

*An investigation in software process assessment in the
software development department of a large electricity
utility*

Melanie Teena Lang

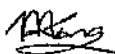
A dissertation submitted to the Faculty of Engineering,
University of the Witwatersrand, Johannesburg, in fulfilment
of the requirements for the degree of Master of Science in
Engineering.

Johannesburg,

1998

DECLARATION

I declare that this dissertation is my own, unaided work - apart from reviews and discussions with area experts. It is being submitted for the degree of Master of Science in Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before any degree or examination in any other University.



(Signature of candidate)

28

day of **August**

1998

ACKNOWLEDGEMENTS

I wish to thank Alastair Walker as supervisor who provided guidance in both subject matter and the SEAL support structure. Without the facilities that the SEAL offers, i.e. the SEAL Quality Management System, this project would not have been possible or would have required more effort.

Reviews and feedback are a critical requirement for improvement and I would like to thank the following people - Barnie Barnard, Ian Campbell, Chris Dale, Christine Griesel, Bram Meyerson, Erich Roberts and Mike Rodd - for their patience and assistance in this regard.

Subject matter experts and experienced resources are often reluctant to share information or cannot spare the time. For this, I am grateful to Chris Dale, Debbie Dickson, Mary Fisher, Bram Meyerson, Jessica van Wyk, Jay van Zyl, and Alastair Walker..

Special thanks to Jim Glorie who supplied a very hard-to-find classical reference and more.

To all those members of Eskom who helped with the case studies by allowing their projects to be assessed and contributing their time for interviews - Ashley Byrch, Barnie Barnard, Ian Campbell, Johan Delport, Athina Flammos, Paul Gerakis, Brenda Holton, Erika Human, Paul Meehan, John Miller, Sanet Mulder, Erich Roberts, Ruth Stead, Charl Viljoen, Diana Vorster and Mike Wyndham - I am most thankful.

I would also like to express appreciation to Eskom for supporting this project financially in terms of a further study bursary.

I am grateful to Ivan Cheong and my family - Edmund, Joy, Conrad, Cherilyn and Stephanie - for their encouragement, patience and support during the late nights and weekends.

ABSTRACT

The software development division in the Eskom Information Technology Department has recently implemented process assessment techniques as well as metrics. Lack of these tools may have resulted in projects being over-budget, overdue or not satisfying customer requirements, if not all three. This transpires in many other organisations regardless of size or industry sector. The techniques implemented are Function Point Analysis (FPA) and the ISO/IEC 15504 international standard for software process improvement and capability determination (SPICE). Subscription to the Computer Sciences Corporation (CSC) Index Research and Advisory Services Performance Enhancement Programme (PEP) has facilitated the collection of baselining and measurement data, of which FPA is part. This paper seeks to provide background to these techniques, details of the four projects chosen for the comparative case study, and the approach taken for the study. This report discusses compatibility and comparability of these models within typical departmental projects where information was captured within the 1996 timeframe. The discussion revolves around data needed as input by both and data output as part of the corresponding profiles. Other comparisons include relation of these to specific quality properties or lack of quality best practices and the relationships between the two methods. The results have been disappointing in that the analysis provided no clear correlation between the two techniques. The paper observes possibilities for future research based on issues encountered which exceeded the scope of this project.

TABLE OF CONTENTS

	Page Number/
	Document Number
Declaration.....	ii
Acknowledgements	iii
Abstract.....	iv
Table of Contents.....	v
Foreword.....	viii
MSc Paper - Melanie Teena Lang.....	
Technical Paper: An Investigation in Software Process Assessment in the Software Development Department of a Large Electricity Utility.....	MLA 120
Research Assessment.....	MLA 130
Learning from the Project.....	MLA 150
Literature Survey.....	MLA 160
Bibliography/References.....	MLA 140
A: Management Documentation.....	
Master Document List.....	MLA 001
Quality Plan.....	MLA 003
Product Description.....	MLA 004
Project Management Plan Part 1.....	MLA 005
Project Management Plan Part 2.....	MLA 005-10
Configuration Management Plan.....	MLA 006
B: Assessment Results	
Project A.....	
FPA Count for Project A.....	MLA 310

PEP Footprint for Project A	MLA 312
Work Breakdown Structure for Project A.....	MLA 304
SPICE Profile for Project A.....	MLA 311
SPICE Assessment Feedback Report for Project A	MLA 308
Project B.....	
FPA Count for Project B	MLA 320
PEP Footprint for Project B	MLA 322
Work Breakdown Structure for Project B.....	MLA 314
SPICE Profile for Project B.....	MLA 321
SPICE Assessment Feedback Report for Project B	MLA 318
Projects C and D.....	
FPA Count for Project C	MLA 330
PEP Footprint for Project C	MLA 332
FPA Count for Project D	MLA 340
PEP Footprint for Project D	MLA 342
Work Breakdown Structure for Projects C and D	MLA 324
SPICE Profile for Project C.....	MLA 331
SPICE Profile for Project D.....	MLA 341
SPICE Assessment Feedback Report for Projects C and D.....	MLA 328
Summary	
SPICE Assessment Feedback Summary.....	MLA 348
FPA vs SPICE Comparison.....	MLA 352

FOREWORD

The format for this Masters Dissertation differs from the conventional format in that it comprises a short body (including a technical paper and supplementary documents which provide insight into other aspects of the project) and a number of appendices. The technical detail of this project is in documents comprising the appendices. It is therefore considered helpful to provide the reader with guidance regarding the order in which these should be reviewed.

The reader is directed to the technical paper entitled "An Investigation in Software Process Assessment in the Software Development Department of a Large Electricity Utility" to gain a broad perspective on this project. This material is supplemented by:

1. Research Assessment: An assessment by the candidate of the research effectiveness and achievements of this project and research proposals for future work in this field.
2. Learning from the Project: A review of the lessons learned from the project from a quality system and product quality viewpoint, and recommended improvements for subsequent projects.
3. Literature Survey: A review of the literature that exists covering function points, SPICE, assessments and the intersection of these.
4. Bibliography/References: A numbered list of papers and useful references in the project.

The appendices within the dissertation are discussed below.

The Management Documentation consists of the following:

1. The Master Document List (MDL), document number MLA 001, is a register of all documents created or anticipated to be created within this project.
2. The Quality Plan, document number MLA 003, presents the reader with an overview of the project, particularly as to how the essential requirements of ISO 9001 will be addressed. It reviews the quality system being applied to the project.
3. The Product Description (PD), document number MLA 004, serves to identify the functional and non-functional requirements of this particular project.

4. The Project Management Plan Part 1, document number MLA 005, identifies the product resource requirements in terms of schedule, hardware and software, and humans resources.
5. The Project Management Plan Part 2, document number MLA 005-10, tracks the project in terms of schedule.
6. The Configuration Management Plan, document number MLA 006, reviews the configuration management practices to be applied to the product development.

The Assessment Results consists of the following:

1. Each case study project contains the following documents:
 - 1.1. The FPA Count, document numbers MLA 310, MLA 320, MLA 330 and MLA 340, provides the details for the inputs and outputs of the function point count for the project.
 - 1.2. The PEP Footprint, document numbers MLA 312, MLA 322, MLA 332 and MLA 342, provides the footprint and associated figures for the project.
 - 1.3. The Work Breakdown Structure, document numbers MLA 304, MLA 314 and MLA 324, serves to plan and track the schedule for the SPICE assessments. MLA 324 covers both projects C and D, as the same resources were involved and the assessments were done concurrently.
 - 1.4. The SPICE Profile, document number MLA 311, MLA 321, MLA 331 and MLA 341, provides the outputs for each process category and overall from the SEAL process assessment tool.
 - 1.5. The SPICE Assessment Feedback Report, document numbers MLA 308, MLA 318 and MLA 328, provides the summary of the feedback provided to assessment participants. MLA 328 covers both projects C and D, as the same resources were involved and the results were similar.
2. The summary documents are:
 - 2.1. The SPICE Assessment Feedback Summary, document number MLA 348, provides the consolidation of results from the case study feedback reports.
 - 2.2. The FPA vs SPICE Comparison, document number MLA 352, which

analyses the case study data.

Detailed PEP and SPICE results cannot be included due to confidentiality and contractual agreements. Details on SPICE assessments can be obtained from MLA 306 (project A), MLA 316 (project B) and MLA 326 (projects C and D).

An Investigation in Software Process Assessment in the Software Development Department of a Large Electricity Utility

MT Lang

Information Technology Department, Eskom, South Africa

Abstract

The software development division in the Eskom Information Technology Department has recently implemented process assessment techniques as well as metrics. Lack of these tools may have resulted in projects being over-budget, overvalue or not satisfying customer requirements, if not all three. This transpires in many other organisations regardless of size or industry sector. The techniques implemented are Function Point Analysis (FPA) and the ISO/IEC 15504 international standard for software process improvement and capability determination (SPICE). Subscription to the Computer Sciences Corporation (CSC) Index Research and Advisory Services Performance Enhancement Programme (PEP) has facilitated the collection of baselining and measurement data, of which FPA is part. This paper seeks to provide background to these techniques, details of the four projects chosen for the comparative case study, and the approach taken for the study. This report discusses compatibility and comparability of these models within typical departmental projects where information was captured within the 1996 timeframe. The discussion revolves around data needed as input by both and data output as part of the corresponding profiles. Other comparisons include relation of these to specific quality properties or lack of quality best practices and the relationships between the two methods. The results have been disappointing in that the analysis provided no clear correlation between the two techniques. The paper observes possibilities for future research based on issues encountered which exceeded the scope of this project.

Keywords: ISO/IEC 15504, function point analysis, software metrics, software measurements, software quality management, software engineering standards, capability determination, software process assessment.

1. Introduction

There are many techniques for both measurement and process assessment in the information technology industry - some freely available, while others are proprietary, some recognised by standards bodies while others are de facto. This software development department has implemented three such techniques.

The techniques implemented are the more widely known Function Point Analysis (FPA) and the ISO/IEC 15504 international standard for software process improvement and capability determination (SPICE). SPICE has been released as an international standard. Subscription to the Computer Sciences Corporation (CSC) Index Research and Advisory Services (RAS) Performance Enhancement Programme (PEP) has facilitated the collection of baselining and measurement data, of which FPA is part.

The context of this study is a number of typical projects supporting the core business of electricity supply. These results may not specifically be linked to the fact that the business for which software was being developed was the electricity business. However, due to the fact that the case studies were restricted to this business and this specific department, it is indicated as such.

This report discusses compatibility and comparability of these models within typical departmental projects. The discussion revolves around data needed as input by both; data output as part of the corresponding profiles and relation of these to specific quality properties or lack of quality best practices.

2. Background

Some background is provided on the history of the techniques finishing with the history of their implementation in IT Application Systems.

2.1 Software process assessment - CSC

2.1.1 Functional point analysis

The International Function Point User Group (IFPUG) [17] defines a measure as a number that assigns relative value. As a verb, measure means to ascertain or appraise by comparing to a standard. They see measurement as assigning relative value. Usually, in the improvement process, measures gained from this activity are combined to form metrics. Also, a metric is a combination of two or more measures or attributes. [20]

Function points originated in 1979 when Allan Albrecht [2], then working for IBM was approached to develop a method to monitor and estimate productivity independent of the programming language and technology used. Albrecht believed that size was the

primary driver of a project, and centred the development of his measure around software size.

The essence of any software system is that it has a number of inputs, some processing logic, a number of outputs and accesses some files. These concepts are demonstrated in a function point context in Figure 1.

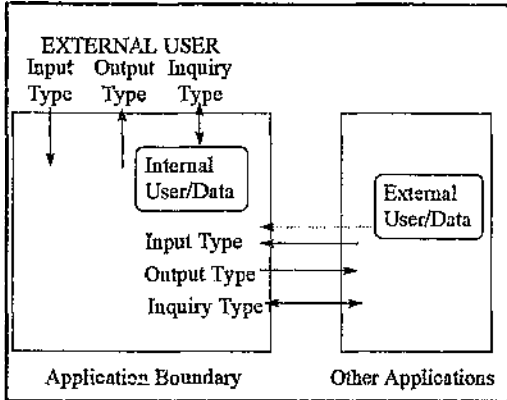


Figure 1: A basic application and its function point parameters [37]

User perspective dictates the approach to the count by identifying logical (interpreted in business terms), and not physical files and functions. The "size" of a function or file is based on standard values, which were originally statistically calculated.

Table 1 below lists the process to be followed when performing a function point count.

Table 1 – Function Point Process	
Step	Action
1.	Identify all the logical elements represented in the diagram, which are part of the system to be counted.
2.	Categorised these elements into the following types: 1. External Interface File (EIF) or Internal Logical File for data accessed; and 2. External Input (EI), External Output (EO) or External Inquiry (EQ) for functions on data.

Table 1 – Function Point Process

3.	If the element is a file, then count the number of logical files grouped together and the number of attributes on each of these. Else If the element is a function, then count the files and fields accessed to perform the function.
4.	Translate values from previous step to simple, average or complex.
5.	Translate simple, average or complex to values depending on element type.
6.	Total translated values from previous step to give unadjusted function point count.
7.	Calculate value adjustment factor (VAF) by weighting 14 complexity factors using the supplied questions between 0 and 5, where 0 is no complexity and 5 is the highest.
8.	Calculate the adjusted function point count using the unadjusted count with the VAF as a multiplier.

Exact values and formulas for the steps above are supplied by IFPUG's Counting Practices Manual. [19] The adjusted function point count is accepted as the system size.

Note that function point analysis is not a CSC product or method, but has been chosen by Eskom as a sizing method.

2.1.2 Performance Enhancement Programme (PEP)

CSC [6] have developed a method of comparing projects within an organisation. The method requires information on:

- project size,
- estimate and actual work effort and cost,
- defects and errors,
- platforms, technologies, packages,
- methods, tools and techniques,
- staff and user experience and
- project life cycle or methodology.

2.1.3 Overview of PEP footprint

One of the outputs of their assessment is a *footprint* (Figure 2) which is a device for summarising a number of metrics in a visual way. *It does not isolate and measure every part of the system lifecycle, e.g. the footprint is not applied to the business systems analysis and design stage.* [50]

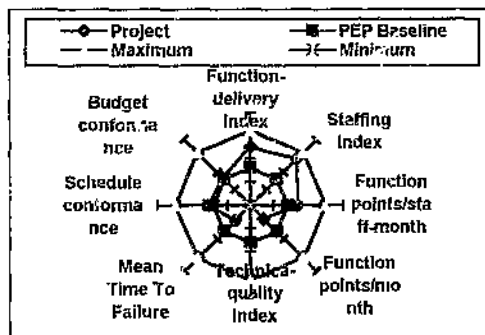


Figure 2: PEP Footprint

2.1.4 PEP footprint metrics

As described in IT Review [40], the descriptions of the measures displayed in Figure 2 are as follows:

- Function Delivery Index (FDI) - Overall efficiency of project team which is a measure of the relationship between project size, time and effort.
- Staffing Index (SI) - Whether a project appears to be overstaffed, which is often an indicator of poor planning or unrealistic deadlines. This appears to have a strong correlation to Brook's Mythical Man Month [4], which states that adding people to an already late project makes it even later.
- Function Points/staff month (fp/sm) - How much is delivered for resource invested. This incorporates size and effort.
- Function Points/month (fp/m) - Speed of delivery.
- Technical Quality Index (TQI) - Errors detected during testing and early operation.
- Mean Time To Failure (MTTF) - Average time between failures once a system is released into production.
- Schedule Conformance - How much the project is over or under its planned schedule.
- Budget Conformance - How much the project is over or under its planned budget.

2.1.5 PEP baselines

For a particular metric (e.g. fp/sm), the *footprint* displays a minimum, a maximum, a project value and the PEP baseline value. The baseline is a value that enables comparison of the results of a given project, with the results for similar projects, in the rest of the world, using the PEP database. The baseline uses a formula to determine the median value of the distribution of values of the metric. The formula takes into account the project type, language mix, platform and size of the project which applies to the comparison.

2.1.6 Plotting of PEP footprint

The scale of each metric is determined in such a way that the baseline falls midway between the centre and the outside of the *footprint*. The baseline helps to ensure that an organisation compares with suitable projects.

Project values are plotted on that scale, with better values (than baseline) plotted towards the outside, and worse values (than baseline) towards the middle. The aim is to give an overall impression of project performance, with a large *footprint* being better than a small one. [46]

2.1.7 PEP footprint difficulties

Missing spokes (e.g. TQI of Figure 2) indicate that information submitted was insufficient to generate the required information.

Every attempt is made to ensure that data collected is accurate. However, high values may be an indication that the physical data collection is based on recollection rather than accurate records being logged and maintained. For example, if recording of testing and operational errors was inaccurate, or estimated, the graph may be skewed and appear as having high technical quality.

An important point to note is that the *footprint* may behave like a rubber band, e.g. increasing speed may decrease quality.

2.1.8 PEP process assessment

Footprints are aggregated and baselined for the department and a detailed statistical analysis is undertaken by CSC and South African PEP representative, QuantiMetrics. The *footprints* alone give no guidelines to the teams or management on what process needs to be improved, but provides management with helpful graphical summaries.

2.1.9 PEP process improvement

Following this assessment, a workshop (for managers and invited participants) to find explanations for some of the statistics and discuss possible courses of action, is facilitated by QuantiMetrics [45] and aimed at systems development managers. QuantiMetrics then produce a report [44] containing a set of agreed recommendations for improvement action.

Additional conversations and meetings with QuantiMetrics can derive statistics to provide advice for future planning, resource allocation and quality improvement. Baselineing should provide an impetus for performance improvement initiatives, and give supervisors a tool for effective management. It provides a language that is more suited to discussions with business. [40]

2.2 Software process assessment - SPICE

ISO/IEC 15504 is also known as Software Process Improvement and Capability Determination or by the acronym SPICE. It is an international standard developed by ISO/IEC JTC1/SC7 WG10 to provide a structured approach for the assessment of software processes. [28]

2.2.1 The SPICE model [29]

The model adopted by ISO/IEC 15504 is shown in Figure 3. Fundamental to the model is the concept of a process, which is described as a set of interrelated activities, which transform inputs into outputs.

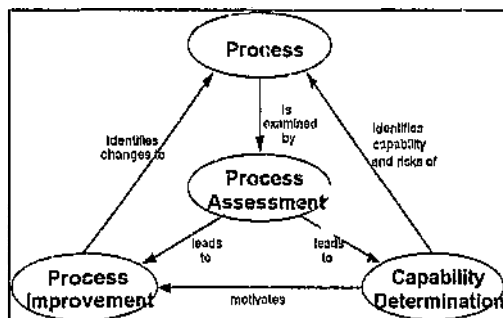


Figure 3: The Assessment Process

Processes are examined using the mechanism of process assessment, defined as a disciplined evaluation of an organisation's software processes. The output of the assessment exercise is a profile, which can be used variously for process improvement and/or for determination of process capability. Process assessment is Action taken to change an organisation's processes so that they meet the organisation's business needs and achieve its business goals more effectively. Capability determination is defined as a systematic assessment and analysis of

selected software processes within an organisation against a target capability, carried out with the aim of identifying the strengths, weaknesses and risks associated with deploying the processes to meet a particular specified requirement.

The two key components of the standard are a process model and guidance on conducting assessments. [30]

The process model is made up of a framework of attributes in two dimensions: Process and Capability.

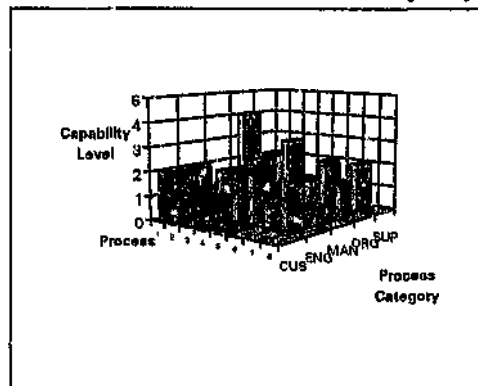


Figure 4: The Dimensions of the SPICE Model

2.2.2 The SPICE process dimension

Processes (x-axis of Figure 4) are grouped into general areas of activity called process categories (z-axis of Figure 4):

- Customer-Supplier (CUS)
- Engineering (ENG)
- Support (SUP)
- Management (MAN)
- Organisation (ORG)

The processes in Figure 4 are enumerated for illustrative purposes, but they are not the same across all the process categories, as seen in Table 2.

Table 2 – List of processes	
Identifier	Name
CUS.1	Acquire software
CUS.2	Manage customer needs
CUS.3	Supply software
CUS.4	Operate software

Table 2 – List of processes

Identifier	Name
CUS.5	Provide customer service
ENG.1	Develop system requirements and design
ENG.2	Develop software requirements
ENG.3	Develop software design
ENG.4	Implement software design
ENG.5	Integrate and test software
ENG.6	Integrate and test system
ENG.7	Maintain system and software
SUP.1	Develop documentation
SUP.2	Perform configuration management
SUP.3	Perform quality assurance
SUP.4	Perform work product verification
SUP.5	Perform work product validation
SUP.6	Perform joint reviews
SUP.7	Perform audits
SUP.8	Perform problem resolution
MAN.1	Manage the project
MAN.2	Manage quality
MAN.3	Manage risks
MAN.4	Manage subcontractors
ORG.1	Engineer the business
ORG.2	Define the process
ORG.3	Improve the process
ORG.4	Provide skilled human resources
ORG.5	Provide software engineering infrastructure

Each process contains a number of base practices, which could be seen as current quality best practices.

2.2.3 The SPICE capability dimension

A capability level (y-axis of Figure 4) is a set of process and management attribute(s) that work together to provide a major enhancement in the capability of a Supplier to perform a process.

