIF(3) 'external interface file counter for Low, Av, Hi complexities

"System characteristic variables.
Dim Shared scDC
Dim Shared scDP
Dim Shared scP
Dim Shared scHUC
Dim Shared scTR
Dim Shared scOE
Dim Shared scEE
Dim Shared scOU
Dim Shared scCP
Dim Shared scR
Dim Shared scIE
Dim Shared scOE
Dim Shared scMS
Dim Shared scFC

Sub MAIN
'Initialisations.
    ModCtr = 0 'Number of modules to be analysed.
    Analyse = 1
    NumIT = 0
    NumCol = 0
    For IndexCount = 1 To 3
```

EO(IndexCount) = 0
EI(IndexCount) = 0
EQ(IndexCount) = 0
ILF(IndexCount) = 0
{EIF(IndexCount) = 0

Next IndexCount

CnsAnalysePrompt 'Analyse another module?
ParseTextFiles 'Parse each module text file.
ILFComplexity 'Determine complexity for ILF.
{EIFComplexity 'Determine complexity for EIF.
If ModCtr > 1 Then
GetSysCharsDlg 'System characteristic ratings.
FileOpen "C:\TEMP\REPORT.DOC"
End If
GenerateReport 'Generate a report on the FPA.

End Sub

******************************************************************************
Sub CnsAnalysePrompt
While Analyse = 1
AnalyseModuleDlg
Wend
End Sub

******************************************************************************
Sub ParseTextFiles
For Counter = 1 To (ModCtr - 1)
NumB = 0
NumBCol = 0
ParseThisFile(ModName$(Counter))
DetermineComplexity(ModType$(Counter))
Next Counter
End Sub 'OpenModNames

******************************************************************************
Sub{EIFComplexity
Select Case NumT
Case 0
Case 1
Select Case NumCol
Case 0
Case 1 To 50
{EIF(1) ={EIF(1) + 1 'External Output = LO
Case Else
{EIF(2) ={EIF(2) + 1 'External Output = AV
End Select
Case 2 To 5
Select Case NumCol
Case 0
Case 1 To 19
   EIF(1) = EIF(1) + I  'External Output = LO
Case 20 To 50
   EIF(2) = EIF(2) + I  'External Output = AV
Case Else
   EIF(3) = EIF(3) + I  'External Output = HI
End Select
Case Else
   Select Case NumCol
      Case 0
      Case 1 To 19
         EIF(2) = EIF(2) + I  'External Output = AV
      Case Else
         EIF(3) = EIF(3) + I  'External Output = HI
   End Select
End Select
End Sub

---

\textbf{ILFComplexity}

\textbf{Sub ILFComplexity}

Select Case NumIT
   Case 0
   Case 1
      Select Case NumICol
         Case 0
         Case 1 To 50
            ILF(1) = ILF(1) + I  'External Output = LO
         Case Else
            ILF(2) = ILF(2) + I  'External Output = AV
      End Select
   Case 2 To 5
      Select Case NumICol
         Case 0
         Case 1 To 19
            ILF(1) = ILF(1) + I  'External Output = LO
         Case 20 To 50
            ILF(2) = ILF(2) + I  'External Output = AV
         Case Else
            ILF(3) = ILF(3) + I  'External Output = HI
      End Select
   Case Else
      Select Case NumICol
         Case 0
         Case 1 To 19
            ILF(2) = ILF(2) + I  'External Output = AV
         Case Else
            ILF(3) = ILF(3) + I  'External Output = HI
      End Select
   End Select
End Select
End Sub
Function TotalUFP
    TotalUFP = TotalEI + TotalEO + TotalEQ + TotalLF + TotalEIF
End Function TotalUFP

Function TotalEI
    TotalEI = (EI(1) * 3) + (EI(2) * 4) + (EI(3) * 6)
End Function TotalEI

Function TotalEO
    TotalEO = (EO(1) * 4) + (EO(2) * 5) + (EO(3) * 7)
End Function TotalEO

Function TotalEQ
    TotalEQ = (EQ(1) * 3) + (EQ(2) * 4) + (EQ(3) * 6)
End Function TotalEQ

Function TotalEIF
    TotalEIF = (EIF(1) * 5) + (EIF(2) * 7) + (EIF(3) * 10)
End Function TotalEIF

Function TotalLF
    TotalLF = (LF(1) * 7) + (LF(2) * 10) + (LF(3) * 15)
End Function TotalLF

Function TDI
    Calculates the total degree of influence by summing each of the system characteristics.