There are six capability levels in the reference model:

- Level 0: Incomplete

- Level 1: Performed
- Level 2: Managed
- Level 3: Established
- Level 4: Predictable
- Level 5: Optimising

Each level represents a major enhancement of capability in the performance of a process. The levels constitute a rational way of progressing through improvement of the capability of any process.

In the Capability dimension, a capability level consists of process attributes, which contain one or more management practices. Quality properties of the process could be represented by management practices, while quality properties of products could be represented by work product characteristics.

2.2.4 SPICE assessment

The capability level of each process is independently assessed, by a qualified assessor (with their assessment team) [33] making a judgement supported by documented objective evidence. This may be based on practice attributes (by interviewing process practitioners and managers) or work product characteristics (by examining documents, plans, etc.) provided by the SPICE embedded model [32]. The ratings supported by the judgement are fully, largely, partially and no achievement. These can be aggregated and lead to a collection of profiles which represent the assessment output, as seen in Figure 4. This profile can be set to different degrees of detail showing achievement percentage scales ranging from organisational unit (OU) (defined as that part of an organization that is the subject of an assessment - in this case, IT Application Systems) capability level to process capability level. [31]

The aggregation of the results is meaningless on its own. It is the data gathering and analysis process that provides insights into possible improvements, which needs to be prioritised by organisational goals, as is stated by ISO/IEC 15504-7. [34]

Each assessment may produce different results depending on the assessment input, i.e. it is possible that an organisation of capability level 5 achieves mainly capability level 1 if their worst projects are selected. It is unlikely however, that an organisation with capability level 1 will be able to achieve capability level 5 on a specific project, by virtue of the dependence on processes which are outside their control. An organisation which can achieve Level 5, will thus be able to selectively apply processes, based on risk and cost effectiveness.

Recommendations for improvement can be made based on the process achievement.

2.2.5 SPICE process improvement

A first assessment can form part of a baseline. Thereafter, using the Guidelines for Process Improvement [34], improvements can be prioritised and implemented in accordance with organisational goals.

2.3 Application systems

2.3.1 Structure

The Information Technology Department (ITD), which supports all IT requirements of Eskom, consists of Operations and Application Systems divisions. Operations takes care of networks, mainframe, servers, database administration and general operational issues, while Application Systems develops systems for use by the business. Business managers with their solution team leaders are separate from these two groups and manage customer relations.

Eskom is divided into Generation, Transmission, Distribution and Services:

- Generation deals with the generation of electricity by the power plants.
- Transmission deals with the lines which transport the electricity from the power plants to local areas
- Distribution deals with the supply of electricity to individuals and organisations, as well as the related customer care process, and
- Services deals with support services, such as finances and human resources.

Teams in the Application Systems department are structured such that they work on projects in one of the four areas listed above. Teams within these areas may also work on one of the major integrated initiatives (programmes), e.g. Phoenix.

Apart from the teams that develop the software, there are a number of independent groups such as business analysis, project management and the quality team. They can service more than one of the four areas above. The Quality team does the main data collection and collation for both process assessment initiatives.

2.3.2 Process assessment initiatives - PEP

The metrics programme was initiated in first quarter 1995 by the Professional Competencies Manager (who reported to the Application Systems Manager and was

responsible for business analysis, project management, etc.) and QuantiMetrics. A number of systems analysts and developers were sent on function point analysis training (as a prerequisite for the sizing which was one of the main measures of PEP). The project was originally led by a project manager, with the trained counters providing information. The project manager also performed the data collection for the PEP Baselineing programme. Despite the fact that the Counting Practices Manual was a standard for usage of function points, there were a number of discrepancies and problems due to differences in interpretation of standard definitions. A metrics advisor was appointed to standardise the practice and take over from the project manager.

The implementation of the original metrics programme was difficult, as it was based on needs from the metrics advisor rather than needs from within IT Application Systems management. This is a common problem of failure of a Metrics programme [50]

With the move from charging on a time and materials basis to charging on a fixed cost basis, some project managers came to realise the benefits of using function points for estimating and cost justification. They proactively trained teams (solution managers, programmers, project managers, team leaders), and used the technique, gathering their own history base that was then used in future estimations. As a result of improved accuracy of estimations, one IT programme's customers asked that all feasibility studies include a function point count. The count is used for cost justification to their managers.

Another IT programme chose to perform application function point counts on all their systems as part of an 'asset registration' exercise. The fact that support on information analysis and usage has not been offered; and the promised usage of these metrics as part of the balanced scorecard has not yet materialised, has discouraged this team. Metrics cannot be used in the balanced scorecard due to the fact that the other teams have ignored the initiative.

PEP is now in its fourth year in Eskom - there does not appear to be any direct actions as a result of the workshops that have taken place.

The additional benefits discussed in the preceding paragraphs were not yet realised at the time of the projects chosen for the case study.

2.3.3 Process assessment initiatives - SPICE

ISO 9000 was believed by management to be inappropriate for the department's needs. This perception was due to the controversy surrounding the fact that an ISO 9000 certified company may not necessarily provide either good quality product or effective processes.

The IT Application Systems Manager elected that the department participate in the SPICE trials with the hope of establishing whether it would be usable by the department. Although, feedback has been positive, ISO/IEC 15504 has not yet been taken on as a major initiative.

Internationally, there have been some criticisms regarding the length of time and volume of information required to do assessments. Usage for process improvement has not yet been widely proven, but it is hoped that the Phase 3 trials will establish the newly released standard's usability as an improvement and capability determination standard.

3. Detailed problem definition

Profiles from the selected case study projects will be collected and the results analysed separately to determine intersections, unions and specific indicator relationships. The goal of the analysis is to establish to what degree of detail each one will provide insight into process improvement and recognition of champions of good software engineering practices. This insight can come from identifying problem areas and providing possible solutions. It is expected that there will be a large degree of correlation between the two techniques.

It may be possible after performing several assessments and gathering some information to establish a suitable hypothesis to prove in further assessments.

Recommendations for going forward in Eskom ITD and for further research outside Eskom ITD will be provided.

4. Research approach

This section describes the research process.

4.1 Preparation and infrastructure

The SEAL QMS management products were created based on the SEAL QMS templates to support the research process. This consisted of a master document list, quality plan, product description, project plan,

configuration management plan, contract and various labels and templates.

The requirements for the research project were developed in conjunction with the research sponsor, interested parties in Eskom and the research supervisor and consolidated in the product description. Tasks and activities identified as a result of the product description were scheduled and recorded in the project plan.

4.2 Project management

The activities were executed as per schedule, which was adjusted intermittently. Periodic meetings were held with the research supervisor to provide feedback in terms of project pace and task completion and to obtain guidance in terms of research and SEAL QMS. Selected Eskom resources were regularly informed of updates using the defined configuration management procedures, and some ad hoc meetings.

4.3 Case study approach

The main activities for the case study are discussed below.

4.3.1 Initial project selection

The research project was initiated in 1996, so the projects of the 1996 PEP cycle was selected for the study.

4.3.2 Project selection, PEP initiation and project management

In early 1996, applications managers selected projects from within their teams for submission to the PEP cycle. QuantiMetrics provided an overview of PEP to those members of the department, whose projects had been selected for hopeful inclusion in the PEP cycle.

Other costs, in addition to the time and effort of those involved, include subscription to PEP and the additional consulting time of QuantiMetrics.

4.3.3 Data collection

Project data and function point counts were collected for the following seven months according to the schedule developed by the metrics advisor and constrained by the submission dates supplied by QuantiMetrics and CSC.

4.3.4 Data collection - function point count

Function point counts, with a senior function point counter, using Function Point Workbench software

[11], took 1 hour to 1½ days. The length of time depended on:

- whether the project was a small enhancement or large systems development;
- how experienced the assistant/system expert was in the function point count process; and
- how much knowledge the system expert had of the project scope and elements which were part of the function point count.

Senior function point counters had been on a 2-day practical course and done at least 2 counts in the presence of a mentor/auditor (other senior function point counter).

4.3.5 Data collection - PEP inputs

The PEP data collection took 1-4 hours per project. The length of time depended on availability of data; and diligence for information accuracy by the person supplying the information.

4.3.6 Project selection - PEP

At this time, several project submissions were postponed, to the next cycle, since they were not yet complete; or omitted, since they did not fit the PEP submission criteria.

4.3.7 Data collection - PEP output

Reviews were performed on the data (captured in PEP software) and submitted to QuantiMetrics. After several CSC data validation and QA cycles, CSC and QuantiMetrics assessed the results, formulated the PEP baseline, and then held the ½ day workshop in November 1996. Attendees included not only those involved in the assessment but also key members of the department who may have an understanding of the processes from their own point of view and management.

4.3.8 Project selection and SPICE initiation

From the 1996 PEP cycle, it was decided to select three of the seventeen participating PEP projects as case studies for the corresponding SPICE assessments.

The basis of software process improvement is that it be linked to organisational goals. Since the departmental vision was to develop systems which would contribute to Eskom's vision of the provision of the lowest cost electricity, another criterion for the selection of projects was that they be direct contributors to core business. A number of projects were shortlisted for

SPICE assessments, and some were rejected when problems with resource availability were discovered. For example, resources had left the OU or were unavailable for interview. From such a small group of candidates, three were selected based on their more interesting PEP footprints, i.e. more information was available and they were the most extreme of the candidates. There was no project whose footprint represented the standard footprint among the projects.

4.3.9 Subproject management - SPICE

Using the SEAL Of Quality methodology, a feasibility study, work breakdown structure and quality plan was set up for each SPICE Assessment. These were presented, together with an overview of SPICE for ½ hour, to each interviewee and the identified members of the assessment team. When interviews for SPICE began, one of the project teams had had two projects as part of the PEP Baseline and requested that their second project be included as well.

The SPICE assessments were performed using ISO/IEC 15504 Release 2 with the methodology encapsulated by the SEAL process assessment tool release 0.82 [48].

Qualified assessor (*An individual who has attained the qualifications for carrying out process assessments, as defined in part 6 of this Technical Report*) and auditors had gone on training and performed SPICE assessments on v1.0 of the standard prior to these assessments. The local trials co-ordinator was the external auditor and did not charge for these hours. However, participation in the SPICE trials had some initial cost.

4.3.10 Data collection - SPICE

Data collection (which included interviews and validations of work products and ratings) for each project took 34-44 qualified assessor hours and 16-20 process practitioner hours; and results presentation and analysis took 10-15 hours. These were not consecutive hours - interviewees pointed out that the assessment session is exhausting and they were thus run for 1-2 hours. Some process participants played roles in more than one assessment.

The data gathering process included comments from the participants on improvements to the process.

4.3.11 General

The schedule from the PEP cycle and SPICE assessments revolved around availability of interviewees and system experts.

4.3.12 Case study analysis

After the PEP baselining and SPICE assessments were completed, tables were drawn up for comparison and expected hypotheses and conclusions explored looking at the positive and negative influences and based on some assumptions. [52]

4.3.13 Research write-up

Using SEAL QMS technical paper template, the documents which you are now reading were developed.

5. Case study attributes

The following table discusses some of the characteristics of the chosen projects:

Table 3 – Description of Case Study Projects

Project	Description
A	- New development on predominantly 4GL platform. - Fixed cost contract. - Project across different teams i.e. not part of same IT programme.
B	- New standalone development on predominantly 4GL platform. - Part of larger IT programme, but subcontracted an external team. - Development was external to larger IT programme due to urgency. - Time and materials billing, but no major constraint.
C	- New integrated development on 4GL platform. - Time and materials billing. - Heavy time constraint with milestones during Christmas.
D	- New integrated development on 4GL platform. - Time and materials billing - Heavy time constraint with milestones during Christmas.

Projects C and D were developed by the same team, but for different customers and using different technologies.

6. Comparison: inputs of techniques

This section provides the inputs of the various techniques. In-depth details of these provide no additional insight and are omitted.

Table 4: Inputs of techniques

Technique	Input Requirement
FPA	System expert (usually lead programmer who often plays the role of the system analyst and sometimes the business analyst too) provided files, functions and insight into complexity to complete calculations. Resources: Function Point Workbench software, senior function point counter, system expert Time: 1 hour - 1 ½ days
PEP	System expert (usually team leader) completed questionnaire containing project size, estimate and actual work effort and cost, defects and errors, platforms, technologies, packages, methods, tools and techniques, staff and user experience and project life cycle or methodology. Resources: PEP subscription (including PEP software), QuantMetrics consultancy, metrics advisor, system expert. Time: 1-4 hours per project + full time metrics advisor.
SPICE	Process practitioners and process owners, with cross-verification provided insight into performance of base practices supplying work products for validation where available. Resources: ISO/IEC 15504, SEAL Of Quality software, assessment team, process practitioners, process owners. Time: 34-44 qualified assessor hours, 16-20 process practitioner hours, 10-15 results presentation and analysis hours.

7. Comparison: outputs of techniques

This section provides the outputs of the various techniques and some participant perceptions.

7.1.1 Function point count

The following table lists the function point counts (or an explanation if one does not exist) for each case study project.

Table 5: Function point counts as specified in [53,54,55,56]		
Project	Analysis Count	Implementation Count
A	146	172
B	None, since requirements were gathered through prototyping.	307
C	None, since metrics were gathered after implementation.	89
D	None, since metrics were gathered after implementation.	128

The project functional sizes are relatively small. Since smaller projects are easier to manage, these sizes should indicate greater control. The fact that the analysis count was less than the implementation count support the difficulties experienced in requirements or scope management - as found in the SPICE assessments.

7.1.2 Function point experiences

Those teams (usually by virtue of their team leader or project manager) which adopted function point analysis, for estimation, and as a means of managing customer's expectations and requirements change management, found it useful. For those groups that had just performed it as part of the PEP benchmarking exercise, they felt it was an unendurable overhead, which wasted their time on meaningful work.

7.1.3 Function point improvements

Proposed improvements to the function point process could include:

- automatic data collection using type III certified software;
- configuration management on the current information in the tool used;
- additional training for system experts on Counting Practices Manual to improve understandability; and
- developing a function point special interest group, which would share knowledge and assist in problem solving.
- Increased usage will improve the history base and ultimately all estimation.
- Usage by all members of the department could produce a 'software balance sheet' listing systems as assets that increase income within the department.
- Certified specialists would become consultant counters to spread expertise and standardise further.
- Usage of the Functional Size Measurement standards (ISO/IEC 14143) under development by WG12 could also have a positive influence.

7.1.4 PEP footprint

The *footprints* below (Figure 5, Figure 6, Figure 7, Figure 8, Figure 9), as indicated by PEP's analyses, show that productivity signified by the function delivery index is high above baseline, however effort overrun was experienced, but schedule met. High productivity was found in particular for the legacy systems that were written in a language where the department has a large skills base. The error data submitted indicated ineffective systems testing, as the available Mean Time To Failure was less than the baseline [44].

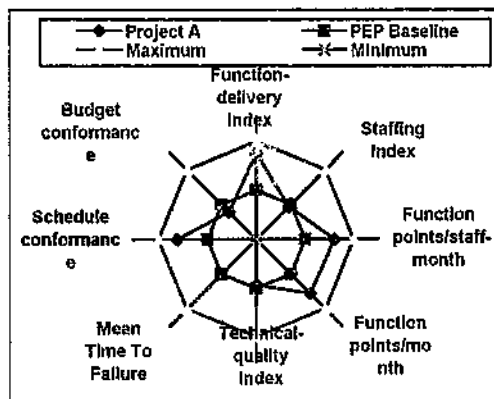


Figure 5: PEP Footprint of Project A courtesy of QuantiMetrics [57]

Interesting points are the fact that project A had high productivity and efficiency, met its schedule, but not its budget.

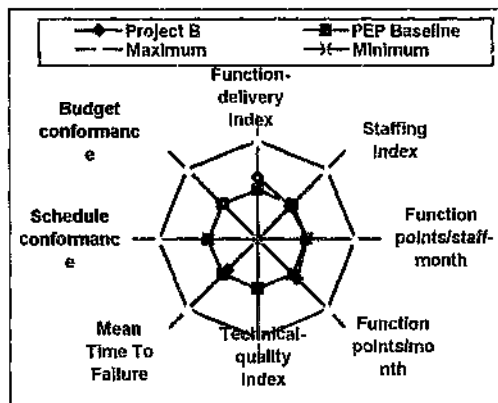


Figure 6: PEP Footprint of Project B courtesy of QuantiMetrics [58]

Project B had high productivity and average efficiency. No data on time and budget were recorded - this could have been an indicator of time and materials billing or loss of information regarding project tracking. Error information was also unavailable.

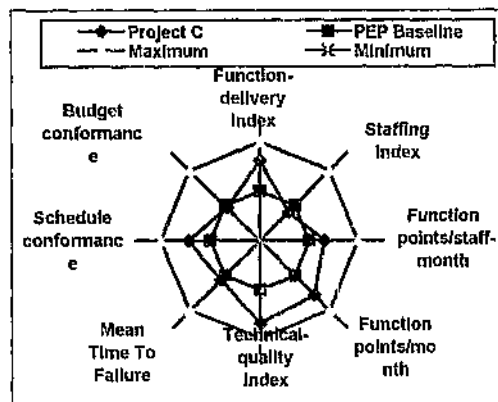


Figure 7: PEP Footprint of Project C courtesy of QuantiMetrics [59]

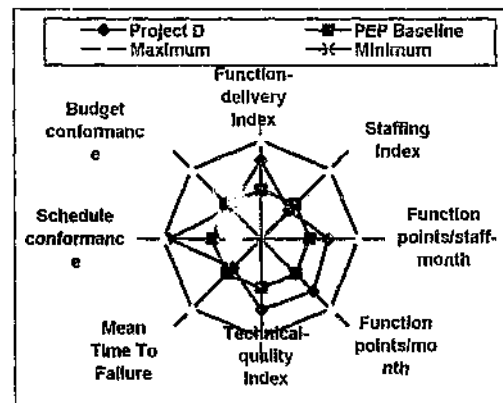


Figure 8: PEP Footprint of Project D courtesy of QuantiMetrics [60]

Projects C and D gave similar results. This could mean that the same mistakes were made by the person who provided the project information, or the same team working on the project had the same performance measures.

They had high productivity and efficiency, met their Christmas time schedule, but the project cost more than planned. Error information indicated that the team had produced a relatively high quality system, but the system had failed while in operation.

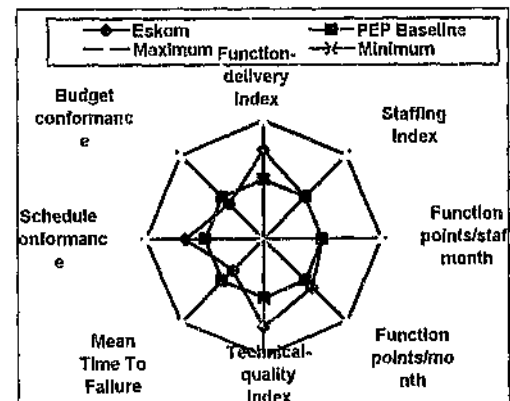


Figure 9 PEP Footprint of Eskom projects courtesy of QuantiMetrics [44]

From the *footprint*, one would believe that 'all was well', except for operational failures and meeting budget.

PEP *footprints* are provided where the baseline values can be chosen as either the entire PEP database, the top quartile of the PEP database, or the South African database.

7.1.5 PEP experiences

It was seen by management as a useful technique, particularly as a way of explaining to customers that the OU performed well.

Independent of the PEP process, the international PEP database itself is used in function point analysis to give information on estimations from similar projects.

Since most of the workshop participants usually are under the impression that someone else (management or teams) ought to be improving the processes, these actions have not taken place yet.

Improvements along any of the axes would give the OU the confidence that their productivity/efficiency/quality/management is improving, and could be used as a marketing tool both internally and externally. Also, if it was understood what was the reason for the improvement, they could be shared between other teams and individuals.

7.1.6 PEP improvements

Recommendations for improvement of PEP process revolved around:

- the collection of better project data, by making all information a part of the current processes and responsibilities;
- function point analysis and data collection (e.g. timesheets), education and standardised documentation;
- communication at all levels of the positive results;
- strategy defined for negative results (this marketing role seemed to not have a 'home');
- a more rigorous selection process for submission to the PEP cycle. This is necessitated by the fact that there is currently no validation as to whether these projects are indeed representative of the entire group of projects developed within the department; and
- separate cycles would be required as a result of the different methods used by the different groups.

Recommendations by Bram Meyerson [49] for improvement of PEP process were:

- using G-Q-M approach to define Metrics programme needs, within the context of the BSC.
- follow through of actions.

- inclusion of all projects in metrics collection, but submission of selected projects only.
- 'mature' process to enable data collection as a natural by-product of process.

7.1.7 PEP process improvements

Recommendations for process improvement for management consisted of:

- making projects smaller or more modular to improve control, the hockey stick phenomenon in terms of project management and rework, improved planning and control, the need for formal project estimation,;
- giving a reality shock in terms of quality, appointment of a dedicated quality manager;
- quality requirements definition;
- usage for macro performance management as *Carrot and not stick*;
- benchmarking;
- increased usage of defined processes;
- the need for discipline and culture shift,
- root cause analysis; and
- cost recovery.

Recommendations for technology and people process improvement consisted of:

- rollout in chunks;
- usage of code generators and advanced technology;
- standardisation on a limited tool set to allow focus of skills;
- peer reviews and audits required;
- fault analysis for repeat failures, more accurate error recording;
- development of skills, mix of resources;
- lucrative bonuses and
- process training.

Recommendations for customer process improvement consisted of:

- concentration on business functionality and use of function points to improve customer communications by justifying costs and improving change control;
- reacting to their needs;
- prioritisation and improving specifications received; and
- formal sign offs.

CSC Index have been improving their own processes in terms of PEP, as well as the software which is used to capture the data. CSC Index Research and Advisory Services are now called CSC Research Services.

7.1.8 SPICE profiles

There was an indication that experienced software engineering resources; small sized systems; some procedures and libraries lead to a positive outcome. However, problems with management control; process ownership; process pilot, feedback and change management; requirements management as a result of intangibility of a system; work product maintenance and difficulty in distinguishing between OU boundaries were negative contributors.

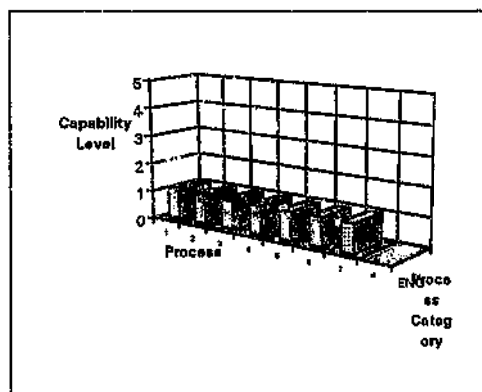


Figure 10: Derived SPICE Profile for Engineering process category [66]

All Engineering processes were assessed where applicable and the profile is shown in Figure 10.

Base practices of the Engineering process category was performed, with some projects having the full infrastructure and architecture support in terms of components and standards. Process performance was based on team's experience, but most documents were

not under configuration management or high level quality management. Projects C and D had made use of a Maintenance process, which projects A and B had not.

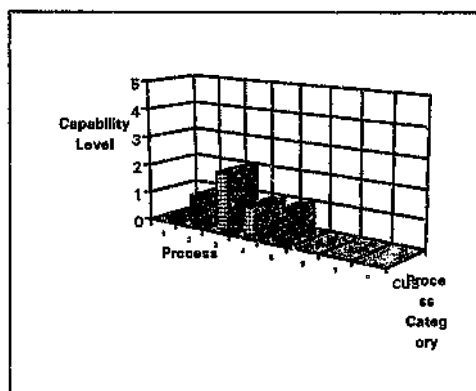


Figure 11: Derived SPICE Profile for Customer-Supplier process category [66]

All Customer-Supplier processes were assessed except 'Acquire software' and the profile is shown in Figure 11. The reason for this was although it was an IT process, it did not fall within the scope of the OU assessed.

Most Customer-Supplier base practices are performed. The strengths of this process category are mainly as a result of the customer's relationship with the team. The weaknesses of this process category is that minimal configuration management would make it difficult to repeat. Project A, achieved Level 3 for 'Supply Software', as a result of the small scope which this process covered, and as a result, they did not require 'Operate Software' process to be assessed either.

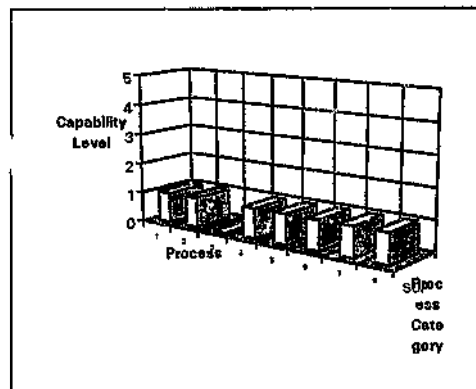


Figure 12: Derived SPICE Profile for Support process category [66]

All Support processes were assessed and the profile is shown in Figure 12.

The strengths of the Support process category consist mostly of the fact that a customer was fully involved in all verification, validation and joint reviews. The major weaknesses are that record keeping (i.e. change records, verification and validation test results, problem analysis, configuration item tracking and history) is not always done, although the quality practice may have been performed. Project B achieved a higher capability level for many of the Support processes, as a result of their more formal documentation, procedures and standards defined. Projects C and D achieved a higher capability level for 'Perform Work Product Verification', as a result of their more formal reviews with a wide range of users. This supports the fact that there were values for the Technical Quality Index on the PEP footprint for projects C and D only.

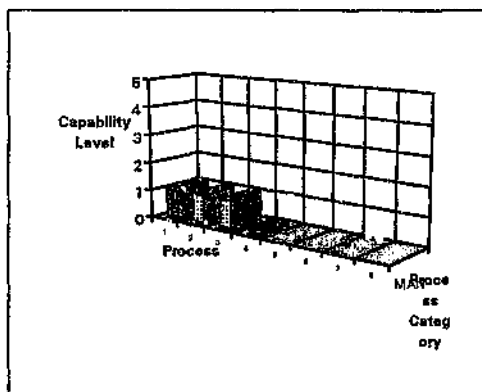


Figure 13: Derived SPICE Profile for Management process category [66]

All Management processes were assessed except 'Manage subcontractors' and the profile is shown in Figure 13. The reason for this was that no external resources were contracted as part of the project.

The project management process is performed, but not all base practices. Most notably, project evaluation was not performed on any projects. More formal management is required in the areas of quality and risk. Projects C and D achieved Level 1 for quality management, since they had resources officially responsible for these activities. Project B had resources officially responsible for risk management.

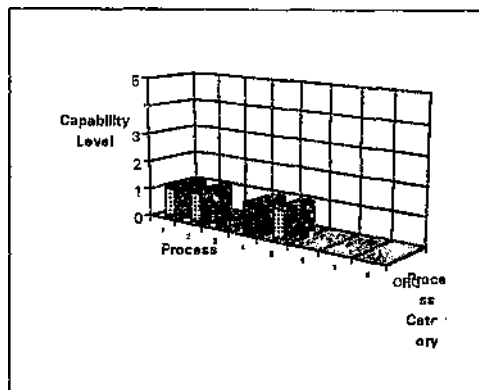


Figure 14: Derived SPICE Profile for Organisation process category [66]

All Organisation processes were assessed and the profile is shown in Figure 14. This had to be partially assessed in context of the entire OU, except where teams were large enough (i.e. projects B, C and D) to have their own influence on these processes.

For the 'Provide Skilled Human Resources' process, SPICE suggests that training and skilling is the responsibility of managers, however the OU took a human-centred approach, where each individual is responsible for his/herself, and empowered to make their own decisions. This may be the reason that it performed better than the others. Although processes are defined (projects C and D had resources dedicated to this and achieved a higher capability level), there is no arrangement for future process improvements. Infrastructure by means of organisation-wide standards and resource libraries (of all configuration items) did not exist, but was provided for the physical and language software engineering environments. More of this was available for the IT programmes (projects B, C and D) than the independent project. IT programmes seem to have made more provision for the libraries and standards. One IT programme had a high degree of team co-ordination, co-operation and transparency and most of their processes were at Level 1.

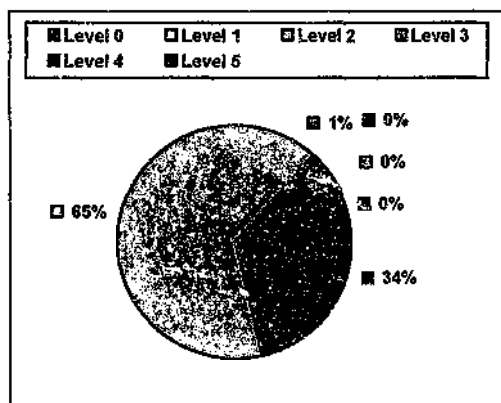


Figure 15: Derived SPICE Profile per organisational unit [66]

Aggregated, the projects are mainly at capability level 1 (Figure 15), performing a large number of the base practices. As a result of processes not existing, or the ones being used on the project not being documented, the project would not be repeatable. Projects B, C and D, coincidentally, have the same aggregated capability levels. The achievement of Level 1 means that this OU would fall in the category with the majority of other organisations, as mentioned earlier.

7.1.9 SPICE experiences

Interesting results from the assessment were that:

- assessment had to be planned, resourced, managed and tracked;
- the Pareto principle should be taken into account to avoid concentrating too long on anything;
- processes are habitual;
- interviewees are keen to improve and are honest;
- lack of work product impairs higher capability level assessment;
- recommended minimum SPICE assessor skill set;
- validation of SPICE assessment ratings takes a large amount of time; and
- the task order.

From an assessor's point of view:

- data collection was time consuming and for the interviewees, taxing, but analysis of data revealed interesting results.

- The fact that the assessor was internal and interviewed resources, rather than gathering questionnaires also assisted with deductions and assumptions, which might not have been made otherwise.
- With an OU without many institutionalised processes, this amount of detail is not necessary for improvement. The reason for this is that it is simple to check whether processes have advanced to the next capability level, by asking for additional work products, which are not available at present.

Current processes are individual-dependent, and high staff turnover introduces the risk that you could one day produce an excellent product, and the next day, with a resource without the same magnitude of (both technical and business) knowledge, a bad product could be produced.

All process participants and sponsors agreed with the results and recommendations. A significant fact is that individuals need time to implement any improvements and with the high time pressures and inefficient project estimations, there is no hope of this happening unless specific projects for this are set up, or individual time is allocated.

7.1.10 SPICE improvements

A proposal is to do detailed assessment (down to work product and base practices) on processes that are focus areas for improvement, and just do estimations at the capability level for all other processes to reduce time.

ISO/IEC 15504 will be fully released as a technical report at the beginning of next year. Moving from v2.0 to v4.0, the SPICE document set has changed and been improved. In the release version, Measurement has been classified as an Organisation process of its own, rather than just a management practice of Level 4.

7.1.11 SPICE process improvements

Recommendations for process improvement revolved around:

- defining a common process framework with improved process role definition, deployment, tracking and change management;
- or else to focus on maintenance processes that currently generated higher revenue for the department.

Other independent recommendations were:

- creation of a work product archive;
- usage of new templates and standards;
- definition of communication procedures;
- more proactive career development and training (particular in Support and Management base practices);
- and formal knowledge sharing, as part of, or independent of centres of excellence.

7.1.12 General

Process improvements OU wide have already taken place since this measurement, but largely due to outside factors and not these measurements and assessments. These have included improvements to the project management, test and change control process. Interestingly, since these improvements are 'Level 1' improvements, i.e. individual driven and dependent, they have not gained the support required which would have put them on Level 3.

Also, the product measures area is to be addressed shortly, when the requirements definition template is released. However, this will probably suffer the same problems which other initiatives have experienced.

8. Analysis and significance

It was anticipated that a high degree of correlation may not have been possible, but there would be some indication as to how a specific software process could link to a specific performance indicator.

Due to the fact that there was such a small range of functional size and capability levels, it was difficult to make any definite assertions.

8.1 Comparison of indicator relationships

The next section lists the relationships which appeared to be possible from the comparison of the case studies. This is followed by the list of relationships which did not result from the comparison, but were believed to be plausible. [52]

8.1.1 Possible indicator relationships - 2 FPA counts/SPICE genera

Relationships which arose from the FPA/SPICE analysis are next considered in this section.

Finding: Determining the functional size pre- and post- development provides a higher OU capability level and 'Supply Software' capability level.

Discussion: If the functional size is used within the processes to assist with project estimation and with managing customer's expectations, it would make a positive impact. This would imply that the 'Manage the Project' capability level should also be higher. The case of the 'Supply Software' capability level seems to be incidental.

Finding: Higher OU and 'Supply Software' capability levels allows for pre- and post- development functional size.

Discussion: Higher OU capability level allows the processes to be in place for determining pre- and post-development functional size. The case of the 'Supply Software' capability level seems to be incidental.

8.1.2 Possible indicator relationships - FPA/SPICE OU

Finding: Regardless of the OU capability level, it could deliver any small size application.

Discussion: This implies that size has no impact on the software engineering processes. This may not be valid, since the selection process means that only completed projects are included in PEP.

8.1.3 Possible indicator relationships - FPA/SPICE Customer-Supplier process category

Finding: The basis of a function point count is that it measures the size of a system delivered to a customer from the business point of view. Although there was no obvious correlation between functional size and Customer-Supplier processes, a system delivering no business value, which then could be functional size zero, should have a Level 0 Customer-Supplier process.

Discussion: This is an abstract notion, since it is unlikely that any reasonable business will deliver such a system.

8.1.4 Possible indicator relationships - FPA/SPICE Engineering process category

Finding: There is no clear correlation between functional size and Engineering processes, although a larger sized system may exclude 'Maintain System and Software' initially - particularly if it does not fall within a PEP cycle or scope of an assessment.

Discussion: The reason for this is that a large system would probably not complete both development and maintenance within the interval of a year (time span of a PEP cycle), so the project would either be assessed as a development or a maintenance project.

8.1.5 Possible indicator relationships - FPA/SPICE Support process category

Finding: There is no obvious correlation between functional size and Support processes, although a larger sized system may have higher 'Develop Documentation', 'Perform Configuration Management', and 'Perform Audits' capability levels.

Discussion: This may be a result of the programme being in place for a longer time, and having the processes in place, rather than any relation to size. Another rationale is that a smaller system requires less control mechanisms, where the mechanism could be the documentation, configuration management and audit processes.

8.1.6 Possible indicator relationships - FPA/SPICE Management process category

Finding: There is no obvious correlation between functional size and Management processes, although a larger sized system may have a lower 'Manage Quality' capability level and higher 'Manage Risks' capability level and vice versa.

Discussion: This may be a result of the programme being in place for a longer time, and having the processes in place, rather than any relation to size. Another rationale is that a larger system has higher risks, but has reached the limit on control mechanisms, where the mechanism could be the quality management process.

8.1.7 Possible indicator relationships - FPA/SPICE Organisation process category

Finding: There is no obvious correlation between functional size and Organisation processes, although a smaller sized system may have a higher 'Engineer the Business' and 'Define the Process' capability level.

Discussion: The smaller sized systems were not used for business re-engineering or process definition specifically, but possibly their size was an indication that these exercises or infrastructure had already been previously defined as part of an IT programme.

Possible indicator relationships for FPA and SPICE are summarised in Table 6.

Table 6: Comparison summary

FPA	SPICE
Functional Size	'Define the Process' capability level (inverse)
Functional Size	'Develop Documentation' capability level
Functional Size	'Engineer the Business' capability level (inverse)
Functional Size	'Manage Quality' capability level (inverse)
Functional Size	'Manage Risks' capability level
Functional Size	'Perform Audits' capability level
Functional Size	'Perform Configuration Management' capability level
Functional Size = 0	Customer-Supplier capability level = 0
Large Functional Size	No 'Maintain System and Software' process
Pre- and post-development count performed.	Higher 'Supply Software' capability level
Pre- and post-development count performed.	Higher OU capability level

8.1.8 Possible indicator relationships - Small FPA/SPICE Customer-Supplier process category

Assuming the functional size of the case study projects is small.

Finding: Small size results in a higher capability level for 'Manage Customer Needs' and 'Provide Customer Service'.

Discussion: It would appear that a smaller sized system would be easier to manage with a customer, since any changes would have a smaller impact than a change to a larger system.

Finding: Higher capability level for 'Manage Customer Needs' and 'Provide Customer Service' results in a small size system.

Discussion: The reason may be if the project was timeboxed and less functionality was delivered due to customer service and relationship management.

8.1.9 Possible indicator relationships - Small FPA/SPICE Engineering process category

Finding: Small size results in higher capability level for all Engineering processes, except 'Maintain System and Software'.

Discussion: This could support the fact that smaller systems are easier to control and allow one to concentrate on the primary processes of software development.

Finding: Higher capability level for all Engineering processes, except 'Maintain System and Software' produces small size.

Discussion: The reason may be if the project was timeboxed and less functionality was delivered due to software development management.

8.1.10 Possible indicator relationships - Small FPA/SPICE Support process category

Finding: Small size results in a higher capability level for 'Perform Work Product Validation', 'Perform Joint Reviews' and 'Perform Problem Resolution'.

Discussion: The only plausible reason for this relationship is that a smaller system requires less support mechanisms, where the mechanism could be the validation, joint review and problem resolution processes.

Finding: High capability level for 'Perform Work Product Validation', 'Perform Joint Reviews', 'Perform Problem Resolution' results in a small sized system.

Discussion: This may be caused by a project which was timeboxed and less functionality was delivered as a result of the additional controls from these processes.

Finding: Small size produces a lower capability level for 'Perform Work Product Verification'.

Discussion: Results of not performing verification is not directly detectable by a customer, as opposed to, for example validation, unless the customer performs thorough testing or uses the system thoroughly. This

could imply that small sized systems have less formal testing.

Finding: Lower capability level for 'Perform Work Product Verification' results in a small sized system.

Discussion: This may be caused by a project which was timeboxed and less functionality was delivered as a result of the additional controls from the processes and lack of verification and rework required.

8.1.11 Possible indicator relationships - Small FPA/SPICE Management process category

Finding: Small size produces a higher capability level for 'Manage the Project'.

Discussion: This could support the fact that smaller systems are easier to control and allow one to concentrate on the primary processes of software development.

Finding: Higher capability level for 'Manage the Project' results in a small sized system.

Discussion: This may be caused by a project which was timeboxed and had good estimation practices, resulting in less functionality being delivered.

8.1.12 Possible indicator relationships - Small FPA/SPICE Organisation process category

Finding: Small size causes a lower capability level for 'Improve the Process'.

Discussion: Small size could mean there is not enough time to institutionalise a process improvement.

Finding: Lower capability level for 'Improve the Process' causes small size.

Discussion: This may be caused by a project which was timeboxed and process improvements were introduced, which required time to be spent on learning them; and resulting in less functionality being delivered.

Finding: Small size results in a higher capability level for 'Provide Skilled Human Resources'.

Discussion: Small projects could have increased the skills in the department by creating opportunities on a larger number of diverse projects.

Finding: Higher capability level for 'Provide Skilled Human Resources' results in small size.

Discussion: The projects assessed all had highly skilled resources through a mature training and employment process. This could not have had an influence on the size of the projects.

Possible indicator relationships for small counts and SPICE are summarised in Table 7.

Table 7: Comparison summary	
FPA	SPICE
Functional Size	'Develop System Requirements and Design' capability level (inverse) 'Develop Software Requirements' capability level (inverse) 'Develop Software Design' capability level (inverse) 'Implement Software Design' capability level (inverse) 'Integrate and Test Software' capability level (inverse) 'Integrate and Test System' capability level (inverse)
Functional Size	'Improve the Process' capability level
Functional Size	'Manage Customer Needs' capability level (inverse)
Functional Size	'Manage the Project' capability level (inverse)
Functional Size	'Perform Joint Reviews' capability level (inverse)
Functional Size	'Perform Problem Resolution' capability level (inverse)
Functional Size	'Perform Work Product Validation' capability level (inverse)
Functional Size	'Perform Work Product Verification' capability level
Functional Size	'Provide Customer Service' capability level

Table 7: Comparison summary	
FPA	SPICE
	(inverse)
Functional Size	'Provide Skilled Human Resources' capability level (inverse)

8.1.13 Possible indicator relationships - PEP/SPICE OU

Relationships which arose from the PEP/SPICE analysis are next considered in this section.

Finding: There is no obvious correlation between footprint performance indicators and capability level of an OU, although an OU with a higher capability level may have a higher technical quality index and/or vice versa.

Discussion: This seems to indicate a relationship between error tracking and capability. Examining ISO/IEC 15504-5 [32], it is seen that for the first time at capability level 2, *Problem report and corrective actions database* is an infrastructure characteristic.

8.1.14 Possible indicator relationships - PEP/SPICE Customer-Supplier process category

Finding: There is a relationship between function delivery index and/or staffing index; and 'Manage Customer Needs' and/or 'Provide Customer Service'.

Discussion: A strong customer relationship could improve the gathering and controlling of requirements changes, support, training and establishment of customer satisfaction. This in turn would make the project functional size more manageable and communication and require an average number of people to be involved in the project, thereby improving the function delivery and staffing index.

8.1.15 Possible indicator relationships - PEP/SPICE Engineering process category

Finding: There is a relationship between function delivery index and all Engineering processes, except 'Maintain System and Software'.

Discussion: It could be argued that following basic software engineering practices would have a positive effect on your project size, time and effort and thus on your function delivery index.

Finding: There is a relationship between staffing index and all Engineering processes, except 'Maintain System and Software'.

Discussion: Good software engineering practices could indicate team are fairly experienced, and thus require an average number of people to be involved in the project, making the staffing index average.

8.1.16 Possible indicator relationships - PEP/SPICE Support process category

Finding: There is an inverse relationship between function delivery index and 'Perform Quality Assurance'; an inverse relationship between function points per (staff) month and/or schedule conformance and 'Develop Documentation', 'Perform Configuration Management' and/or 'Perform Audits'; and a relationship between staffing index and 'Perform Quality Assurance' process.

Discussion: It could be argued that minimising these practices would decrease the amount of "administration", and therefore also the time and effort to produce a system of that size. This would increase functionality delivered per (staff) month, or improve the meeting of the schedule, thereby increasing function delivery index and ensuring that an average size team is not required and decreasing schedule conformance, since the projects are fairly small. However, the future negative effects cannot be assessed.

Finding: There is a relationship between function delivery index, staffing index and/or schedule conformance; and 'Perform Work Product Validation', 'Perform Joint Reviews' and/or 'Perform Problem Resolution'.

Discussion: A strong customer relationship could improve the gathering and controlling of requirements changes, and thus the project functional size. This would improve the function delivery index; schedule conformance and communication, requiring an average number of people to be involved in the project, making the staffing index average.

Finding: There is a relationship between technical quality index and 'Perform Work Product Verification'.

Discussion: Usage of formalised testing process would mean a larger number of records kept. Also, the higher the capability level of the process, the greater the number of errors detected during testing and early operation.