    TDI = scDC + scOU + scDP + scCP + scP + scR + scHUC + scIE + scTR + scOE + scODE + scMS + scEE + scFC
End Function TDI

Function TCF
    Total Complexity Factor
TCF = (TDI * 0.01) + 0.65
End Function

Sub GetSysCharsDlg
Dim DIScale$(5)
DIScale$(1) = "Not present"
DIScale$(2) = "Incidental Influence"
DIScale$(3) = "Moderate Influence"
DIScale$(4) = "Average Influence"
DIScale$(5) = "Significant Influence"
Dim Dlg As UserDialog
Begin Dialog UserDialog 768, 314, "System Characteristics"
DropListBox 24, 37, 329, 76, DIScale$(0).DataCommList
DropdownList 24, 70, 329, 76, DIScale$(0).DistributedList
DropdownList 24, 103, 329, 76, DIScale$(0).PerformanceList
DropdownList 24, 136, 329, 76, DIScale$(0).HeavyList
DropdownList 24, 169, 329, 76, DIScale$(0).TransactionList
DropdownList 24, 202, 329, 76, DIScale$(0).EntryList
DropdownList 24, 235, 329, 76, DIScale$(0).EfficiencyList
DropdownList 426, 37, 329, 76, DIScale$(0).UpdateList
DropdownList 426, 70, 329, 76, DIScale$(0).ComplexList
DropdownList 426, 103, 329, 76, DIScale$(0).ReuseList
DropdownList 426, 136, 329, 76, DIScale$(0).InstallList
DropdownList 426, 169, 329, 76, DIScale$(0).EaseList
DropdownList 426, 202, 329, 76, DIScale$(0).MultipleList
DropdownList 426, 235, 329, 76, DIScale$(0).ChangeList
OK Button 297, 277, 88, 21
CancelButton 415, 277, 88, 21
Text 24, 24, 164, 13, "Data Communications", .Text1
Text 24, 57, 212, 13, "Distributed Data Processing", .Text2
Text 24, 90, 96, 13, "Performance", .Text3
Text 24, 123, 207, 13, "Heavily Used Configuration", .Text4
Text 24, 156, 132, 13, "Transaction Rate", .Text5
Text 24, 189, 145, 13, "On-Line Data Entry", .Text6
Text 24, 222, 151, 13, "End User Efficiency", .Text7
Text 426, 24, 120, 13, "On-Line Update", .Text8
Text 426, 57, 152, 13, "Complex Processing", .Text9
Text 426, 90, 94, 13, "Reusability", .Text10
Text 426, 123, 127, 13, "Installation Ease", .Text11
Text 426, 156, 131, 13, "Operational Ease", .Text12
Text 426, 189, 103, 13, "Multiple Sites", .Text13
Text 426, 222, 133, 13, "Facilitate Change", .Text14
End Dialog
If Dialog(dlg) Then
scDC = dlg.DataCommList
scDP = dlg.DistributedList
scP = dlg.PerformanceList
scHUC = dlg.HeavyList
End If
scTR = dlg.TransactionList
scODE = dlg.EntryList
scEE = dlg.EfficiencyList
scOU = dlg.UpdateList
scCP = dlg.ComplexList
scR = dlg.ReuseList
scIE = dlg.InstallList
scOE = dlg.EaseList
scMS = dlg.MultipleList
scFC = dlg.ChangeList
End Sub

End If

*****************************************************************************
** GenerateReport
*****************************************************************************

Sub GenerateReport
'Generates a report on the results of the function point analysis process, based on the parsing of the individual files.