Finding: There is a relationship between budget conformance and 'Perform Work Product Verification'.

Discussion: Verification could minimise rework, which would allow the project to meet its schedule and therefore its estimated cost. However, this is not reflected in a relationship between schedule and verification.

8.1.17 Possible indicator relationships - PEP/SPICE Management process category

Finding: There is a possibility of relationships between function delivery index, staffing index and/or schedule conformance and 'Manage the Project'.

Discussion: These are factors influencing project management - higher productivity and/or better schedule conformance and/or proper staffing should be an indication of a well-managed project. Also, an average team size may be easier to manage as a result of there being less communication overhead, but still a reasonable amount of resources to complete work. This could increase the capability level of 'Manage the Project'.

Finding: There is a possibility of relationships between technical quality index and budget conformance and 'Manage Quality'.

Discussion: The higher the capability level of the process (an indication of a more formalised testing process), the greater the number of errors detected during testing and early operation. This could decrease rework, and give a higher technical quality index and greater probability of meeting budget.

Finding: There is an inverse relationship between function points per (staff) month, schedule conformance and 'Manage Risks'.

Discussion: More risk management mechanisms could decrease the number of function points delivered per staff month.

8.1.18 Possible indicator relationships - PEP/SPICE Organisation process category

Finding: There is a possibility of relationships between function delivery index and 'Improve the Process' (inverse); schedule conformance and 'Improve the Process' (inverse); staffing index and 'Improve the Process' (inverse).

Discussion: It has been pointed out in texts that introducing changes to an environment will require a learning curve. This will initially decrease productivity, require additional resources and ultimately impact negatively on schedule.

Finding: There is a possibility of relationships between function delivery index and 'Provide Skilled Human Resources'; staffing index and 'Provide Skilled Human Resources'; schedule conformance and 'Provide Skilled Human Resources'.

Discussion: It is likely that more proficient resources will be available and thus more productive with a well-defined Human Resource process. Having more proficient resources, will mean that less resources are required to complete the same amount of work in that time and a project is also more likely to meet schedule requirements. Process definition and SE infrastructure may have resulted in the availability of the process. This would have allowed for a greater number of errors to be detected during testing and early operation, and reducing rework, allowing budget to be met.

Finding: There is a possibility of relationships between technical quality index and/or budget conformance and 'Define the Process' and/or 'Provide Software Engineering Infrastructure'.

Discussion: This seems to support the facts that process definition and environmental factors improve product quality.

Finding: There is a possibility of relationships between technical quality index and/or budget conformance and 'Engineer the Business' process

Discussion: An OU engineering its business, having as a business goal 'improving quality' might introduce better testing and reviews. This would improve the technical quality, and ultimately budget conformance through reducing rework.

Possible indicator relationships for PEP and SPICE are summarised in Table 8.

Table 8: Comparison Summary

PEP	SPICE
Budget Conformance	'Define the Process' capability level
Budget Conformance	'Engineer the Business' capability level
Budget Conformance	'Manage Quality' capability level
Budget Conformance	'Perform Work Product Verification' capability level
Budget Conformance	'Provide Software Engineering Infrastructure' capability level
Function Delivery Index	'Develop System Requirements and Design' capability level 'Develop Software Requirements' capability level 'Develop Software Design' capability level 'Implement Software Design' capability level 'Integrate and Test Software' capability level 'Integrate and Test System' capability level
Function delivery index	'Improve the Process' capability level (inverse)
Function Delivery Index	'Manage Customer Needs' capability level
Function delivery index	'Manage the Project' capability level
Function Delivery Index	'Perform Joint Reviews' capability level
Function Delivery Index	'Perform Problem Resolution' capability level
Function Delivery Index	'Perform Quality Assurance' capability level (inverse)
Function Delivery	'Perform Work Product

Table 8: Comparison Summary

PEP	SPICE
Index	'Validation' capability level
Function Delivery Index	'Provide Customer Service' capability level
Function delivery index	'Provide Skilled Human Resources' capability level
Function Points/Month	'Develop Documentation' capability level (inverse)
Function points/month	'Manage Risks' capability level (inverse)
Function Points/Month	'Perform Audits' capability level (inverse)
Function Points/Month	'Perform Configuration Management' capability level (inverse)
Function Points/Staff Month	'Develop Documentation' capability level (inverse)
Function points/staff month	'Manage Risks' capability level (inverse)
Function Points/Staff Month	'Perform Audits' capability level (inverse)
Function Points/Staff Month	'Perform Configuration Management' capability level (inverse)
Schedule Conformance	'Develop Documentation' capability level (inverse)
Schedule Conformance	'Improve the Process' capability level (inverse)
Schedule Conformance	'Manage Risks' capability level (inverse)
Schedule conformance	'Manage the Project' capability level
Schedule Conformance	'Perform Audits' capability level (inverse)
Schedule Conformance	'Perform Configuration Management' capability level (inverse)
Schedule Conformance	'Perform Joint Reviews' capability level
Schedule Conformance	'Perform Problem Resolution' capability level

Table 8: Comparison Summary

PEP	SPICE
Schedule Conformance	'Perform Work Product Validation' capability level
Schedule Conformance	'Provide Skilled Human Resources' capability level
Staffing Index = average	High - 'Develop System Requirements and Design' capability level 'Develop Software Requirements' capability level 'Develop Software Design' capability level 'Implement Software Design' capability level 'Integrate and Test Software' capability level 'Integrate and Test System' capability level
Staffing Index = average	High 'Manage Customer Needs' capability level
Staffing index = average	High 'Manage the Project' capability level
Staffing Index = average	High 'Perform Joint Reviews' capability level
Staffing Index = average	High 'Perform Problem Resolution' capability level
Staffing Index = average	High 'Perform Work Product Validation' capability level
Staffing Index = average	High 'Provide Customer Service' capability level
Staffing index = average	High 'Provide Skilled Human Resources' capability level
Staffing index = average	Low 'Improve the Process' capability level
Staffing Index = average	Low 'Perform Quality Assurance' capability level
Technical Quality	'Define the Process'

Table 8: Comparison Summary	
PEP	SPICE
Index	capability level
Technical Quality Index	'Engineer the Business' capability level
Technical quality index	'Manage Quality' capability level
Technical Quality Index	'Perform Work Product Verification' capability level
Technical Quality Index	'Provide Software Engineering Infrastructure' capability level
Technical Quality Index	OU capability level

8.1.19 Unproven indicator relationships - FPA/SPICE

Relationships of FPA and SPICE which were believed to be true, but could not be proved from the analysis are next considered in this section.

Hypothesis: A larger application would require more rigorous Management processes, but due to the fact that the projects were small (and most projects in the department are small), it could not be proved. This contradicts the possible inverse relationship between quality management and functional size.

Rationale: Larger projects need more control.

Unproven indicator relationships for FPA and SPICE are summarised in Table 9.

Table 9: Comparison summary	
FPA	SPICE
Functional Size	'Manage the Project' capability level 'Manage Risks' capability level 'Manage Subcontractors' capability level

8.1.20 Unproven indicator relationships - PEP/SPICE

Relationships of PEP and SPICE which were believed to be true, but could not be proved from the analysis are next considered in this section.

Hypothesis: At a higher capability level, the function delivery rate would increase. Processes required to achieve this higher capability level would be constant, causing cost (and therefore budget) to decrease and schedule to be met, making the footprint appear high above baseline in three spokes.

Rationale: Indications [69] are that as one moves up the capability maturity scale, productivity would increase, costs would decrease, estimations would improve and quality would increase.

Hypothesis: Having all Customer-Supplier, all Support, 'Develop Software and System Requirements', and 'Integrate and Test System and Software' processes at a higher capability level would improve the technical quality index and decrease MTTF, thereby making the footprint appear better.

Rationale: The checks required by the V-model would be fully institutionalised.

Hypothesis: The PEP results categorically state that projects are over-budget, on-time and meeting customer requirements.

Rationale: Considering the SPICE assessment results, it is likely that the excellent Customer-Supplier relationship had an influence on the last measure. The combination of 'Manage the Project' and Customer-Supplier processes, together with excellent resources had an influence on the second measure. Project estimation would have influenced the first measure, and since the function point counts were done in retrospect, they could not improve the estimation. The 'Manage the Project' - on-time relationship appears in the possible relationships above.

Hypothesis: Once the relationship between the footprint performance indicators is stabilised, it may then be possible to "stretch the rubber band" evenly across all performance indicators. This may relate directly to an organisation's capability level, i.e. the achievement of a managed process by moving from capability level 1 to 2.

Rationale: See discussion on chaos in section 8.4.

Unproven indicator relationships for PEP and SPICE are summarised in Table 10.

Table 10: Comparison summary	
PEP	SPICE
Budget conformance	'Manage the Project' capability level, particularly Estimation

Table 10: Comparison summary

PEP	SPICE
Budget conformance	OU capability level
Function delivery index	OU capability level
Mean time to failure	'Acquire Software' capability level
Mean time to failure	'Develop Documentation' capability level
Mean time to failure	'Develop Software Requirements' capability level
Mean time to failure	'Develop System Requirements and Design' capability level
Mean time to failure	'Integrate and Test Software' capability level
Mean time to failure	'Integrate and Test System' capability level
Mean time to failure	'Manage Customer Needs' capability level
Mean time to failure	'Operate Software' capability level
Mean time to failure	'Perform Audits' capability level
Mean time to failure	'Perform Configuration Management' capability level
Mean time to failure	'Perform Joint Reviews' capability level
Mean time to failure	'Perform Problem Resolution' capability level
Mean time to failure	'Perform Quality Assurance' capability level
Mean time to failure	'Perform Work Product Validation' capability level
Mean time to failure	'Perform Work Product Verification' capability level
Mean time to failure	'Provide Customer Service' capability level
Mean time to failure	'Supply Software' capability level

Table 10: Comparison summary

PEP	SPICE
Schedule conformance	'Acquire Software' capability level
Schedule conformance	'Manage Customer Needs' capability level
Schedule conformance	'Manage the Project' capability level
Schedule conformance	'Operate Software' capability level
Schedule conformance	'Provide Customer Service' capability level
Schedule conformance	'Supply Software' capability level
Schedule conformance	OU capability level
Technical quality index	'Acquire Software' capability level
Technical quality index	'Develop Documentation' capability level
Technical quality index	'Develop Software Requirements' capability level
Technical quality index	'Develop System Requirements and Design' capability level
Technical quality index	'Integrate and Test Software' capability level
Technical quality index	'Integrate and Test System' capability level
Technical quality index	'Manage Customer Needs' capability level
Technical quality index	'Operate Software' capability level
Technical quality index	'Perform Audits' capability level
Technical quality index	'Perform Configuration Management' capability level
Technical quality index	'Perform Joint Reviews' capability level
Technical quality index	'Perform Problem Resolution' capability level
Technical quality index	'Perform Quality Assurance' capability level

Table 1C: Comparison summary

PEP	SPICE
	level
Technical quality index	'Perform Work Product Validation' capability level
Technical quality index	'Perform Work Product Verification' capability level
Technical quality index	'Provide Customer Service' capability level
Technical quality index	'Supply Software' capability level

8.2 Comparison: models

8.2.1 Similarities

The models do not appear to have anything in common.

8.2.2 Differences - measurement type

SPICE looks at qualitative measures, i.e. capability levels and gives an idea of why things are happening to processes in 'operational' terms. [38] PEP looks at quantitative measures, i.e. cost, quality, effort and gives an idea of what is happening to processes in business terms. [51]

PEP displays a limited number of measures, which should be standard project measures, recorded as outputs of a normal software engineering project management process. If they were regular process outputs, they would be assessed as the work product 'Measures'. SPICE provides the process measure.

8.2.3 Differences - complementary nature

As stated by Pfleeger and Rombach[41], the two techniques should be able to complement each other, as *measurement helps you draw an objective process model, while application of improvement techniques improves your ability to measure quality*, by confirming improvements in process and product, albeit in small increments. *The organization will normally use a mixture of effectiveness measures and capability levels to set targets for improvement. Capability levels will indicate the most promising improvement areas according to the distance between the organization's practices and the baseline; on the other hand, effectiveness measures of the processes will provide information about the efficacy of the organization's processes compared to the needs* [34]

8.2.4 Differences - people and technology interpretation

PEP uses people issues and technology to interpret the results. SPICE limits this influence to Level 1 (Performed), so that, if an OU does not have reasonably skilled resources on these technologies, they will not perform the base practices. Since base practices are the basis of processes, a process would not assist the people anyway. In PEP it may be difficult to isolate the influence of the process alone - this could be a symptom of a Level 1 OU. Since Level 2 is a Managed process, it seems to indicate that the effectiveness of the PEP measures are reliant on certain management practices being in place.

8.2.5 Differences - product quality

No indication by PEP of whether product quality is predictable and consistent. However, comparing graphs from year to year, may be able to indicate trends in terms of quality. At such a low capability level, SPICE believes performance is very much dependent on human (including environment) and technological factors.

8.2.6 Limitations of PEP - benchmarking

Using the PEP database with varying OU capability levels, one could benchmark against organisations outside one's league. This is of concern, since it could cause one to set unrealistically high expectations or having the opinion that one is performing relatively well according to industry standard, when one is not at all.

8.2.7 Limitations of SPICE - influence on organisational performance

The influence of the current processes independently on the organisation's overall performance is unknown.

Garbajosa-Sopena [12] seems to weight cost at the same significance as product and process. PEP can consider cost as one of their performance measures. SPICE does not consider it in the assessment.

It is not necessarily true that a high capability level would yield the best product, but it is believed it would be able to yield a product of a predefined minimum standard [73,3,72]. Other studies have indicated that processes do indeed improve product [10,5,39].

Improvements of isolated or groups of processes, e.g. project estimation, subcontracting management, configuration management, software process organisational and management infrastructure establishment within different industries and countries also indicated varying returns on investment [73].

In 1993, the following figures were obtained - 82-96% of organisations were at Level 1, 3-17% at Level 2 and 1% at Level 3 [69]. They had made use of CMM and Bootstrap in Europe, USA and Japan.

8.2.8 Limitations of PEP and SPICE - intra-influences

There is no detail on which processes influence others, or which footprint performance indicators influence each other. However, methodologies such as CMM and Trillium provide roadmaps or key process areas as guidance on the order in which processes may be improved. [73]

8.2.9 Limitations of PEP and SPICE - collaboration

The organisers of the second international software metrics symposium [42] state that the most successful measurement occurs when researcher, practitioner and customers collaborate.

8.2.10 Limitations of PEP and SPICE - group differences

Separate assessments within PEP and SPICE may be required as a result of the different methods used by the different groups within IT Application Systems (also a characteristic of a Level 1 organisation).

8.2.11 Limitations of PEP and SPICE - additional measures

It is noteworthy that although 'Measures' is a work product of a number of different processes, it appears for the first time at capability level 4 of the SPICE model. This does not necessarily suggest that an OU which achieves Level 4 is the only one that should have this work product, but possibly that at this level, it is most effectively used. Also, the work product 'Measures' can include any of the following: Project measures, Process measures, Quality measures, Field measures, Service level measures, Risk measures and Staff performance measures.

IFPUG's view (Figure 16) is that measurement is the commonality among several disciplines.

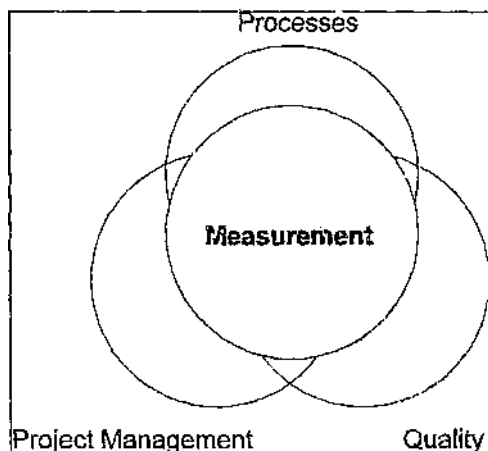


Figure 16: Relationship between measurement and other disciplines [20]

This indicates an intersection between process, project and quality (product) measures. Product quality measures were not included as part of this research. However, based on the SPICE assessment, they were often missing from requirements definition. This may be an indication that a fundamental metric is not being formally considered within the current processes. Quality measures are an important part of measurement and do not replace process measures. [38,1,73]

Abran considers that product and process measures provided the input for the feedback loop of total quality management. [1]

8.2.12 Limitations of PEP and SPICE - complete process assessment

Garnus and Herron have a 'Complete Process Assessment Model' (Figure 17) which includes both measures represented above, but some which are not fully included.

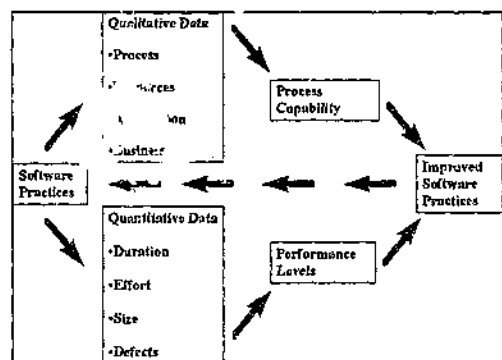


Figure 17: Garmus and Herron Complete Process Model [13]

According to the guidance provided in ISO/IEC 15504-7 (Figure 18), PEP could be seen as fulfilling the role of the 'Industry norms and benchmarks', with a SPICE assessment falling into the process assessment request.

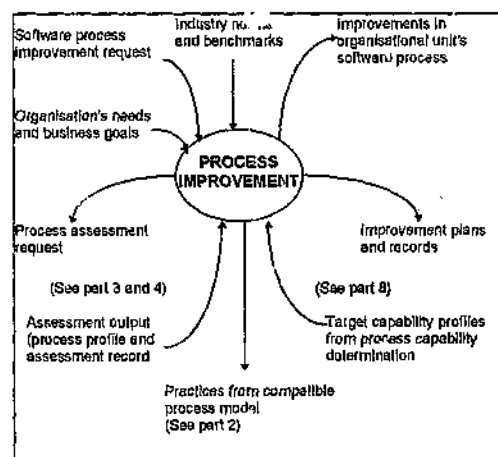


Figure 18 Process improvement context [34]

8.2.13 Limitations of PEP and SPICE - complete process measurement

Also, Figure 19 represents a software process measurement framework standard being developed by ISO/IEC JTC1/SC7 WG13 to address information needs for project management, product engineering and process improvement, but exclude product quality attributes. [35]

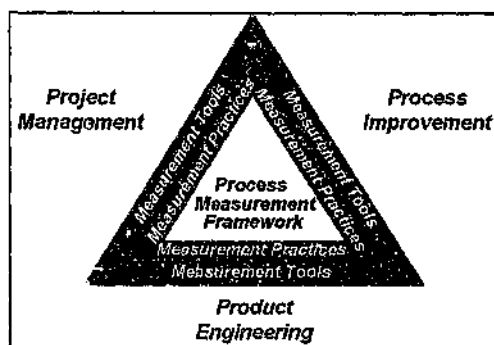


Figure 19 Software Process Measurement Applications [35]

Gasston and Rout [14] assessed software process effectiveness of a configuration management process using a defined set of metrics for each level and under the categories Economic, Human and Managerial factors. They developed the model in Figure 20.

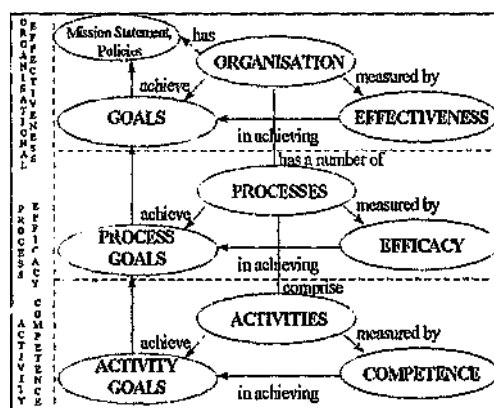


Figure 20 Hierarchical conceptual model for assessment of process effectiveness within organisations [14]

Gasston [15] expanded on this by adding STMT (Standards, Tools, Methods and Technology). Gasston then discussed re-engineering/revolution as opposed to evolution and suggests a Process/Product Quality Model (Figure 21). In the model, the evaluation of product model uses SPICE; the product profile consists of the product quality attributes identification; the software product quality evaluation consists of Dromey's product quality framework[9]; and the process effectiveness evaluation covers a large number of areas. PEP covers the economic factors - the extent of coverage of the other measures is uncertain.

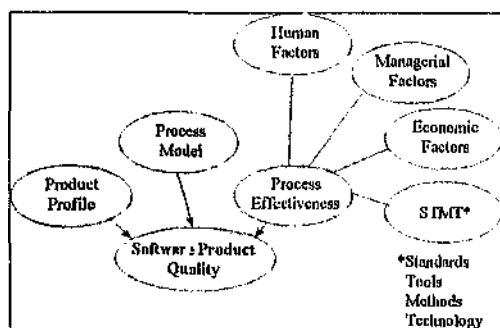


Figure 21 Process/Product Model [15]

Johnson and Brodman's study [showed that a Level 1 organisation did not calculate productivity, focus on process, track costs, schedule variances, requirements changes, or defects - only tracked coding and testing progress. This would agree with the assessment findings, since the PEP measures force a project to measure all of the above - unfortunately this is in retrospect, and often inaccurate.

This is related to the problem of 'You can't measure chaos' [73]. Measurement would lead to inconsistent results, since they are based purely on individual performance

8.3 Comparison: assessment process

8.3.1 Similarities

Internal qualified SPICE assessors can be trained and assessments can be done as required. PEP baselining can be done ad hoc, provided the external consultant is available.

Both methods require data collection with a number of ITD resources, supported by a tool and resources with specific skills and provide measures as outputs. Some measures are presented visually.

Analysis is performed and feedback is provided to a selected audience. Both provide a possible action list, which requires commitment and co-operation from managers, teams and individuals.

8.3.2 Differences - problem analysis

Data analysis seems to be approached differently for both methods, and takes less time than the data collection. Analysis is considered of greater importance than the data collection itself [16].

CSC analyses the data and returns a report provided by QuantiMetrics. The action workshop is facilitated by QuantiMetrics, and although workshop participants suggest reasons for low performance indicators, these

are not always validated. The facilitator also provided objective target levels of performance to aim for. The facilitator leads a discussion on opportunities for improvement. The ownership of these responsibilities is with the client. [49] A large variety of action points are suggested.

The qualified assessor analyses the SPICE assessment profiles, and can list the processes requiring improvement, as well as providing recommendations (as an internal resource, who is part of the process).

8.3.3 Limitations of PEP - 'domestic' knowledge

For the PEP workshop, the fact that the person is part of a process that may be bad, does not help them see what is necessary to help them improve. For example, if one does not know what configuration management is, how would one suggest that it is necessary for improvement. Suggestions may also be influenced by 'preferred work', e.g. if one dislikes documentation and dismisses it as administration, one would not recommend that all systems have standardised analysis documentation.

SPICE is supposed to encapsulate software engineering best practices, as it was developed by world-wide experts.

8.3.4 Limitations of PEP - strengths

Strengths of the processes were also highlighted by the SPICE assessment (this may have been as a result of the assessor), but were sometimes overlooked at the PEP workshop. People often overlook the good and focus on the bad.

8.3.5 Limitations of PEP - independent assessment

The external PEP consultant is independent, and does not have the insight into the internal OU workings which are known, but not 'documented'. The consultant relies on the workshop participants to understand the results.

The internal SPICE assessor may have some preconceptions. However, these cannot be put forward as actions, if there is no available validation from the SPICE assessment. The assessor can perform process analysis and re-engineering, based on the SPICE interviews and other sources.

8.3.6 Limitations of PEP - individual recollection

Information required for PEP is provided by the project leader and can be outdated, based on memory and unverifiable.

For a SPICE assessment, the qualified assessor is required to validate all ratings and cross check with output work products. Also, since process performance is very much a habit [3], resources will usually remember how they performed a process.

8.3.7 Limitations of PEP - scope

The fact that PEP process measures cross OU boundaries makes it difficult to distinguish which software engineering process is influencing the results.

The SPICE assessment input identified the OU boundary, and processes which fell outside this were not assessed.

8.3.8 Limitations of PEP - standard

Although PEP has an international database, SPICE is a type 2 technical report international standard, and many other process improvement techniques are already beginning to incorporate SPICE into their current models.

8.3.9 Limitations of SPICE - benchmarking

Currently, no organisations provide international SPICE benchmarking. In order to provide this, a standard assessment input would be required.

3.4 Comparison: improvement process

8.4.1 Similarities - route

In both cases, it seemed to be difficult to decide where to start with process improvement, particularly as there are so many changes which can be made. OU goals are often broader, and not specifically focused on a process (and should not be).

Reiblein and Symons [47] recommend a means of weighting business gains and prioritising improvements.

8.4.2 Similarities - critical success factors

With most process improvement initiatives, difficulties have been quoted as being management commitment and culture change. This seems to be the case with PEP and SPICE too. SPICE provides a process improvement process, which if controlled as a project may result in continual improvements. PEP, too has an action workshop following the results, and if the proposed actions are prioritised and put together as a project, they could result in improvements.

8.4.3 Differences and limitations

These could not be determined, since they were not directly actioned.

8.5 Solutions and recommendations

IT Application Systems must go ahead with measurement and process assessment, since waiting for perfection of the theory is not alternative.

It is advisable to begin moving from Level 1 to Level 2 by setting up a process and measurement framework. This does not imply that the entire model needs to be rolled out at once - development, testing and operation can take place in phases and based on priorities. It is important to remember that these must be incorporated into individual's learning - productivity and efficiency will initially need to be sacrificed to improve quality.

Integration of the techniques may necessitate the following:

- PEP providing the facility to factor out the benchmarking results according to software process capability maturity to enable comparison within class, i.e. 'apples with apples'.
- alignment of the schedules of the PEP programme, the SPICE assessments and determination of the OU goals/strategy. In this way, input from all measures can be provided at the same time. An informed decision can then be taken by workshop participants on what actions are to be taken, as well as what is required of those actions. The Quality Team's main deliverable for the year could be achievement of this project scope.
- alignment of the metrics programme with both organisational goals and capability level to allow tracking of achievement of goals.
- definition of a number of facilitating base practices for measurement - this could include for example establishing OU process and data models.

8.6 Summary

It is very difficult to determine the exact relationships between performance indicators and capability levels, given that performance indicators influence each other, and the limited dataset for the study. The cause and effect relationships are not always apparent. However, it can be seen that improvement of a single measure without analysing the impact on other processes and measures can be risky.

The diagrams (Figure 22, Figure 23, Figure 24, Figure 25) below present a summary of the relationships. Blue arrows are positive relationships, while red arrows are inverse relationships; the solid line represents the possible relationships and the dashed line represents unproven relationships. The dashed processes are ones dependent on there being a pre- and post- function point count performed. Notice the conflicts and agreements between some unproven and some possible relationships.

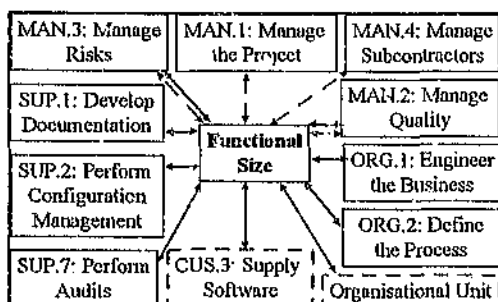


Figure 22 Relationship between functional size and process capability

If these systems are small size, then the following relationships exist too:

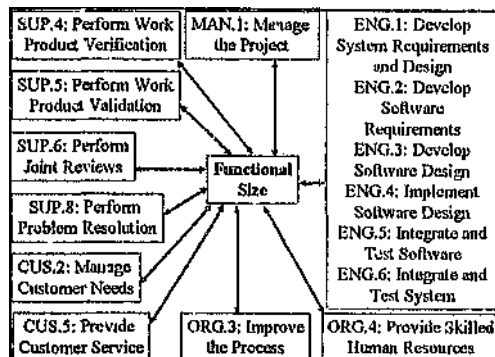


Figure 23 Relationship between functional size and process capability assuming systems small

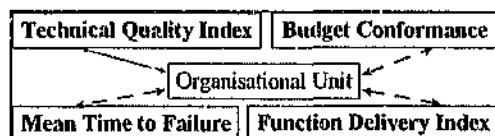


Figure 24 Relationship between performance indicators and organisational unit process capability

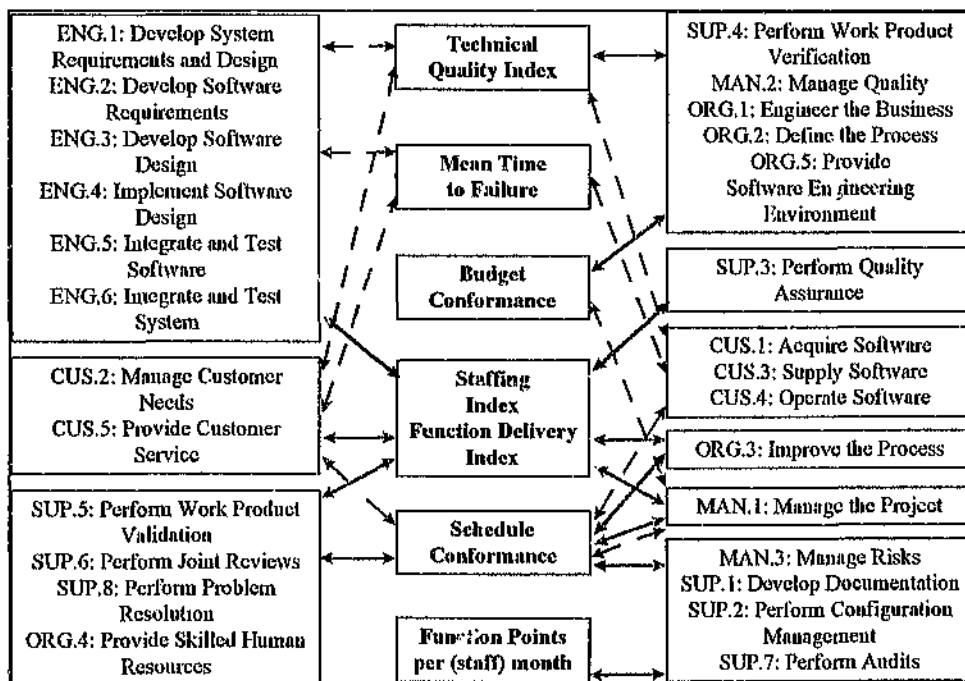


Figure 25 Relationship between performance indicators and process capability

It is important to remember that these relationships were only seen within the context of a limited number of projects of a specific size range and with low capability levels.

PEP tells an OU what has happened to their business, SPICE tells an OU what they could do to improve those measures at the process level.

It is believed that a view with several layers and several measures exists (Figure 26) - an extension to Gasston and Rout's model. [14] Similar to the model, there would be goals for each level, drawing from the organisation's mission and policy. However, it is a 'layered' model, where the outermost layer is the business, within that the information technology management and then the systems development management. Each layer has its own set of measures. PEP would fall within the Application Systems management measures, SPICE capability levels would fall within the Application Systems process measures and SPICE base practices would fall within the Application Systems activity measures. 'Fall within' implies these methods do not necessarily cover the entire measurement scope.

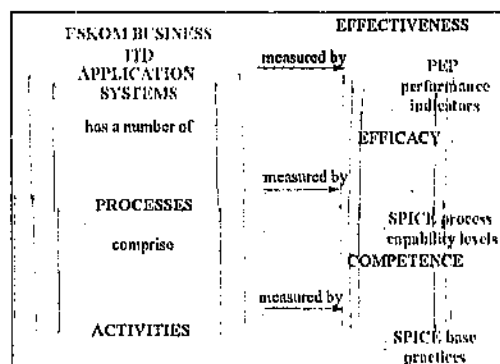


Figure 26 Relationship within Eskom Hierarchy, Measures and Methods

9. Discussion

Following the feedback of this report, both initiatives could be actively used for process improvement to the benefit of customer, supplier and resources.

Both methods provide useful information on improvements, but the time and resource investment are unjustified unless action takes place as a result of assessment. Used correctly, these techniques should work together in assisting with the development of a balance of better quality, faster and cheaper software. It is not the data collection (independent of technique)

which should be the focus, but rather the analysis, visibility and ultimate improvement application.

The final recommendation is that a process and measurement framework be established to advance the OU to Level 2, but must draw on a common thread, namely IT strategy to ensure alignment. There should be an emphasis on process, to determine why things are not working as they should be, and performance, to determine what the impacts could be. The processes need not be implemented simultaneously, but the Organization processes seem to be a requirement for the infrastructure for future building and seeing that most Primary life cycle processes are at Level 1.

Although this study originally started off looking at process improvement methods, it was evident that no actions were as a direct consequence of either of these methods. As a result, the research had to be limited to process assessment. This study is in no way an indicator that at the lowest capability levels there is no correlation at all. It is rather an indicator that a more in-depth statistical study, with more data gathering and a larger sample, is required to establish this. A continuation of this research would be measuring the impact across all the measures as this OU matures and advances.

10. Acknowledgements

The contributions of all who participated in the conduct of assessments, as well as the reviewers of the paper, IFPUG and QuantiMetrics for giving permission to publish proprietary information, are gratefully acknowledged.

11. References

- [1] Abran A., *Quality - The Intersection of Product and Process*, Second IEEE International Software Engineering Standards Symposium. p 206, August 21-25, 1995.
- [2] Albrecht A.J., *Measuring Application Development Productivity*, Proceedings of the Application Development Symposium 1979, GUIDE International Inc., SHARE Inc., International Business Machines Corporation, Monterey, CA, pp 83-92.
- [3] Bach, J.T., *Enough about process: What we need are heroes*, IEEE Software, Vol. 12 No. 2, March 1995, pp 96-98.
- [4] Brooks F.P., *Mythical Man Month*, Addison-Wesley Publishing Company, Reading, Mass., ISBN 0-201-83595-9, 1995.

- [5] Craigmyle M. and Fletcher I., *Improving IT effectiveness through software process assessment*, Software Quality Journal, Vol. 2, Issue 4, 1993, pp 257-264.
- [6] CSC Index Research Advisory Services, Peter Hill, 12 Bloomsbury Square, London, WC1A 2LL.
- [7] Davis A., *Between Scylla and Charybdis*, IEEE Software, Vol. 14 No. 5, September/October 1997, pp 4-6.
- [8] Dreger J.B., *Function Point Analysis*, Prentice-Hall, Englewood Cliffs, NJ, ISBN 0-13-332321-8, 1989.
- [9] Dromey R., *Cornering the chimera*, IEEE Software, Vol. 13 No. 1, January 1996, pp 33-43.
- [10] El Emam K. and Madhavji N.H., *Does organisational maturity improve quality*, IEEE Software, Vol. 13 No. 5, September 1996, pp 109-110.
- [11] Function Point Workbench v3.01, CHARISMATEK Software Metrics, 175 Dorcas St, South Melbourne VIC, Australia, 3205.
- [12] Garbajosa-Sopeña J., *Quality Intersection between Process and Product*, Second IEEE International Software Engineering Standards Symposium, pp 204-205, August 21-25, 1995.
- [13] Garmus D. and Herron D., *Measuring the Software Process*, Prentice Hall, Upper Saddle River, NJ, ISBN 0-13-349002-5, 1996.
- [14] Gasston J.L. and Rout T.P., *Can the effectiveness of software processes be assessed?*, Software Quality Journal, Vol. 3, Issue 3, 1994, pp 153-166.
- [15] Gasston J.L., *Process improvement: an alternative to BPR for software development organizations*, Software Quality Journal, Vol. 5, Issue 3, 1996, pp 171-183.
- [16] Humphrey W., *Managing the Software Process*, Addison-Wesley Publishing Company, Reading, Mass., ISBN 0-201-18095-2, 1990.
- [17] IFPUG, Blendonview Office Park, 5008-28 Pine Creek Drive, Westerville, OH 43081-5899.
- [18] IFPUG, *Function Points as Assets - Reporting to Management*, 1992.
- [19] IFPUG, *IFPUG Counting Practices Manual v4.0*, January 1994.
- [20] IFPUG, *IFPUG Guidelines to Software Measurement*, Release 1.1, August 1994.
- [21] ISO 12207, *Information Technology - Software Life-Cycle Processes*, 1995.
- [22] ISO/IEC 14143-1, *Information technology - Software measurement - Functional size measurement - Part 1: Definition of concepts*, IS, November 1997.
- [23] ISO/IEC 14143-2, *Information technology - Software measurement - Functional size measurement - Part 2: Compliance assessment of software size measurement methods to ISO/IEC 14143-1:1998*, CD Version 0.36, May 1998.
- [24] ISO/IEC 14143-3, *Information technology - Software measurement - Functional size measurement - Part 3: Verification of functional size measurement methods*, WD Version 22, June 1998.
- [25] ISO/IEC 14143-4, *Information technology - Software measurement - Functional size measurement - Reference Model*, PDTR Version 13, May 1998.
- [26] ISO/IEC 14143-5, *Information technology - Software measurement - Functional size measurement - Determination of Functional Domains for Use with Functional Size Measurement*, PDTR Version 17, June 1998.
- [27] ISO/IEC 15288, *Information Technology - System Life Cycle Processes*, WD, May 1998.
- [28] ISO/IEC 15504-1, *Software Process assessment Part 1: Concepts and introductory guide*, PDTR, October 1996.
- [29] ISO/IEC 15504-2, *Software Process Assessment Part 2: A Reference Model For Processes And Process Capability*, PDTR, October 1996.
- [30] ISO/IEC 15504-3, *Software Process Assessment: Part 3 : Performing an assessment*, PDTR, October 1996.
- [31] ISO/IEC 15504-4, *Software Process Assessment: Part 4 : Guide to performing assessments*, PDTR, October 1996.
- [32] ISO/IEC 15504-5, *Software Process Assessment: Part 5. An assessment model and indicator guidance*, PDTR, October 1996.
- [33] ISO/IEC 15504-6, *Software Process Assessment: Part 6. Guide To Qualification Of Assessors*, PDTR, October 1996.
- [34] ISO/IEC 15504-7, *Information Technology - Software Process Assessment Part 7: Guide for use in process improvement*, PDTR, October 1996.
- [35] ISO/IEC JTC1/SC7, *Information Technology - Software Life Cycle Processes Definition and Application of a Software Process Measurement Framework*, Proposed Draft Technical Report, 30 April 1996.

- [36] Johnson D.L. and Brodman J.G., *Realities and Rewards of Software Process Improvement*, IEEE Software, Vol. 13 No. 6, November 1996, pp 99-101.
- [37] Jones T.C., *Applied Software Measurement*, McGraw-Hill, New York, ISBN 0-07-032826-9, 1996.
- [38] Konrad M., *Quality Intersection between Process and Product*, Second IEEE International Software Engineering Standards Symposium, pp 202-203, August 21-25, 1995.
- [39] Laitinen M and Fayad M.E., *Surviving a process performance crash*, Communications of the ACM, Vol. 41 No 2, February 1998, pp 83-86.
- [40] Meyerson B., *Made to Measure*, Information Technology Review, Vol. 2 No.7, p 8, Computer Society of South Africa, August, 1995.
- [41] Pfleeger S.L. and Rombach H.D., *Measurement based process improvement*, IEEE Software, Vol.11, Issue 4, July 1994, pp 8-11.
- [42] Pfleeger S.L., Jeffery R., Curtis B and Kitchenham B., *Status Report on Software Measurement*, IEEE Software, Vol. 14 No. 2, March/April 1997, pp 33-43.
- [43] Pressman R.S., *Software Process Perceptions*, IEEE Software, November 1996, pp 16-18.
- [44] QuantiMetrics and CSC Index Research and Advisory Services Performance Enhancement Programme, *Performance Baseline Charts & Tables for Systems Development for Eskom LTD*, September, 1996.
- [45] QuantiMetrics, Bram Meyerson, PO Box 37010, Birnam Park, 2015.
- [46] QuantiMetrics, *How we shape up*, Information Technology Review, Vol. 4 No 3, Computer Society of South Africa, April, 1997, pp 6-7.
- [47] Reiblein S and Symons S, *SPI: 'I can't get no satisfaction' directing process improvement to meet business need*, Software Quality Journal, Vol. 6, Issue 2, 1997, pp 89-98.
- [48] SEAL process assessment tool, URL http://www.seal.ac.za/1995_45/soq910.htm
- [49] SEAL, Communication with Bram Meyerson, MLA1043.
- [50] SEAL, Communication with Chris Dale, MLA1022-5.
- [51] SEAL, Communication with Mary Fisher, MLA 1026-7.
- [52] SEAL, FPA vs SPICE Comparison, , MLA 352, Revision 1.00
- [53] SEAL, *Function Point Count for project A*, MLA310, Revision 1.00.
- [54] SEAL, *Function Point Count for project B*, MLA320, Revision 1.00.
- [55] SEAL, *Function Point Count for project C*, MLA330, Revision 1.00.
- [56] SEAL, *Function Point Count for project D*, MLA340, Revision 1.00.
- [57] SEAL, *PEP Profile for project A*, MLA 312 Revision 1.00.
- [58] SEAL, *PEP Profile for project B*, MLA 322 Revision 1.00.
- [59] SEAL, *PEP Profile for project C*, MLA 332 Revision 1.00.
- [60] SEAL, *PEP Profile for project D*, MLA 342 Revision 1.00.
- [61] SEAL, SEAL QMS procedures and templates, Department of Electrical Engineering, University of the Witwatersrand, PO WITS, 2050, Johannesburg, South Africa.
- [62] SEAL, *Software Quality and ISO 9000: Concepts course*, 96-04.
- [63] SEAL, *Software Quality and ISO 9000: Documentation course*, 96-05.
- [64] SEAL, *Software Quality: Practices course*, 96-03.
- [65] SEAL, *Software Quality: Principles course*, 96-02.
- [66] SEAL, *SPICE Assessment Feedback Summary*, MLA 348, Version 1.00.
- [67] SEAL, *SPICE Practices course*, 96-09.
- [68] SEAL, *SPICE Principles course*, 96-08.
- [69] SEAL, *SPICE Slides for local Trials Support*, SPA600, Version 0.01.
- [70] Software Engineering Institute, Carnegie Mellon University, Pittsburgh, PA, USA.
- [71] SPICE, *Phase 2 Trials Interim Report*, Version 1.00, March 1998.
- [72] Weinberg, G.M., *Quality Software Management Volume 2 - First Order Measurement*, Dorset House Publishing, New York, ISBN 0-932633-24-2, 1993.
- [73] Zahran S., *Software Process Improvement - Practical Guidelines for Business Success*, Addison-Wesley, Reading, Mass., ISBN 0-201-17782-X, 1997.

12. Author contact details



Melanie Lang has obtained a B.Sc. (Computer Science and Mathematics) and a B.Sc.Hons (Computer Science) culminating in a research project on Human Computer Interaction. She has completed research in software process assessment for a M.Sc Eng (Electrical). She is a member of the CSSA, SASMA, SABS TC71.1C and SASQ.