Close #1
Open "C:\TEMP\AAA.TXT" For Output As #2
Print #2, "FPA REPORT" + Str$(Counter) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr$(13) + Chr(95)
Insert "TOTAL"
NextCell
Insert "EI"
NextCell
Insert "External Input"
NextCell
Insert Str$(EI(1)) + " x 3 = " + Str$(EI(1) * 3)
NextCell
Insert Str$(EI(2)) + " x 4 = " + Str$(EI(2) * 4)
NextCell
Insert Str$(EI(3)) + " x 6 = " + Str$(EI(3) * 6)
NextCell
Insert Str$(TotalEI)
RightPara
NextCell
Insert "EO"
NextCell
Insert "External Output"
NextCell
Insert Str$(EO(1)) + " x 4 = " + Str$(EO(1) * 4)
NextCell
Insert Str$(EO(2)) + " x 5 = " + Str$(EO(2) * 5)
NextCell
Insert Str$(EO(3)) + " x 7 = " + Str$(EO(3) * 7)
NextCell
Insert Str$(TotalEO)
RightPara
NextCell
Insert "EQ"
NextCell
Insert "External Inquiry"
NextCell
Insert Str$(EQ(1)) + " x 3 = " + Str$(EQ(1) * 3)
NextCell
Insert Str$(EQ(2)) + " x 4 = " + Str$(EQ(2) * 4)
NextCell
Insert Str$(EQ(3)) + " x 6 = " + Str$(EQ(3) * 6)
NextCell
Insert Str$(TotalEQ)
RightPara
NextCell
Insert "ILF"
NextCell
Insert "Internal Logical File"
NextCell
Insert Str$(ILF(1)) + " x 7 = " + Str$(ILF(1) * 7)
NextCell
Insert Str$(ILF(2)) + " x 10 = " + Str$(ILF(2) * 10)
NextCell
Insert Str$(ILF(3)) + " x 15 = " + Str$(ILF(3) * 15)
NextCell
Insert Str$(TotalILF)
RightPara
NextCell
Insert "EIF"
NextCell
NextCell
Insert "External Interface File"
NextCell
Insert Str$(EIF(1)) + " x 5 = " + Str$(EIF(1) * 5)
NextCell
Insert Str$(EIF(2)) + " x 7 = " + Str$(EIF(2) * 7)
NextCell
Insert Str$(EIF(3)) + " x 10 = " + Str$(EIF(3) * 10)
NextCell
Insert Str$(Total(EIF))
RightPara
NextCell
NextCell
NextCell
NextCell
NextCell
NextCell
NextCell
Bold
Insert "Total Unadjusted FP"
NextCell
Bold
InsertPara
Insert Str$(TotalUFP)
RightPara
LineDown 1
End Sub 'GenerateTUFPI

'*****************************************************************************
='GenerateSysChars
*****************************************************************************'
Sub GenerateSysChars
    Insert Chr$(13) + Chr$(13) + Chr$(13)
    Bold
    Insert "TECHNICAL COMPLEXITY CALCULATION" + Chr$(13) + Chr$(13)
    Bold
    Insert "GENERAL SYSTEMS CHARACTERISTIC"
    NextCell
    Bold
    RightPara
    Insert "DI"
    TableColumnWidth .RulerStyle = "l", .ColumnWidth = "1.2 cm"
    NextCell
    Bold
    Insert "GENERAL SYSTEMS CHARACTERISTIC"
    NextCell
    Bold
    RightPara
    Insert "DI"
    TableColumnWidth .RulerStyle = "l", .ColumnWidth = "1.2 cm"
    NextCell
    Insert "Data communications"
    NextCell
    RightPara
    Insert Str$(scDC)
NextCell
Insert "On-Line update"
NextCell
RightPara
Insert Str$(scOU)
NextCell
Insert "Distributed Processing"
NextCell
RightPara
Insert Str$(scDP)
NextCell
Insert "Complex Processing"
NextCell
RightPara
Insert Str$(scCP)
NextCell
Insert "Performance"
NextCell
RightPara
Insert Str$(scP)
NextCell
Insert "Reusability"
NextCell
RightPara
Insert Str$(scR)
NextCell
Insert "Heavily used configuration"
NextCell
RightPara
Insert Str$(scHUC)
NextCell
Insert "Installation ease"
NextCell
RightPara
Insert Str$(scIE)
NextCell
Insert "Transaction rates"
NextCell
RightPara
Insert Str$(scTR)
NextCell
Insert "Operational ease"
NextCell
RightPara
Insert Str$(scOE)
NextCell
Insert "On-Line data entry"
NextCell
RightPara
Insert Str$(scODE)
NextCell
Insert "Multiple sites"
NextCell
RightPara
Insert Str$(scMS)
NextCell
Insert "End-User efficiency"
NextCell