She is an Analyst-Programmer and part of the Application Systems Quality team of the Eskom Information Technology Department. Projects have included SQL Windows, Oracle, C++, Robohelp, Pascal, Delphi and Visual Basic et al development for systems for metering and billing; algorithm animation; a Distribution call-in centre; a data model view tool; a technology simulator; Transmission energy trading, client/server components, test and change control tool and a Distribution application interface to Groupwise.

Other work has been in customer support; journal publication; test and change control procedures training; function point counting; metrics and ISO/IEC 15504 (SPICE) assessments, establishing configuration management procedures, project management templates and procedures; design of user interface standards; training material; programmer mentoring and tools knowledge sharing forum. She has also contributed to ISO/IEC JTC1/SC7 WG10 and WG12.

Contact details: M.T. Lang, ESKOM Information Technology Department, ESKOM, P O Box 1091, Johannesburg, 2001, South Africa. Internet E-mail: Melanie.Lang@eskom.co.za.



Research Assessment

MT Lang

Information Technology Department, Eskom, South Africa

Summary: An assessment by the candidate of the research effectiveness and achievements of this project and research proposals for future work in this field.

1. Introduction

Evaluation of the research process, in terms of the Software process assessment investigation undertaken, in Eskom Information Technology Department (ITD) is discussed, as well as suggestions for future research.

2. Research methodology

2.1 Definition

The methodology used for this research was a case study.

2.2 Advantages

Advantages of the case study method are discussed in this section.

2.2.1 Pilot project

The fact that one did not know the capability level of the organisational unit (although a 'guesstimate' (best guess estimate) could have been made) meant that one would not know whether there would be anything valid to compare. Therefore, one had to assess the capability levels of the processes before the comparison could be done.

One advantage of this type of research is that one is able to establish whether there is any value in conducting a large scale study of this type. It was established that it was unlikely that the same research would yield anything useful as a result of the large number of dependent variables - except for organisational units assessing at Level 2 and above.

Any person who undertakes these further studies should note that the amount of detailed information is likely to be low for organisational units with low capability levels. Consequently, this type of study is unlikely to yield anything useful, although the value of such a study may be great, since it is these organisations and not the more mature ones that require assistance.

2.2.2 Statistical research

The research was limited to this organisational unit, and the amount of time required for data collection on each technique was high. Therefore, it would not have been

possible to do a statistical study, due to insufficient instances. The case study was the best possible method.

2.2.3 Dependence on research subject

A point of interest is that, if one measures and improves based on the results of the measurement, human nature will drive one to want to find out more, to categorise and analyse data and collect more. This continual cycle should drive improvement, so that eventually information will be able to be retrieved, to any degree of detail. However, if one measures but does not improve, one will stay in the same cycle forever - *ever seeing, but never perceiving*.

This implies that research of this type in the first organisation, using an experiment would be difficult, since the environment will be continually changing and the variables difficult to track. Research of this type in the second organisation would be difficult too, for the reason that the information required for the experiment will be unavailable or inadmissible. Thus, the case study is the best method.

2.3 Disadvantages

Disadvantages of the case study method are discussed in this section.

2.3.1 Generalisation

As case study projects are specifically looking at a situation in a particular environment, it is difficult to generalise any results. There could be any number of factors influencing the results, which are restricted to the case study domain, and may not exist elsewhere. These factors are documented, so that others referencing the project can understand the influences.

2.3.2 Modelling

As a result of the large number of influencing factors, one is usually unable to build a theoretical model or formula to model the complete case study situation. One would have to build a very specific mathematical model to include all the variables, and much research would have to be done, into the interdependencies.

2.3.3 Human nature

Individualism makes a profound difference to the case study environment. It is a factor which cannot be sufficiently accounted for or modelled.

2.3.4 Technology

Also, ever-advancing technology changes the case study environment. These have positive and negative influences, as they can enforce or relax processes and/or measures. For example, the inclusion of a version control mechanism into the software development tool, which is required in order for software development to be possible, could partially introduce configuration management. If the tool also contains reports on the available versions, this would become an available measure. The move from the mainframe to the PC environment weakened some of the control mechanisms in place.

2.4 Summary

The scope and constraints of the research problem meant that the case study was the most appropriate method to use. Difficulties of the case study appear to be more as a result of the IT environment, but would probably impact other methodologies too. Extensions of the scope, changes to the constraints and selection of a different method would make an interesting variation on this study.

3. Research project

3.1 Definition

The requirements of this research are listed below.

Profiles from these projects were to be collected and the results analysed separately (intersections, unions, specific indicator relationships). This would be used to establish to what degree of detail each one would provide insight into process improvement and recognition of champions of good software engineering practices. Detail would include identification of problem areas and provision of possible solutions. It was expected that there would be a large degree of correlation between the two techniques.

It may be possible after performing several assessments and gathering some information to establish a suitable hypothesis to test in further assessments.

Recommendations for going forward in Eskom ITD and for further research outside Eskom ITD will be provided.

3.2 Achievements

Achievements of the project are discussed below.

3.2.1 Assessment outputs

Profiles from the 4 projects were collected, including a full process measurement and software process assessment. A list of recommended process improvement actions from both techniques was obtained.

3.2.2 Data analysis

Profiles were analysed separately (intersections, unions, specific indicator relationships). However, it was found that the profiles themselves were just summaries of the information and the real value came out of the data analysis by either the assessor or within the workshop.

3.2.3 Comparisons

The expectation that there would be a large degree of correlation between the two techniques was not met as a result of the organisational unit having Level 1 processes.

3.2.4 Groundwork

These assessments could, indeed, provide the foundation for future research.

3.2.5 Recommendations

Some recommendations for going forward in Eskom ITD and for further research outside Eskom ITD were established and are listed in section 3.6.

3.3 Complications - project management

3.3.1 Scope

This research was limited to comparing the function point count, PEP footprint indicators and the SPICE profile capability levels. There were other areas that may have been relevant, but outside the project scope.

3.3.2 Project roles

One of the matters outside the project's control was staff turnover and staff role changes during the course of the project. Requirements from Eskom staff were documented at the beginning of the project. These were reviewed as staff changed, but scope of project could not be changed as the end stages were reached.

3.3.3 Project extensions

Communications [11,12] seemed to indicate that organisations involved in PEP baselining were Level 1-2. For this research, it did not cause a problem, but it will have to be factored in if this study is continued as the organisational unit matures. In order to 'compare apples with apples', there is a need to perform PEP baselining on projects, per capability level. This is supported by the fact that for Capability Maturity Model (CMM) and Bootstrap 80-90% of organisations were Level 1 in 1993 [13]. In other words, with baselining, it would probably show that an organisational unit is in the top decile, which would be meaningless for improvement, but an excellent marketing tool.

This implies that this research, after using the recommendations, could be the feasibility study for a more extensive future project.

The study could not be extended outside the organisational unit. This was due to the fact that there were no other resources outside Eskom ITD available which was using both types of measurement (except for Old Mutual and BRBS Rail).

3.4 Complications - metrics and process assessment

3.4.1 Relationship between indicators and levels

I agree with Konrad [8] that these lower level relationships are difficult to determine, since experimentation mechanisms in terms of a control sample would be difficult. This is due to the fact that capability Level 1 organisations are dependent on the individual's performance on a project.

This is also supported by International Function Point User Group (IFPUG) [4] which specifies *One important aspect of higher organizational maturity is the increase in the level of detail, or granularity, of information. At low levels of maturity, information requirements are relatively low and the objects being measured are large, such as project phase. As the organization matures, the detail of information required becomes finer, such as activity, task, or deliverable.*

3.4.2 Support

Difficulties were experienced due to the fact that the organisational unit did not seem to support this type of activity fully. Although they were supporting the programmes, they did not support the people by providing time to implement improvements.

3.4.3 Differentiation between outside work

Initially, this study was supposed to be a part of the student's work, rather than something outside work.

Although the student did eventually move to the team who was responsible for these activities, the team was responsible for many other activities, and the study was done outside normal work.

At the same time, working in the industry environment gave the student an insight which one would not have benefited from outside the environment. This was both from being continually involved in the environment and indirectly doing work in the area of research. Eskom also gave much support - in particular, the Information Centre (library). Working within this team allowed one access to material and books which would have been unavailable elsewhere. The student was able to gain insight into the direct applications of the techniques.

It was sometimes difficult to separate development from research work.

3.4.4 Independent progression

The organisational unit (or its programmes or team) was moving ahead with process improvement and measurement, independent of the research.

3.5 Complications - literature

There are conflicting theories on whether measurement or process assessment was more important. Nevertheless, it was realised that both were equally important and became effective only at Level 2, i.e. a process and measurement framework had to be established first.

There are many readings on process and measurement infrastructure. Some are discussed below.

3.5.1 Process infrastructure

Boehm [1] suggests three milestones - life cycle objectives, life cycle architecture and initial operational capability in order to create the environment.

3.5.2 Software process measurement standard

Also, Figure 1 represents a software process measurement framework standard being developed by ISO/IEC JTC1/SC7 WG13 to address information needs for project management, product engineering and process improvement, but exclude product quality measures. [7]

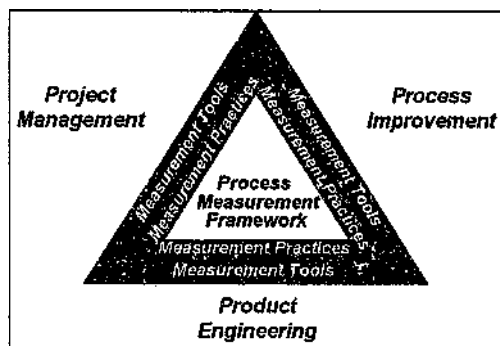


Figure 1 Software Process Measurement Applications [7]

3.5.3 Measurement maturity models

Comer and Chard [2] suggest a measurement maturity model after comparison with Trillium and CMM, since they feel that the capability dimension can be misleading and irrelevant. However, movement up the maturity scale will not mean that less things are measured. They make some valid points which could be incorporated into the current base practices of ISO/IEC 15504 Measurement process.

Gulezian [3] mentions a measurement-based maturity model that moves through the levels Defined (1), Measured (2), Controlled (3), Capable (4) and Improved (5). The elementary problem may be related to the lack of organisational unit wide process definition - which results in the measurement of a chaotic process. This may indicate the need for beginning with maturing the 'Define the process' Organisational process, before considering the others. Perhaps the Organisational process supporting infrastructure has to be in place, before any meaningful improvements can be made. Process definition could be based on ISO/IEC 12207 or ISO/IEC 15288. [5,6] It is also important to note that 'Define the process' should not be defined alone, but also 'Improve the process', otherwise other problems can result.

Gulezian [3] also discusses the Rome Laboratory Software Framework which is a measurement based approach for software quality improvement relating to developmental subprocesses and intermediate and final products of the development process. Gulezian believes that statistical control needs to be introduced early in the process.

3.5.4 Measurement-based process improvement

Rosenberg and Sheppard [10] report success of using measurement-based process improvement at NASA, however their concept of process is limited to

application of resource hours, while product focuses on size, complexity and readability of code.

Paulish and Carleton [9] examined case studies in Siemens business units using measures where the first grouping is based on SEI-recommended core measures. These are primary data (defects, product size, effort, estimate and actual schedule duration time), environmental data (staff size, staff turnover, maturity level, morale). Derived from these are organisational performance measures (defect detection distribution, defect rate, project productivity, schedule cycle time and schedule adherence). Interestingly, many of these measures are similar to the ones collected as input into PEP and provided as output in the footprint, but the unit of product size measurement is function points rather than lines of code (LOC). They also suggest some critical success factors for software process improvement.

3.6 Summary

Most of the original requirements were met, considering the complications encountered. These complications have led to questions with defined options for moving forward. Most options appear to lead to the definition of a framework, which is a project of its own.

4. Future research

This section documents ideas for additional exploration.

4.1 Extensions in the same environment

A direct continuation of this research would be measuring the long term impact across all the measures, as this organisation follows its selected improvement route. The PEP trend graphs could be included in this comparison. As part of this, the long term effect of this type of development (higher productivity, lower quality) on the eventual system maintenance, in terms of impact on measures, could be exciting.

The effect of larger functional size on capability level or vice versa could also be tested.

The research extension is dependent on the action taken by the organisation based on the research results. It is important that the organisational unit have a proper process or measurement programme in place first to avoid the hindrances experienced in this project.

4.2 Extensions in other environments

Extensions of this research may include variations on:

- organisational units.
- capability levels.
- use of capability determination as well as process improvement.
- industry sectors.
- benchmarking organisations.
- software or functional size or performance metrics.
- process assessment methods

Researching these variations with the same goal of comparison, a questionnaire or survey could have been used as the main research tool. This would have been most interesting in tracking the measures taken between different capability levels, and their use in improvement.

Validation of the possible and unproven relationships by statistical analysis using organisational units with a capability level of 2 or above would also be viable.

5. Discussion

In research, regardless of methodology, and purpose, one will continually come across new references which may impact research project's ideas, methodology or direction, positively or negatively. As supported by Prof. Walker, the Masters research is one of the starting points and/or stops for the never-ending journey of research.

This research has established some valuable information and future actions. Other research methodologies would not have been possible, unless the research had been extended or significantly changed. Since the main customer was this organisational unit, it was believed to be sufficient for the project's intents and purposes. Extending the research as listed above would be most interesting.

6. Reference

- Boehm B., *Anchoring the software process*, IEEE Software, Vol. 13 No.4, July 1996, pp 73-82.
- Comer P. and Chard J., *A Measurement Maturity Model*, Software Quality Journal, Vol. 2, 1993, pp 277-289.
- Guiezian R., *Software Quality Measurement and Modelling, Maturity, Control and Improvement*,

Second IEEE International Software Engineering Standards Symposium, pp 52 - 59, August 21-25, 1995.

- IFPUG, *IFPUG Guidelines to Software Measurement*, Release 1.1, August 1994.
- ISO 12207, *Information Technology - Software Life Cycle Processes*, 1995.
- ISO/IEC 15288: *Information Technology - System Life Cycle Processes*, WD, May 1998.
- ISO/IEC JTC1/SC7, *Information Technology - Software Life Cycle Processes Definition and Application of a Software Process Measurement Framework*, Proposed Draft Technical Report, 30 April 1996.
- Konrad M., *Quality Intersection between Process and Product*, Second IEEE International Software Engineering Standards Symposium, pp 202-203, August 21-25, 1995.
- Paulish D.J. and Carleton A.D., *Case Studies of Software-Process-Improvement Measurement*, IEEE Computer, Vol. 27 No. 9, September 1994, pp 50-57.
- Rosenberg L.H. and Sheppard S.B., *Metrics in Software Process Assessment, Quality Assurance and Risk Assessment*, Second IEEE International Software Engineering Standards Symposium, pp 10 - 16, August 21-25, 1995.
- SEAL, Communication with Chris Dale, MLA1022-5.
- SEAL, Communication with Mary Fisher, MLA 1026-7.
- SEAL, *SPICE Slides for local Trials Support*, SPA600, Version 0.01.



Learning from the project

MT Lang

Information Technology Department, Eskom, South Africa

Summary: Review of the lessons learned from the project from a quality system and product quality viewpoint, and recommended improvements for subsequent projects.

1. Introduction

We review my previous knowledge of quality systems, education and informal training as a result of this project; and improvements that could be made to the process and product for use by future students.

2. Earlier knowledge

I had previously done research project, in partial fulfilment for an honours in Computer Science at Wits University. I was familiar with research, but not within either the SEAL framework or within the software engineering and case study context.

I was a part-time student who had been working in industry for 1 year before undertaking the research. I understood the industry drivers such as cost and deadlines, which were not always the same as the academic drivers - curiosity and peer recognition.

Although I had attended seminars on ISO 9000 and had heard of the SPICE project, I had had no prior experience in using such quality systems. I had mainly had software engineering experience in development and maintenance (i.e. the entire process from requirements definition to testing). During the course of my research, I had worked in areas from process definition (including training), project (including quality and risk) management, configuration management and quality assurance and reviews.

3. Formal training

In preparation for the research, I attended courses on both ISO 9000, the SEAL structure and SPICE, [8,7,5,6,10,9]

4. Quality system

The SEAL quality management system was used for this project, as it evolved between 1996 and 1998.

4.1 Lessons learned

4.1.1 Processes and procedures

Although the courses covered what the SEAL QMS was, an initial overview on how to start using the SEAL QMS had to be provided. Procedures were well

documented, but the higher level process was not always clear, except from individuals who had used the process before. This could be a lack of a visual process model.

4.1.2 Beyond training

Interestingly (as has been confirmed recently in my work environment), training alone does not ensure that a trainee will use the new knowledge gained or use it correctly. A period of 'handholding' is required and an element of 'management commitment' [Prof. Walker strongly agreed with this statement]. This management commitment is not only in requiring that the process be used, but allowing some time for the people to understand what is required of them, and how to integrate it into their usual way of work.

4.1.3 On-the-job training

Over the course of the research, I gained an understanding of configuration management, project management, requirements definition (from a document rather than a software system perspective), as well as areas such as reviews and assessment.

There is a certain amount of discipline required to ensure that one performs backups, keeps the Master Document List in sync, records actual dates in the project plans and maintains the product description. It is not something that a person coming from a Level 0-1 environment is used to, and something that requires practice.

4.1.4 Good research

Dr. Kennedy's [3] characteristics of good research is that it is *clearly defined, purposeful, organized, systematic, planned, critical, clear, parsimonious, precise, accurate, responsible, repeatable, reliable, valid, testable, objective, defensible, thorough, honest, data-based, with an adequate data analysis, valid conclusions and provides useful results. Other signs of good research include originality, generality and meticulousness.* SEAL QMS provides the structure to ensure it is at least clearly defined, purposeful, organised, systematic, planned, repeatable and testable. The other characteristics should be provided by researcher and supervisor.

4.1.5 Repeatability and preservation

The SEAL QMS [4] is an excellent way of ensuring repeatability of the research by requesting approved 'management' documents (product description, configuration management plan, project plan, quality plan et al.). The documents fulfil the main requirement for ensuring the infrastructure for the research, as well as important information be preserved. The supervisor and process auditors are still required to check that these plans are being followed. In particular, it formalises the note-taking which not all first time researchers are used to doing. However, the signing and witnessing would only be formalised if one kept older versions of documents, with complete change histories; and if the document was approved by the research supervisor, during project meetings, and noted in the minutes. This could add some complications for electronic records in patent rights lawsuits.

4.1.6 'RAD' for research

SEAL seems to give a 'RAD' (rapid application development) for research' process. In other words, it gives a student the infrastructure and architecture for research work. This leaves the student free to concentrate on the actual research, instead of being concerned with how to write-up, where to track all of their research outputs (which may not have been documented) et al. It also provides the supervisor with a means of tracking deliverables as part of a system (rather than just the intermediate reports); and allows them to keep all deliverables in their environment (in the event that a new student would like to extend the research).

4.1.7 Project duration

It is important to remember that one of the obstacles which a part time student experiences is the length of time and the 'other information' which they are constantly gathering. One can understand that a person may not remember exactly where, when and how they learned of a particular fact, if they are working on multiple, diverse projects simultaneously. However, for research, this is important to track, otherwise the fact will be a piece of useful information, which has been excluded, since the original reference is unavailable.

4.1.8 Project verification and validation

The product description together with the project meetings and audit was a means of performing verification, while the document reviews were a means of validation. This is similar to the V model for testing in the software development environment.

4.1.9 Project extension

Similar to the industrial environment, once the developer leaves the project, the only thing left for the maintenance personnel is often the source code - or in academic case, the thesis. This is sometimes insufficient for a new resource - the exact motivations behind all the choices are not always thoroughly captured. Perhaps this is the difference between a first class and a third class product, but this should not mean that the maintenance resource should suffer from the developer's third class product.

As in ISO 9000, it is possible to keep meaningless or useless information in the system, but it is up to the supervisor to track the intermediate outputs.

4.2 Suggested improvements

4.2.1 Case study

Availability of a 'case study project' which has been through the SEAL quality system would be useful in directing a new student, particularly if the entire project follows the full process and passes all audits. Prof. Walker mentioned that this would have been available on request.

4.2.2 Technical product preservation

As the final documents were being put together, it was realised that, although the management infrastructure was in place, this did not always ensure that the technical products (those documents which are not management products or records, but project documents) could be found at any point in time, unless they were defined in the project plan.

A way of ensuring that research information be preserved is that work products (which should be the parts of the final research paper) be scheduled for outputs at milestone dates. This will be dependent on the type of research conducted.

4.2.3 Project plan template - work breakdown structure

An improvement would be to use the final technical paper as guidance in directing the project plan, i.e. the product description for the technical paper (paper content) and the project plan (research methodology) should be aligned as early as possible. Prof. Walker mentioned that one of the purposes of presenting the South African Institute for Computer Scientists and Information Technologists (SAICSIT) paper was to get this type of thought process going. So, early submission to a journal or conference is recommended.

The type of research should set the initial structure for the paper which could drive the project plan, including amount of effort, for the research. At the project plan milestone dates, a section of the final paper should be ready for review. This does not mean that the content of the paper is static, just that initial and intermediate thoughts are captured as the research progresses. The SEAL structure indirectly allows one to do this, since the intermediate products become the appendices of the final technical paper.

4.2.4 Backup and storage

The backup register should also record the time or else a list of files backed up, since a student may not remember which files have been backed up, especially when problems on dialup occur.

There may be a gap if the supervisor does not ensure that information is kept up to date. This is not serious for those supervisors who have been trained in the use of, or regularly use SEAL QMS.

4.2.5 Paperless office

There seems to be a problem of control when documents are required both electronically and in paper format, even though the paper is an 'uncontrolled copy'. For audit and project team meetings, duplicate hard copies of all updated documents are required. Usually these documents are only printed on those days, since students work electronically. A recommendation would be that there would be no requirement for hard copies, until the end of the project, i.e. all meetings and audits are 'on-line'.

4.2.6 Project audits

Another problem could be the regular tracking of a project, which is supposed to occur every 2 months (according to the Faculty of Engineering).

The audits provide a mechanism for ensuring that the information that has been 'promised' in the project plan exists and is readily available. However, audits, like exams and tests can be 'cheated on' - if the examinee knows the questions, it is possible to give the answers that the examiner/auditor wants to hear. If computers were available, a possible improvement would be to conduct the audit online, especially to confirm what was on the SEAL server, as opposed to what was in the product developer's files or computer. Auditors may not necessarily have the requirement or the resolution to audit a project correctly - Prof. Walker agreed with this.

4.2.7 One-person project templates

There are some products and plans that have been set up specifically for use within a team context. Possibly, separate templates have to be set up for one-person projects which require less infrastructure, even though they will have the same amount of work to accomplish. For example, the technical paper template has a review process which includes multiple resources. This could be changed to a standard review process for sole authors of papers.

4.2.8 Technical paper - multiple reviewers

A procedure could be set up for papers where there are multiple reviewers. This requires additional controls, especially if different versions of a paper are under review simultaneously and development is still taking place.

4.2.9 Part time student impediments

Part time students do not benefit from the support of other full time students. In other words, they rely to a large extent on their supervisor to provide guidance. This places some burden on a supervisor who has a large number of part time students and also on the student who must depend on email and dial up services which are not always reliable. They do not have the opportunity to discuss with other users what their experiences and ideas for using the system are. For example, numbering was not always followed if a document had to be created, and no guidance as to what numbering convention had to be used could be found. This was particularly the case if something new had been introduced between meetings with the supervisor.

The audit meetings provide students with a chance to meet others. However, full time students already know each other well (if not from being located centrally, then from the SEAL Management Board meetings) and do not always interact with the part time students.

Possibly a support group could be set up for the part time students to contact any SEAL students or staff with questions, as a mailing list or newsgroup. The group does not mean that anyone is required to give assistance, but others can give initial guidance, if a supervisor is unavailable and preceding a supervisor response.

Part time students are also not able to give accurate estimations for their project plans. It is suggested that these students calculate effort based on hours or weeks rather than days. Part-time students will most likely spend a number of hours per week on the project, if they are not over-committed by work. It has been noted that under-estimating a project is demoralising on a team. This theory could have the same impact on a part time student who would like to continue steadily with their

research work, but are unable to due to work commitments.

This does not mean that SEAL should be responsible for managing this - application to do research is a commitment on the student's part. However, estimation by means of hours will give a student a better understanding of how much effort they have applied, and how much is still required for completion of a work product. This will allow for detailed activity planning and scheduling to best fit available time or else to reschedule time, so that sufficient time is available to work on studies. In other words, in addition to what a full time student needs to learn or know, a part time student also needs a good understanding of planning and applied project and task management.

4.2.10 Communicate lessons learned

The student has access to many theses in the university libraries, but these do not record the lessons learned during the Masters process. Access to this particular document would assist other students in directing their initial learning process.

5. Quality product

The deliverable product of this research project was a documented comparison.

5.1 Lessons learned

5.1.1 Quality requirements

Unlike a software system, it was initially unclear what the quality requirements of a document would have to be. As the student reviewed literature, it became clearer.

5.1.2 Validation

The use of the technical paper checklist was most helpful in determining whether a student was 'on the right track' for writing papers. It seemed to add the 'Check' part of the Deming cycle [2], where the paper development was the 'Do' and the product description formed the 'Plan'.

Reviews by a selected Eskom audience may verify that one is still meeting the requirements of the product description (if the reviews go ahead, although occasionally they were bypassed, and left to the student to perform in conjunction with her supervisor). However, it also places an additional communication overhead, especially when managers have busy schedules.

5.1.3 Planning to reduce rework

A recommendation, which may be a personal experience, is that it is easier to keep to a word budget and add information later, than to add too much information and try to edit later. The re-work required by the latter is more than that of the former. However, one must bear in mind what can be said in fewer words, rather than what should be omitted.

5.1.4 Bookmarks for references

Using Microsoft Word's bookmark and cross reference facilities were beneficial. Bookmarks were added to each listed reference, so that they can be cross-referenced in the text, without having to synchronise numbers each time a new reference is added.

5.1.5 Review, presentation and networking

Although Masters students are not required to submit papers to journals or conferences, they greatly assist a student in establishing the standard of their work in relation to 'research at large'. This included review comments and rejection for the EASE conference at Keele University. Acceptance of a paper indicates that one may be on following an interesting direction and provides some encouragement, while rejection with comments provides feedback for improvement.

Conferences are a good place to interact and discuss ideas with others, particularly ones with field experts, who may have 'been there, done that', or just be interested in either testing theories or making suggestions.

If the student is able to attend conferences, especially as a presenter, they can benefit further. The SAICSIT conference gave 3 students the opportunity to interact with other academics in the field in South Africa and showcase SEAL's excellent papers and presentations.

5.1.6 Academia and industry

SAICSIT, particularly the AGM, gave a student from industry an idea of the difficulties which an academic experiences especially in terms of sponsorship. This experience applies more to the pure academic, who often works in areas, which are currently too advanced for industry. Work done by SEAL intersects with requirements from industry and could provide the convergence of fundamental and applied research. It is almost as though industry has to move to the higher capability levels, before they will have projects for the pure academics. While industry is fighting fires (get the system in place, and fix the problems later), they will not be concerned with advanced fire prevention techniques (formal proofs of algorithms, intractability).

It is easy to see how the two sectors can move in their own circles to the benefit of themselves independently. The fact that Computer Society of South Africa (CSSA) and SACSIT are not chapters with a common vision within the same organisation highlights the point.

A partnership between industry and academia would allow industry to concentrate on operational problems, e.g. writing systems to support a customer's requirements, while academia could provide support in terms of answering 'is this possible?' questions, and what needs to be in place to assist the implementors. The problem with this scenario is that academia will then step out of the realm of complete freedom [11] and will be required to follow strict deadlines.

The Software Engineering Institute [11] of Carnegie Mellon University seems to fulfil this intersection role, but they service some mature customers and there is insufficient staff at SEAL to manage this.

5.1.7 Local conferences

It is disappointing that South Africa has few local conferences in this field of research. Prof. Walker agreed with this. It seems to highlight the fact that this field is more technology driven. Industry is only now starting to awaken to the ideas of process. It was even a foreign concept to academia.

5.2 Suggested improvements

5.2.1 Case study

Availability of a 'case study project' which has been through the SEAL paper development process would provide guidance to a first-time author. This may lead to 'copycat' products, but if used correctly, products would have at least the minimum standard embodied by the case study paper, which they should then personally improve. Prof. Walker mentioned that this would have been available on request.

5.2.2 Literature review template

As preparation on a literature survey, a document which can be created is a set of review notes (with required bibliographic information) of each reference read. This assists with tracking, especially when one remembers that something was said in one of the references, but cannot remember exactly which one. This is more formal, but one could easily write notes on copies of papers, but again one would run into the difficulty of locating a specific source.

The master document list or the technical paper could currently be used as a workaround, but a more

formalised template containing biographical and content details is useful for planning and tracking.

5.2.3 Digital libraries

It is highly recommended that students make use of the vast array of digital resources such as access to the searchable back issues or abstracts of various journals. It was not always clear whether these were publicly available or by virtue of the student working for Eskom. The Information Centre staff were willing to provide the student with passwords to some archives.

5.2.4 Guidance for technical paper product description

The exemplar paper gave one an idea of what needed to be included in the paper. However, the introduction of the technical paper product description template at a later stage caused some confusion, and initial guidance had to be given by the supervisor, rather than found within the quality system.

5.2.5 Technical paper template

Sections such as the Author Contact Details are duplicates or if they are not required, there should be separate templates for documents requiring them and ones which do not. They should be a single work product, which is added as a document reference, rather than having to be updated in as many places as used if the details are changed. This would be the equivalent of normalising the data in data model.

Use could be made of Microsoft Word's master document facility, although this would require additional training on the part of the template users. Problems with this facility have been experienced on Microsoft Word 6.0 when the document has been large and included many images, but the same can be said with a single document of this combined magnitude. Prof. Walker noted that typeset features would be overridden when a document is included. He also mentioned that for the moment, it was easier to have a single template and inform students which sections were to be removed.

Other improvements to the technical paper template would be the inclusion of spell checks and grammar checks into the requirements. Also for the technical paper checklist, additional checks which could include those of Dr. Kennedy's characteristics of good research, which are not already in the template. [3]

6. Discussion

I have gained much experience from working in this environment and am bewildered that such infrastructure

is not available to other students undertaking projects. It is believed that other students would take much longer in finding out how to do a Masters rather than just doing it. However, just like software process assessment, measures and metrics for Level 0 and Level 1 Masters processes are unavailable or inaccurate and very much individual-dependent. So, this theory cannot be validated, although it is a question of interest to Prof. Walker.

There will be those students who would have succeeded, regardless of the support available. However, if a department is trying to increase the number of graduating postgraduate students, and the number of research papers available, then such a support structure is invaluable.

7. Reference

- [1] Davis A., *Between Scylla and Charybdis*, IEEE Software, Vol. 14 No. 5, September/October 1997, pp 4-6.
- [2] Deming W.E., *Out of the Crisis*, Cambridge, MIT Centre for Advanced Engineering Study, 1986.
- [3] Kennedy I.G., *How to do Research* hypertext course, PO Box 32320 Constantia 0010 South Africa, 1995.
- [4] SEAL, SEAL QMS procedures and templates, Department of Electrical Engineering, University of the Witwatersrand, PO WITS, 2050, Johannesburg, South Africa.
- [5] SEAL, Software Quality and ISO 9000: Concepts course, 96-04.
- [6] SEAL, Software Quality and ISO 9000: Documentation course, 96-05.
- [7] SEAL, Software Quality: Practices course, 96-03.
- [8] SEAL, Software Quality: Principles course, 96-02.
- [9] SEAL, SPICE Practices course, 96-09.
- [10] SEAL, SPICE Principles course, 96-08.
- [11] Software Engineering Institute, Carnegie Mellon University, Pittsburgh, PA, USA.



Literature Survey

MT Lang

Information Technology Department, Eskom, South Africa

Summary: A review of the literature that exists covering function points, SPICE, assessments and the intersection of these.

1. Introduction

This document assembles the background, philosophies and work that was useful in the context of this research.

2. Function points

2.1 Definition

2.1.1 Measure and metric

The International Function Point User Group (IFPUG) [22] defines a measure as *a number that assigns relative value. As a verb, measure means to ascertain or appraise by comparing to a standard. They see measurement as assigning relative value. Usually, in the improvement process, measures gained from this activity are combined to form metrics. Also, a metric is a combination of two or more measures or attributes.* [25]

2.1.2 Lines of code (LOC)

Lines of code has been a controversial area due to its dependence on language and programmer. Some companies have used this as a productivity metric, taking into account the above influencing factors when using it for estimations.

2.1.3 Function point

Function points originated in 1979 when Allan Albrecht [2], then working for IBM, was approached to develop a method to monitor and estimate productivity independent of the programming language and technology used. Albrecht believed that size was the primary driver of a project, and centred the development of his measure around software size.

A function point is thus an indicator of software size, just as a kilogram would be an indicator of weight.

2.2 Process

The basis of any software system is that it has a number of inputs, some processing logic, a number of outputs and accesses some files. In Figure 1, these concepts are demonstrated in a function point context.

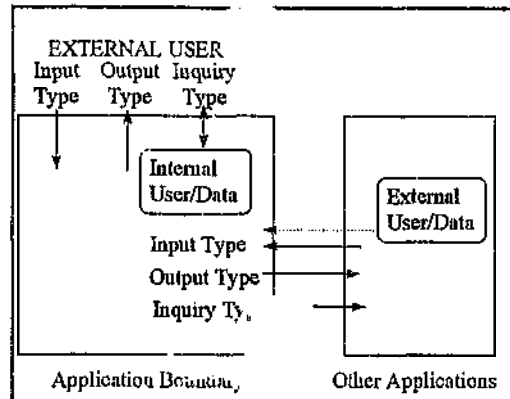


Figure 1: A basic application and its function point parameters [43]

User perspective dictates the approach to the count by identifying logical (interpreted in business terms), and not physical files and functions. The "size" of a function or file is based on standard values, which were originally statistically calculated.

Table 1 below lists the process to be followed when performing a function point count.

Table 1 – Function Point Process	
Step	Action
1.	Identify all the logical elements represented in the diagram, which are part of the system to be counted.
2.	Categorised these elements into the following types: 1. External Interface File (EIF) or Internal Logical File for data accessed; and 2. External Input (EI), External Output (EO) or External Inquiry (EQ) for functions on data.
3.	If the element is a file, then count the number of logical files grouped together and the number of attributes on each of these.

Table 1 – Function Point Process

	Else If the element is a function, then count the files and fields accessed to perform the function.
4.	Translate values from previous step to simple, average or complex.
5.	Translate simple, average or complex to values depending on element type.
6.	Total translated values from previous step to give unadjusted function point count.
7.	Calculate value adjustment factor (VAF) by weighting 14 complexity factors using the supplied questions, between 0 and 5, where 0 is no complexity and 5 is the highest.
8.	Calculate the adjusted function point count using the unadjusted count with the VAF as a multiplier.

Exact values and formulas for the steps above are supplied by IFPUG's Counting Practices Manual. [24] The adjusted function point count is accepted as the system size.

2.3 Advances

One of the earliest books published on function points was written by Droger. [11] IFPUG [22] was then formed by US volunteers interested in development and support of function points. IFPUG has become an organisation with some full time staff and a large international member base. They hold annual information sharing conferences where individuals can attend courses, or write an exam which allow them to obtain a 3-year Certified Function Point Specialist (CFPS) qualification, based on the current Counting Practices Manual. Similar organisations such as EFPU, GUPFI and NESMA have emerged, based in other countries.

Variations have been developed to address some of the issues (listed in the disadvantages below), such as feature points [43], MKII function points [62] and 3D function points. Workarounds and adaptations to the interpretation of the generic function point methodology have been developed and democratically accepted by members of IFPUG [24].

ISO/IEC JTC1/SC7 WG12 is currently working on standards related to functional size measurement and have released an international standard consisting of concepts and definitions of functional size measurement

[26]. The workgroup is currently developing standards for compliance assessment of software size measurement methods [27], verification of functional size measurement methods [28], reference model [29] and determination of functional domains [30].

2.4 Uses

Function points have been/can also be used to:

- Measure staff productivity [15,25,14,48,18]
- Estimate project cost, effort and schedule [15,25,14,48,18]
- Measure productivity against other organisations [15,25]
- Measure support requirements and understand maintenance costs. [15,48,18]
- Monitor outsourcing agreements [9]
- Drive information systems related business decisions, e.g. re-engineering [48,18]
- Normalise other measures. [25,14]
- Estimate test cases [48]
- Expectations management by understanding scope creep and assisting with contract negotiations. [15,14,48]
- Calculate the true cost of software [48]
- Develop a standard set of metrics [48]

2.5 Disadvantages

Function points have some problems which have lead some users searching for the perfect sizing method to reject this technique as being too open to misinterpretation:

- they are misleading if used comparatively, due to their ordinal nature [45, 8]
- they are perceived to apply more to mainframe type applications. [8]
- they tend to favour applications which are not overly technically complex. [43]
- they are easier to calculate based on a newly developed system, or maintenance counts based on already existing function point information. [43]

- e. they do not appear to cover real-time process control, mathematical optimisation, embedded systems and scientific systems. [43]
- f. dependence on skilled function point counters. [44]

2.6 Case studies

Gazmus and Herron discuss four success stories of organisations using function points. [15] These are usually as part of a larger metrics programme.

HP [19,18] can also be classified among the successful. However, they have used function points and established their own metrics programme.

3. Computer Sciences Corporation (CSC) Index Research and Advisory Services (RAS) Performance Enhancement Programme (PEP)

3.1 Definition

3.1.1 PEP

CSC is one of the largest research organisations. Along with META and the Gartner Group, they provide insight into industry trends. CSC Index Research and Advisory Services who developed PEP are now called CSC Research Services.

There is little doubt in any practitioner's mind that Function Points are the key metric here; however, Function Points, in and of themselves, do not reveal much without the use and the combination of other metrics. [15] PEP defines some of those metrics.

The Performance Enhancement Programme (PEP) is dedicated to helping information systems (IS) managers realise the potential of their organisations - transforming them into the creative enablers of new ways to do business. [7]

3.1.2 Benchmarking

Benchmarking is a risky area. If it is not implemented bearing in mind issues such as scope and data validity, it can draw the wrong image and be damaging both to a company's reputation and to employee motivation. [15,25] Conversely, it can play a role in identifying key areas for improvement in relation to other industry players. It is important to compare apples with apples. It is also important that the benchmarking company provide clear definitions in terms of inclusions of effort, scope and life cycle stages to enable accurate and useful comparison.

3.2 Process

CSC [7] have developed a method of comparing projects within an organisation. The method requires information on:

- a. project size,
- b. estimate and actual work effort and cost,
- c. defects and errors,
- d. platforms, technologies, packages,
- e. methods, tools and techniques,
- f. staff and user experience and
- g. project life cycle or methodology.

3.2.1 Overview of PEP footprint

One of the outputs of their assessment is a 'footprint' (Figure 2) which is a device for summarising a number of metrics in a visual way. *It does not isolate and measure every part of the system lifecycle: for example, the footprint is not applied to the business systems analysis and design stage. [56,49]*

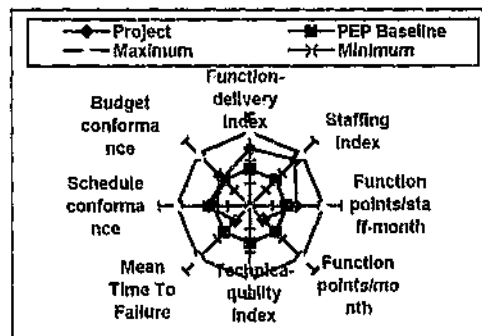


Figure 2: PEP Footprint

3.2.2 PEP footprint metrics

As described in IT Review [49], the descriptions of the measures displayed in Figure 2 are as follows:

- a. Function Delivery Index (FDI) - Overall efficiency of project team which is a measure of the relationship between project size, time and effort.
- b. Staffing Index (SI) - Whether a project appears to be overstaffed, which is often an indicator of poor planning or unrealistic deadlines. This appears to have a strong correlation to Brook's Mythical Man

Month [4], which states that adding people to an already late project makes it even later.

- c. Function Points/staff month (fp/sm) - How much is delivered for resource invested. This incorporates size and effort.
- d. Function Points/month (fp/m) - Speed of delivery.
- e. Technical Quality Index (TQI) - Errors detected during testing and early operation.
- f. Mean Time To Failure (MTTF) - Average time between failures once a system is released into production.
- g. Schedule Conformance - How much the project is over or under its planned schedule.
- h. Budget Conformance - How much the project is over or under its planned budget.

For a particular metric (e.g. FP/sm), the *footprint* displays a minimum, a maximum, a project value and the PEP baseline value. The baseline is a value that enables comparison of the results of a given project, with the results for similar projects, in the rest of the world, using the PEP database. The baseline uses a formula to determine the median value of the distribution of values of the metric. The formula takes into account the project type, language mix, platform and size of the project which applies to the comparison

3.2.3 Plotting of PEP footprint

The scale of each metric is determined in such a way that the baseline falls midway between the centre and the outside of the *footprint*. The baseline helps to ensure that an organisation compares with suitable projects.

Project values are plotted on that scale, with better values (than baseline) plotted towards the outside, and worse values (than baseline) towards the middle. The aim is to give an overall impression of project performance, with a large footprint being better than a small one. [56]

3.2.4 PEP process assessment

Footprints are aggregated and baselined for the department and a detailed statistical analysis is undertaken by CSC and South African PEP representative, QuantiMetrics. The *footprints* alone give no guidelines to the team or management on what process needs to be improved, but provides management with helpful graphical summaries.

3.3 Advances

It is also important to note that there are many other techniques and customisations available, as well as variations of them, e.g. custom metrics as used by HP [18,19], IFPUG's International Software Benchmarking Standards Group (ISBSG) Benchmarking [22], SPQR [43].

3.4 Uses

When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind... - Lord Kelvin

One cannot manage without measuring - measurement provides the quantitative feedback as to what has changed.

3.4.1 PEP process improvement

Following this assessment, a workshop (for managers and invited participants) to find explanations for some of the statistics and discuss possible courses of action, is facilitated by QuantiMetrics [55] and aimed at systems development managers. QuantiMetrics then produce a report [54] containing a set of agreed recommendations for improvement action.

Additional conversations and meetings with QuantiMetrics can derive statistics to provide advice for future planning, resource allocation and quality improvement. Baselining should provide an impetus for performance improvement initiatives, and give supervisors a tool for effective management. It provides a language that is more suited to discussions with business. [49]

3.5 Disadvantages

3.5.1 PEP footprint difficulties

Missing spokes (e.g. TQI of Figure 2) indicate that information submitted was insufficient to generate the required information.

Every attempt is made to ensure that data collected is accurate. However, high values may be an indication that the physical data collection is based on recollection rather than accurate records being logged and maintained. For example, if recording of testing and operational errors was inaccurate, or estimated, the graph may be skewed and appear as having high technical quality.