RightPara
Insert Str$(scEF)
NextCell
Insert "Facilitate change"
NextCell
RightPara
Insert Str$(scFC)
NextCell
NextCell
NextCell
Insert Chr$(13)
Bold
Insert "Total Degree of influence (TDI)"
NextCell
Bold
RightPara
InsertPara
Insert Str$(TDI)
LineDown 1
CharLeft 1
Bold
Insert "Technical Complexity Factor (TCF)"
InsertPara
Insert "= (TDI * .01) + 0.65"
NextCell
RightPara
InsertPara
Insert Chr$(13)
Bold
Insert Str$(TCF)
LineDown 1
InsertChr$(13)+Chr$(13)
Bold
Insert "Total Function Points" + Chr$(9) + "= TCF * TUFF" + Chr$(13)
Insert Chr$(9) + Chr$(9) + Chr$(9) + "= " + Str$(TCF) + "= " + Str$(TotalUFP) + Chr$(13)
Insert Chr$(9) + Chr$(9) + Chr$(9) + "= " + Str$(TCF * TotalUFP) + Chr$(13) + Chr$(13) + 
Chr$(13)
End Sub/GenerateSysChars

************************************************************************************
Sub CleanReport
EditSelectAll
Font "Arial"
FontSize 8
LineDown 1
End Sub

************************************************************************************
Sub AnalyseModuleDlg
End Sub
Begin Dialog UserDialog 355, 85, "Function Point Analysis"
    Text 24, 8, 300, 15, "Analyse another (or the first) module for", .AnalyseIt
    Text 23, 26, 125, 13, "this application?", .Text1
    OK Button 82, 53, 88, 21
    Cancel Button 184, 53, 88, 21
End Dialog

Dim dlg As UserDialog
ModCtr = ModCtr + 1
Button = Dialog(dlg)   'display the dialog
If Button = -1 Then 'ok button
    SelectModTypeDlg
ElseIf Button = 0 Then'cancel button
    Analyse = 0
End If

End Sub

*****************************************************************************
     Sub SelectModTypeDlg
     * Prompt for the module type.
     Begin Dialog UserDialog 400, 118, "Function Point Analysis"
         OK Button 99, 89, 88, 21
         Cancel Button 215, 89, 88, 21
         GroupBox 18, 7, 369, 77, "Select the File Module Type"
         OptionGroup .ModType
         Option Button 48, 23, 250, 16, "Oracle Forms: &Query-only"
         Option Button 48, 41, 250, 16, "Oracle Forms: &Not query-only"
         Option Button 48, 59, 250, 16, "Oracle &Reports"
     End Dialog
     Dim dlg As UserDialog
     If Dialog(dlg) Then
         Select Case dlg.ModType
             Case 0
                 ModType$(ModCtr) = "QO"
                 GetFileName
                 AnalyseModuleDlg
             Case 1
                 ModType$(ModCtr) = "NQO"
                 GetFileName
                 AnalyseModuleDlg
             Case 2
                 ModType$(ModCtr) = "R"
                 GetFileName
                 AnalyseModuleDlg
             Case Else
                 MsgBox "Not a list style"
         End Select
     Else 'cancel button
         ModCtr = ModCtr - 1
     End If
     End Sub 'SelectModTypeDlg
Sub GetFileName
'Fills an array with the names of all files in the current directory. The instructions first count the files to
determine the size of the array. Then they define the array, fill it
'with the filenames, and sort the elements. The array is then presented
'in a user-defined dialog box.
    temp$ = Files$("*.*")
    Counter = -1
    While temp$ <> ""
        Counter = Counter + 1
        temp$ = Files$("")
    Wend
If Counter > -1 Then
    Dim list$(Counter)
    list$(0) = Files$("*.*")
    For i = 1 To Counter
        list$(i) = Files$("")
    Next i
    SortArray list$("")
Else
    MsgBox "No files in current directory."
End If
End Sub

Sub FileNameDlg(List$())
End Sub

Sub FileNameDlg(FileList$())
On Error Resume Next
Begin Dialog UserDialog 440, 160, "Function Point Analysis"
    Text 29, 8, 261, 13, "Select the text file to be analysed:"
    ComboBox 29, 25, 380, 84, FileList$, .FileList
    OKButton 134, 123, 88, 21
    CancelButton 248, 123, 88, 21
End Dialog
Dim dlg As UserDialog
If Dialog(dlg) Then
    ModName$(ModCtr) = dlg.FileList
Else
    ModName$(ModCtr) = ModCtr - 1
End If
ModCtr = ModCtr - 1
End Sub

Sub ParseThisFile(ThisFilc$)
On Error Resume Next
If File$(ThisFilc$) <> "" Then
    FileOpen ThisFilc$
    Search TheTables
    FileClose(2)
Else
MsgBox "File " + ThisFile$ + " not found."
End If
End Sub

Sub SearchTheTables
' DETERMINE THE NUMBER OF POSSIBLE BASE TABLES.
Open "C:\TEMP\REPORT.DOC" For Output As #1
Print #1, "**** A LIST OF POSSIBLE BASE TABLES ****"
Searchlt("B", "Table", 1, "base tables")
Close #1

' DETERMINE THE NUMBER OF POSSIBLE TABLES REFERENCED.
Open "C:\TEMP\REPORT.DOC" For Append As #1
Print #1, "**** A LIST OF POSSIBLE TABLES REFERENCED ****"
Searchlt("T", "From", 0, "tables referenced")
Close #1

' DETERMINE THE NUMBER OF BASE TABLE COLUMNS.
Open "C:\TEMP\REPORT.DOC" For Append As #1
Print #1, "**** A LIST OF POSSIBLE BASE TABLE COLUMNS ****"
Searchlt("BCOL", "Base Table Item True", 0, "base table columns")
Close #1

' DETERMINE THE NUMBER OF COLUMNS REFERENCED.
Open "C:\TEMP\REPORT.DOC" For Append As #1
Print #1, "**** A LIST OF POSSIBLE COLUMNS ****"
Searchlt("TCOL", "Select", 0, "columns referenced")
Close #1

End Sub

Sub SkipSpacesRight
'Skip spaces & CR
While (Asc(Selection$(()) = 13 Or Asc(Selection$(())) = 9 Or Asc(Selection$(())) = 32)
    CharRight 1, 0
Wend
End Sub

Sub SkipSpacesLeft
'Skip spaces & CR
CharLeft 1, 0
While (Asc(Selection$(()) = 13 Or Asc(Selection$(())) = 9 Or Asc(Selection$(())) = 32)
    CharLeft 1, 0
Wend
End Sub
Function NameWith_Symbol$
    'Assumes that the word is already selected.
    TempWord$ = Selection$("")
    CharRight 1, 0
    While Selection$(") = "$
        TempWord$ = TempWord$ + Selection$(")
        CharRight 1, 0
        SelectCurWord
        TempWord$ = TempWord$ + Selection$(")
        CharRight 1, 0
    Wend
    WordLeft 1, 1
    NameWith_Symbol$ = TempWord$
End Function

Function ADuplicate$(PossTabName$)
    Dim NameLength
    ADup$ = "Y"
    NameLength = Len(LTrim$(RTrim$(PossTabName$)))
    Open "C:\TEMP\REPORT.DOC" For Input As #1
    Input #1, name$
    If name$ = "" Then
        ADup$ = "N"
        Goto Finish
    End If
    While LCase$(Left$(Name$, NameLength)) = LCase$(LTrim$(RTrim$(PossTabName$)))
        If Eof(1) Then
            ADup$ = "N"
            Goto Finish
        End If
        Input #1, Name$
    Wend
    ADup$ = "Y"
Finish:
    ADuplicate$ = ADup$
    Close #1
End Function

Function NotDuplicate(TempWord$)
    NotDup = 0
    Close #1
    If (TempWord$ <> Chr$(32) And ADuplicate$(TempWord$) = "N") Then 'not blank nor duplicate
        Open "C:\TEMP\REPORT.DOC" For Append As #1
        Print #1, LCase$(TempWord$)
        NotDup = 1
        Close #1
    End If
    Print table
NotDuplicate = NotDup
End Function

Function IsLastCollnStatement
'Assumes that the word is highlighted.
IsLast = 0
WordRight 1, 0
SkipSpacesRight
SelectCurWord
If (UCase$(Selection$()) = "FROM" Or UCase$(Selection$()) = "INTO") Then
   IsLast = 1
End If Is FROM
WordLeft 1, 0
SkipSpacesLeft
WordLeft 1, 1
IsLastCollnStatement = IsLast
End Function

Function UsesFunction
'Assumes that word is highlighted
UsesFn = 0
CharRight 1, 0
SkipSpacesRight
If Selection$() = "(" Then
   UsesFn = 1
End If
SkipSpacesLeft
WordLeft 1, 1
UsesFunction = UsesFn
End Function

Function ReferenceColumns
'Assumes that the word to the right of "select" is highlighted.
NotColumn$ = "COUNT"
LeaveLoop = 0
TempCols = 0
If InStr(NotColumn$, UCase$(Selection$())) <> 0 Then
   'eg. neglect: select count(*) from emp;
   LeaveLoop = 1
End If
While LeaveLoop = 0
   CharRight 1, 0
   SkipSpacesRight
   If Selection$() = "," Or Selection$() = "." Then
      'eg. select id_number, name from emp;
      SkipSpacesLeft
   End If
End While
WordLeft I, 1
TempWord$ = NameWith_Symbol$
Close #1
If UsesFunction = 1 Then
'eg. select to_date(to_char(...)).
CharRight I, 0
SkipSpacesRight
Goto UsesFunction
Else
LeaveLoop = IsLastCollnStatement
If NotDuplicate(TempWord$) = 1 Then
TempCols = TempCols + 1
End If
CharRight I, 0
SkipSpacesRight
WordRight I
SelectCurWord
End IfOf UsesFunction
ElseIf Selection$() = "," Then
'eg. select e.idnumber from emp e;
CharRight I, 0
WordRight I, 1
TempWord$ = NameWith_Symbol$
Close #1
LeaveLoop = IsLastCollnStatement
If NotDuplicate(TempWord$) = 1 Then
TempCols = TempCols + 1
End If
CharRight I, 0
SkipSpacesRight
WordRight I
SelectCurWord
ElseIf Selection$() = "(" Then
UsesFunction:
'eg. select ltrim(rtrim(name)) from emp;
OpenBracketCounter = 1
CharRight I, 0
While Selection$() <> ")"
If Selection$() = "(" Then
OpenBracketCounter = OpenBracketCounter + 1
End If
CharRight I, 0
Wend
EditFind .Find = "", .Direction = 1, .MatchCase = 0, .WholeWord = 1, .PatternMatch = 0, .SoundsLike = 0, .Format = 0, .Wrap = 0
If EditFindFound() <> 0 Then
CharRight I, 0
SkipSpacesRight
'Ensure it is not a form field eg :id_number
If Selection$() = ";" Then
CharRight I, 0
End If
'Check for alias eg. emp.id_number
WordRight I, 0
If Selection$() = "," Then
Else
  WordLeft 1, 0
End If
SelectCurWord
TempWord$ = NameWith_Symbol$
Close #I
If NotDuplicate(TempWord$) = 1 Then
  TempCols = TempCols + 1
End If

'Check if this is the last column in statement
CharRight 1, 0
For CloseBracketCounter = 1 To OpenBracketCounter
  EditFind .Find = "\)\)", .Direction = 0, .MatchCase = 0, .WholeWord = 1, .PatternMatch = 0, .SoundsLike = 0, .Wrap = 0
  If EditFindFound() <> 0 Then
    CharRight 1, 0
  Else
    LeaveLoop = 1
    MsgBox "Query statement contains a syntax error."
  End If
Next CloseBracketCounter

SkipSpacesRight
If (UCase$(Selection$()) = "F" Or UCase$(Selection$()) = "!)") Then
  SelectCurWord
  If (UCase$(Selection$()) = "FROM" Or UCase$(Selection$()) = "INTO") Then
    LeaveLoop = 1
  End If
  CharLeft 1, 0
End If
End If is FROM
WordRight 1, 0
SkipSpacesRight
WordRight 1, 0
SkipSpacesRight
CharLeft 1, 0
Else
  MsgBox "Error searching for open bracket."
  LeaveLoop = 1
End If
ElseIf (UCase$(Selection$()) = "F" Or UCase$(Selection$()) = "!)") Then
  'Ensure that it is the word "FROM" or "INTO"
  SelectCurWord
  If (UCase$(Selection$()) = "FROM" Or UCase$(Selection$()) = "INTO") Then
    CharLeft 2, 0
    SkipSpacesLeft
    SelectCurWord
    TempWord$ = NameWith_Symbol$
    Close #I
    If NotDuplicate(TempWord$) = 1 Then
      TempCols = TempCols + 1
    End If
  End If

DetermineComplexity(ThisModType$)

Sub DetermineComplexity(ThisModType$)
'called from Searchit.
'This proc determines the complexity rating of Low, Average, or High
'for a component.

Select Case ThisModType$
  Case "R" 'External Outputs
      Select Case NumB
        Case 0 To 1
          Select Case NumBCol
            Case 0
              EO(1) = EO(1) + 1 'External
            Case 1 To 19
              Output = LO
            Case Else
              EO(2) = EO(2) + 1 'External
            End Select
          End Case
        Case 2 To 3
          Select Case NumBCol
            Case 0
              EO(1) = EO(1) + 1 'External
            Case 1 To 5
              Output = LO
            Case Else
              EO(2) = EO(2) + 1 'External
            End Select
          End Case
        Case "NQO" 'External Inputs
          Select Case NumBCol
            Case 0
              EO(2) = EO(2) + 1 'External
            Case 1 To 5
              Output = AV
            Case Else
              EO(3) = EO(3) + 1 'External
            End Select
          End Case
        Case Else
          Select Case NumBCol
            Case 0
              EO(2) = EO(2) + 1 'External
            Case 1 To 5
              Output = AV
            Case Else
              EO(3) = EO(3) + 1 'External
            End Select
          End Case
      End Select
  Case Else
    Select Case NumBCol
      Case 0
        Output = AV
      Case 1 To 5
        Output = HI
      Case Else
        Output = HI
    End Select
  End Case
End Select
End Sub
Select Case NumB
  Case 0 To 1
    Select Case NumBCol
      Case 0
      Case 1 To 15
        EQ(1) = EQ(1) + 1 'External
      Case Else
        EQ(2) = EQ(2) + 1 'External
    End Select
  Case 2
    Select Case NumBCol
      Case 0
      Case 1 To 4
        EQ(1) = EQ(1) + 1 'External
      Case 5 To 15
        EQ(2) = EQ(2) + 1 'External
      Case Else
        EQ(3) = EQ(3) + 1 'External
    End Select
  Case Else
    Select Case NumBCol
      Case 0
      Case 1 To 4
        EQ(2) = EQ(2) + 1 'External
      Case Else
        EQ(3) = EQ(3) + 1 'External
    End Select
End Select
Case "QO" 'External Inquiries
  Select Case NumB
    Case 0 To 1
      Select Case NumBCol
        Case 0
        Case 1 To 15
          EQ(1) = EQ(1) + 1 'External
        Case Else
          EQ(2) = EQ(2) + 1 'External
      End Select
    Case 2
      Select Case NumBCol
        Case 0
        Case 1 To 4
          EQ(1) = EQ(1) + 1 'External
        Case 5 To 15
          EQ(2) = EQ(2) + 1 'External
        Case Else
          EQ(3) = EQ(3) + 1 'External
      End Select
    Case Else
      Select Case NumBCol
        Case 0
        Case 1 To 4
          EQ(2) = EQ(2) + 1 'External
        Case Else
          EQ(3) = EQ(3) + 1 'External
      End Select
  End Select
Inquiry = LO
  Case Else
    EQ(2) = EQ(2) + 1 'External
End Select
Inquiry = AV
Inquiry = HI
End Select
Case Else
  Select Case NumBCol
  End Select
Case 0
Case 1 To 4
   EQ(2) = EQ(2) + 1 'External
End Select
Case Else
   EQ(3) = EQ(3) + 1 'External
End Select

Sub
   Eq(1) = -2
End Sub

Sub SearchIt(ItemType$, WordToSearch$, MatchTheCase, SearchItem$)
   LeaveSearchLoop = 0
   StoredLineNumber = -3
   CommentedLine$ = "--!*"
   SpecialChar$ = Chr$(9) + Chr$(11) + Chr$(32) + Chr$(34) + Chr$(40) + Chr$(41) + Chr$(58) + Chr$(59) + Chr$(60) + Chr$(62) + Chr$(160)
   NotTable$ = "FROM, ITEM, NULL, DUAL, THE, THIS, AND, NAME");" + SpecialChar$
   EndOfDocument
   Insert Chr$(13) + WordToSearch$ + " ENDOFDOCUMENTSYMBOL "
   StartOfDocument
   While LeaveSearchLoop = 0
      EditFind .Find = WordToSearch$, .Direction = 0, .MatchCase = MatchTheCase, .WholeWord = 1, .PatternMatch = 0, .SoundsLike = 0, .Format = 0, .Wrap = 0
      If EditFindFound() <> 0 Then
         If SelInfo(IO) <> StoredLineNumber Then
            'ie. if there are >2 WordToSearch$ words in one line
            StartOfLine
            CharRight 1, 1
            While LTrim$(Selection$()) = ""
               CharRight 1, 1
            Wend
            CharRight 1, 1
            StoredLineNumber = SelInfo(IO)
            If InStr(CommentedLine$, LTrim$(Selection$())) <> 0 Then
               LineDown
            End If
            Else
               StartOfLine
               EditFind .Find = WordToSearch$, .Direction = 0, .MatchCase = MatchTheCase, .WholeWord = 1, .PatternMatch = 0, .SoundsLike = 0, .Format = 0, .Wrap = 0
            End If
            CommentedLine$ = "--!*"
         End If
      End If
      CharRight 1, 0
      SkipSpacesRight
      SelectCurWord
   Goto EndOfLoopLabel
End Sub
If Selection$() = "ENDOFDOCUMENTSYMBOL" Then
  EditReplace .Find = WordToSearch$ + 
  "ENDOFDOCUMENTSYMBOL", .Replace = "", .Direction = 1, .MatchCase = 1, .WholeWord = 1,
  .PatternMatch = 0, .SoundsLike = 0, .ReplaceOne, .Format = 0, .Wrap = 1
  EditClear - 2
  LeaveSearchloop = 1
Else
  If ItemType$ = "BCOL" Then
    CharRight 1
    EditFind .Find = "Name ", .Direction = 1, .MatchCase = 1,
    .WholeWord = 1, .PatternMatch = 0, .SoundsLike = 0, .Format = 0, .Wrap = 0
    WordRight 1, 0
    SelectCurWord
  End If
Else
  If ItemType$ = "TCOL" Then
    Counter = ReferenceColumns + Counter
    CharRight 1, 0
    SkipSpacesRight
  Else
    If InStr(NotTable$, UCase$(Selection$())) = 0 Then
      If Selection$() = Chr$(13) Then Carriage return
      CharRight 1, 0
      SelectCurWord
    End If
    TempWord$ = Selection$()
    CharRight 1, 0
    While Selection$() = " 
      TempWord$ = TempWord$ + " 
      CharRight 1, 0
      SelectCurWord
      TempWord$ = TempWord$ + Selection$()
      CharRight 1, 0
    Wend
    Close #1
    If NotDuplicate(TempWord$) = 1 Then
      Counter = Counter + 1
    End If
  Else
    CharRight 1, 0
  End If
End If
End If
EndOfLoopLabel:
End If
End
End If
EndOfDocSymbol
End If
EndIf
EndIf

End If
End
EndIf

End If
EndIf
EndIf

End If
EndIf
EndIf

If itemCount$ = "BCOL" Then
  CharRight 1
  EditFind .Find = WordToSearch$, .Direction = 0, .MatchCase = MatchTheCase, .WholeWord = 1,
  .PatternMatch = 0, .SoundsLike = 0, .Format = 0, .Wrap = 0
End If

Wend
Close #1
Select Case itemType$
    Case "T"  "Tables referenced in select statements.
        NumT = NumT + Counter
    Case "TCOL" "Columns referenced in select statements.
        NumCol = NumCol + Counter
    Case "B"
        NumB = NumB + Counter
    Case "BCOL"
        NumBCol = NumBCol + Counter
End Select

Open "C:\TEMP\REPORT.DOC" For Append As #1
Print #1, "COUNT = " + Str$(Counter) + Chr$(13) + Chr$(13) + Chr$(13)
Close #1
End SubSearching