An important point to note is that the *footprint* may behave like a rubber band, e.g. increasing speed may decrease quality.

3.5.2 Metrics

Although there are general metrics which may be captured by most companies, there is some company specific measures which should ultimately be based on company goals.

3.6 Case studies

Among the South African companies, who have successfully used PEF for improvements, are Old Mutual and Standard Bank. [49]

4. Software Process Improvement and Capability Determination (SPICE)

4.1 Definition

STD from Compta, the Capability Maturity Model from the Software Engineering Institute, Trillium from Bell SYGMA TeleCom, SQPA from HP, Bootstrap from Esprit, HealthCheck from BT, ISO9001 (as used for assessment, rather than auditing) and SAM from BT are process assessment methods which have been used successfully by other organisations.

ISO/IEC 15504 is also known as Software Process Improvement and Capability Determination or by the acronym SPICE. It is an international standard developed by ISO/IEC JTC1/SC7 WG10 to provide a structured approach for the assessment of software processes and is based on the positives of the above methods. [33]

4.1.1 The SPICE Model [34]

The model adopted by ISO/IEC 15504 is shown in Figure 3. Fundamental to the model is the concept of a process, which is described as a set of interrelated activities, which transform inputs into outputs [40].

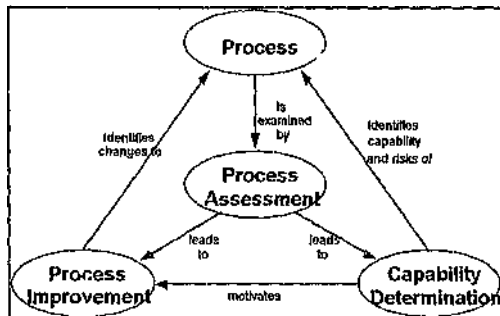


Figure 3: The Assessment Process

Processes are examined using the mechanism of process assessment, defined as a disciplined evaluation of an organisation's software processes [40]. The output of the assessment exercise is a profile, which can be used variously for process improvement (Action taken to change an organisation's processes so that they meet the organisation's business needs and achieve its business goals more effectively [40]) and/or for determination of process capability - a systematic assessment and analysis of selected software processes within an organisation against a target capability, carried out with the aim of identifying the strengths, weaknesses and risks associated with deploying the processes to meet a particular specified requirement [40].

The two key components of the standard are a process model and guidance on conducting assessments. [35]

The process model is made up of a framework of attributes in two dimensions: Process and Capability.

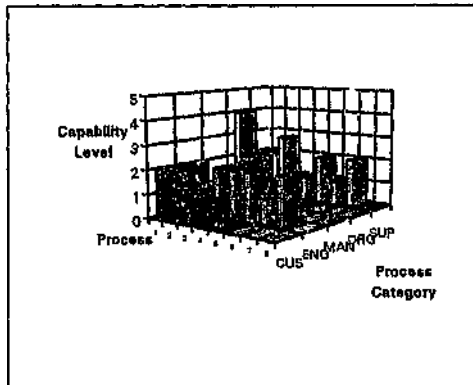


Figure 4: The Dimensions of the SPICE Model

4.1.2 The SPICE process dimension

Processes (x-axis of Figure 4) are grouped into general areas of activity called process categories (z-axis of Figure 4) (Table 2):

Table 2 – Description of process categories

Process category	Brief description
Customer-Supplier	Processes that directly impact the customer, support development and transition of the product to the customer, and provide for its correct operation and use.
Engineering	Processes that directly specify, implement, or maintain a system and product and its user documentation.
Support	Processes that may be employed by any of the other processes (including other supporting processes) at various points in the product development life cycle.
Management	Processes that contain practices of a generic nature which may be used by anyone who manages any sort of project.
Organisation	Processes that establish the business goals of the organisation and develop process, product, and resource assets which, when used by the projects in the organisation, will help the organisation achieve its business goals.

The processes in Figure 4 are enumerated for illustrative purposes, but they are not the same across all the process categories, as seen in Table 3.

Table 3 – List of processes

Identifier	Name
CUS.1	Acquire software
CUS.2	Manage customer needs
CUS.3	Supply software
CUS.4	Operate software
CUS.5	Provide customer service
ENG.1	Develop system requirements and design
ENG.2	Develop software requirements
ENG.3	Develop software design
ENG.4	Implement software design
ENG.5	Integrate and test software
ENG.6	Integrate and test system

Table 3 – List of processes

ENG.7	Maintain system and software
SUP.1	Develop documentation
SUP.2	Perform configuration management
SUP.3	Perform quality assurance
SUP.4	Perform work product verification
SUP.5	Perform work product validation
SUP.6	Perform joint reviews
SUP.7	Perform audits
SUP.8	Perform problem resolution
MAN.1	Manage the project
MAN.2	Manage quality
MAN.3	Manage risks
MAN.4	Manage subcontractors
ORG.1	Engineer the business
ORG.2	Define the process
ORG.3	Improve the process
ORG.4	Provide skilled human resources
ORG.5	Provide software engineering infrastructure

Each process contains a number of base practices, which could be seen as current quality best practices.

4.1.3 The SPICE capability dimension

A capability level (y-axis of Figure 4) is a set of process and management attribute(s) that work together to provide a major enhancement in the capability of a Supplier to perform a process [40].

There are six capability levels in the reference model.

Level 0 Incomplete: There is general failure to attain the purpose of the process. There are no easily identifiable work products or outputs of the process.

Level 1 Performed: The purpose of the process is generally achieved. There may not be evidence of rigorous project planning and tracking. Individuals within the organisation recognise that an action should be performed, and there is general agreement that this action is performed as and when required. There are identifiable work products for the process, and these provide evidence to the achievement of the purpose.

Level 2 Managed: The process delivers work products of acceptable quality within defined timescales.

Performance according to specified procedures is planned and tracked. Work products conform to specified standards and requirements.

Level 3 Established: The process is performed and managed using a defined process based upon good product engineering principles. Individual implementations of the process use approved, tailored versions of standard, documented processes. The resources necessary to establish the process definition are also in place.

Level 4 Predictable: The defined process is performed consistently in practice within defined control limits, to achieve its goals. Detailed measures of performance are collected and analysed. This leads to a quantitative understanding of process capability and an improved ability to predict performance. Performance is objectively managed. The quality of work products is quantitatively known.

Level 5 Optimising: Performance of the process is optimised to meet current and future business needs, and the process achieves capability in meeting its defined business goals. Quantitative process effectiveness and efficiency goals (targets) for performance are established, based on the business goals of the organisation. Continuous process monitoring against these goals is enabled by obtaining quantitative feedback and improvement is achieved by analysis of the results.

Each level provides a major enhancement of capability in the performance of a process. The levels constitute a rational way of progressing through improvement of the capability of any process.

In the Capability dimension, a capability level consists of process attributes, which contain one or more management practices. Quality properties of the process could be represented by management practices, while quality properties of products could be represented by work product characteristics.

4.2 Process

4.2.1 SPICE assessment

The capability level of each process is independently assessed, by a qualified assessor (with their assessment team) [38] making a judgement supported by documented objective evidence. This may be based on practice attributes (by interviewing process practitioners and managers) or work product characteristics (by examining documents, plans, etc.) provided by the SPICE embedded model [37]. The ratings supported by the judgement are fully, largely, partially and no achievement. These can be aggregated and lead to a collection of profiles which represent the assessment

output, as seen in Figure 4. This profile can be set to different levels of detail showing achievement percentage scales ranging from organisational unit (OU) (defined as *that part of an organization that is the subject of an assessment* - in this case, IT Application Systems) capability level to process capability level). [36]

The aggregation of the results is meaningless on its own. It is the data gathering and analysis process that provides insights into possible improvements, which needs to be prioritised by organisational goals, as is stated by ISO/IEC 15504-7. [39]

Each assessment may produce different results depending on the assessment input, i.e. it is possible that an organisation of capability level 5 achieves mainly capability level 1 if their worst projects are selected. It is unlikely however, that an organisation with capability level 1 will be able to achieve capability level 5 on a specific project, by virtue of the dependence on processes which are outside their control. An organisation which can achieve Level 5, will thus be able to selectively apply processes, based on risk and cost effectiveness.

Recommendations for improvement can be made based on the process achievement.

4.3 Advances

Other process assessment methods have been advancing and have based some of their advances on the SPICE project.

Phase II trials for SPICE are complete and the trials report [60] has been released documenting organisational unit's experiences with use of the standard for assessment and analysing the data collected. Since process improvement and process capability determination are long term, rather than short term objectives, the phase III trials should shed more light on the usefulness of the standard for these activities.

4.4 Uses

If you don't know where you are, a map won't help. [21]

4.4.1 SPICE process improvement

A first assessment can form part of a baseline. Thereafter, using the Guidelines for Process Improvement [39], improvements can be prioritised and implemented in accordance with organisational goals.

Weinberg [64] distinguishes Level 1 organisations or pattern 1 (*Variable Culture*) who can be successful if there is one-on-one work between customer and developer - *Emotion, personal relations, and mysticism drive everything... Some of the work is excellent, some is bizarre, and it all depends on the individual.*

El Emam and Madhavi [13] studied the effect of maturity on the success of requirements engineering(RE) process. They concluded that only 2 organisational processes improved RE service quality - documentation and alignment of business goals, overall MIS strategies, missions, goals and priorities; and integration of the budgeting process for systems project with the business priorities. Quoting Craignyle and Fletcher [6] who have developed Software Technology Diagnostic, a derivative of CMM for small to medium sized organisations, *it is the ability of process assessment to clarify, prioritize and rate the problem areas that make process assessment invaluable to invest in.*

As indicated in Figure 5, as an organisation moves up the Capability Maturity scale, they are able to predict schedule, cost and quality more accurately.

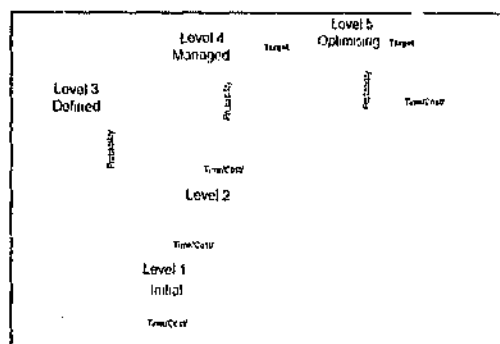


Figure 5 Impact of Predictability of schedule/cost/quality - Presentation by Paulk [59]

82-96% of organisations were at Level 1, 3-17% at Level 2 and 1% at Level 3 in 1993 using CMM and Bootstrap in Europe, USA and Japan. [59]

Laitinen and Fayad [47] agree with this and feel that measuring processes is an excellent measure of management itself. They see the controlling of processes as a good way of establishing whether individuals are perform outstandingly, or just as a result of statistical variation. Contrary to individual argument they feel that more processes means greater creativity, since *people are not expected to turn screws with their fingers but with screwdrivers, it is unreasonable to expect people to do detailed, complex work without tools such as processes.* They speak of Deming's [10] *tampering*,

which is destructive, as opposed to *adjustment*, when making changes without adequate measurement.

4.5 Disadvantages

Zahran [65] mentions that it is possible to produce a quality product with a low capability level, but a low probability. Bach [3] feels that with heroes, anything is possible and that process is a behaviour, and cannot be separated from the person. Bach sees the three P's as being people, problem and process, rather than process, product and project. Bach is inclined to support heroes - *someone who takes initiative to solve ambiguous problems.*

No studies have been done on the specific relationships of the SPICE processes on each other. There are many software engineering sources which refer to best practices and provide a general idea of possible influences. Most notably, improvements in reviews and testing are believed to have a positive impact on a number of processes.

4.6 Case studies

Success stories mainly involve the usage of CMM, Trillium and Bootstrap [65], as SPICE has not been available for use for a long time

5. Process, product, project measurement and assessment

About every ten years, give or take five, the software community redefines "the problem" by shifting its focus from product issues to process issues... While the natural tendency of a pendulum is to come to a rest midway between two extremes, the software community's focus constantly shifts because new force is applied when the last swing fails... The swings also do not solve "the problem" for they are doomed to fail as long as product and process are treated as forming a dichotomy instead of a duality - Margaret Davis [53]

5.1 Complementary

As stated by Pfleeger and Rombach[51], the two techniques (PEP and SPICE) should be able to complement each other, as *measurement helps you draw an objective process model, while application of improvement techniques improves your ability to measure quality, by confirming improvements in process and product, albeit in small increments. The organization will normally use a mixture of effectiveness measures and capability levels to set targets for improvement. Capability levels will indicate the most promising improvement areas according to the distance between the organization's practices and the baseline; on the other hand, effectiveness measures of*

the processes will provide information about the efficacy of the organization's processes compared to the needs [39]

5.2 Collaboration

The organisers of the second international software metrics symposium [52] state that the most successful measurement occurs when researcher, practitioner and customers collaborate.

5.2.1 Additional measures

It is noteworthy that although 'Measures' is a work product of a number of different processes, it appears for the first time at capability level 4. This does not necessarily suggest that an OU which achieves Level 4 is the only one that should have this work product, but possibly that at this level, it is most effectively used. Also, the work product 'Measures' can include any of the following: Project measures, Process measures, Quality measures, Field measures, Service level measures, Risk measures and Staff performance measures.

IFPUG's view (Figure 6) is that measurement is the commonality among several disciplines.

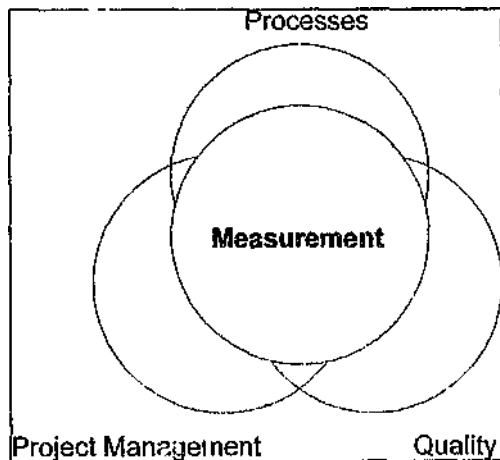


Figure 6: Relationship between measurement and other disciplines [25]

This indicates an intersection between process, project and quality (product) measures. Product quality measures were not included as part of this research. However, based on the SPICE assessment, they were often missing from requirements definition. This may be an indication that a fundamental metric is not being formally considered within the current processes. Quality measures are an important part of measurement and do not replace process measures. [46,1,65]

Abran considers that product and process measures provided the input for the feedback loop of total quality management. [1]

Voas [63] argues that neither process nor product oriented improvements can guarantee a quality product. A problem with a perfect process is that it is still used by imperfect humans and supported by imperfect technologies (although this should theoretically be impossible, since a perfect process should have included the humans by improving its HR process and the technology by improving the SE infrastructure). The intractability of product testing to perfection is highlighted. Voas also outlines the popular use of many metrics, which measure structural(static) properties and the fact that structural metrics cannot capture software's dynamic behaviour. Voas cites David Parnas 'It seems clear to me that not only is a 'mature' process not sufficient, it may not even be necessary.'

5.2.2 Complete process assessment

IFPUG[25] argues that: *The levels of maturity are additive. The levels also provide one path for achieving an environment where continual process improvement is achievable. Measurement is an integral component of the CMM, starting at the Repeatable level...Where the SEI process falls short is that it provides no quantitative measurement of the resulting assessment. We assume that if we move up the SEI maturity scale, we will increase our levels of productivity and quality: but without quantitative measures, we really never know for certain. The dynamic software assessment model, which includes a quantitative component, allows us to maximize our efforts by concentrating our resources on those elements of the process that are quantified as weaknesses.* [15]

Garnus and Herron have a 'Complete Process Assessment Model' (Figure 7) which includes both measures represented above, but some which are not fully included.

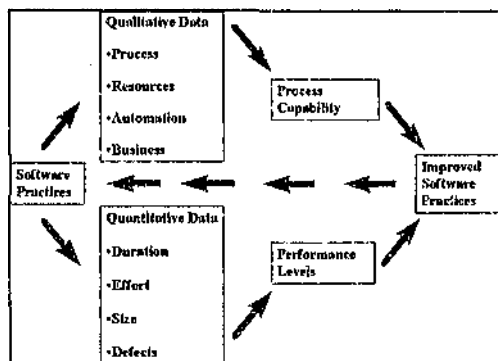


Figure 7: Garmus and Herron Complete Process Model [15]

According to the guidance provided in ISO/IEC 15504-7 (Figure 8), PEP could be seen as fulfilling the role of the 'Industry norms and benchmarks', with a SPICE assessment falling into the process assessment request.

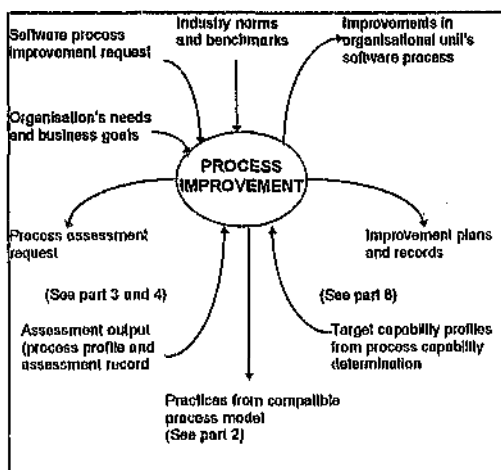


Figure 8 Process improvement context [39]

5.2.3 Measurement maturity

Comer and Chard [5] suggest a measurement maturity model after comparison with Trillium and CMM, since they feel that the capability dimension can be misleading and irrelevant. However, movement up the maturity scale will not mean that less things are measured. They do make some valid points which could be incorporated into the current base practices of ISO/IEC 15504 Measurement process.

Gulezian [20] mentions a measurement-based maturity model which moves through the levels Defined (1),

Measured (2), Controlled (3), Capable (4) and Improved (5). The elementary problem may be related to the lack of organisational unit wide process definition - which results in the measurement of a chaotic process. This may indicate the need for beginning with maturing the 'Define the process' Organisational process, before considering the others. Perhaps the Organisational process supporting infrastructure has to be in place before any meaningful improvements can be made. Process definition could be based on ISO/IEC 12207 or ISO/IEC 15288. [31,32] It is also important to note that 'Define the process' should not be defined alone, but also 'Improve the process', otherwise other problems can result.

Gulezian [20] also discusses the Rome Laboratory Software Framework which is a measurement based approach for software quality improvement relating to developmental subprocesses and intermediate and final products of the development process. Gulezian believes that statistical control needs to be introduced early in the process. Rosenberg and Sheppard [58] report success of using measurement-based process improvement at NASA, however their concept of process is limited to application of resource hours, while product focuses on size, complexity and readability of code.

Johnson and Brodman [42] mentioned an interesting measure on the number of metrics collected at each level:

- Level 1 average of 11 metrics
- Level 2 average of 19 metrics
- Level 3 average of 22 metrics
- Level 4 average of 26 metrics
- Level 5 average of 31 metrics

Johnson and Brodman's study showed that a Level 1 organisation did not calculate productivity, focus on process, track costs, schedule variances, requirements changes, or defects - only tracked coding and testing progress. This would agree with the assessment findings, since the PEP measures force a project to measure all of the above - unfortunately this is in retrospect, and often inaccurate.

5.2.4 Process and measurement relationship

Konrad [46] states that these lower level relationships are difficult to determine and purposeless, since experimentation mechanisms in terms of a control sample would be difficult. This can be attributed to the fact that capability Level 1 organisations are dependent

on the individual's performance on a project and for a statistical experiment a large sample would be required.

This is also supported by IFPUG [25] which specifies *One important aspect of higher organizational maturity is the increase in the level of detail, or granularity, of information. At low levels of maturity, information requirements are relatively low and the objects being measured are large, such as project phase. As the organization matures, the detail of information required becomes finer, such as activity, task, or deliverable.*

5.2.5 Process and measurement improvement

Reiblein and Symons [57] recommend a means of weighting business gains and prioritising improvements.

5.3 Advances

5.3.1 Complete process measurement

Also, Figure 9 represents a software process measurement framework standard being developed by ISO/IEC JTC1/SC7 WG13 to address information needs for project management, product engineering and process improvement, but exclude product quality measures. [41]

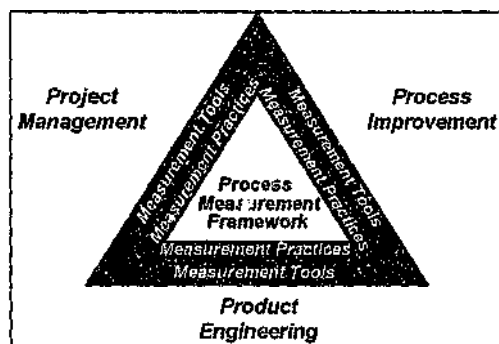


Figure 9 Software Process Measurement Applications [41]

5.4 Case studies

5.4.1 Siemens

Paulish and Carleton [50] examined case studies in Siemens business units using measures where the first grouping is based on SEI-recommended core measures. These are primary data (defects, product size, effort, estimate and actual schedule duration time), environmental data (staff size, staff turnover, maturity level, morale). Derived from these are organisational performance measures (defect detection distribution, defect rate, project productivity, schedule cycle time and

schedule adherence). Interestingly, many of these measures are similar to the ones collected as input into PEP and provided as output in the report, but the unit of product size measurement is function points rather than LOC. They also suggest some critical success factors for software process improvement.

5.4.2 Complete process measurement

Gasston and Rout [16] assessed software process effectiveness of a configuration management process using a defined set of metrics for each level and under the categories Economic, Human and Managerial factors. They developed the model in Figure 10.

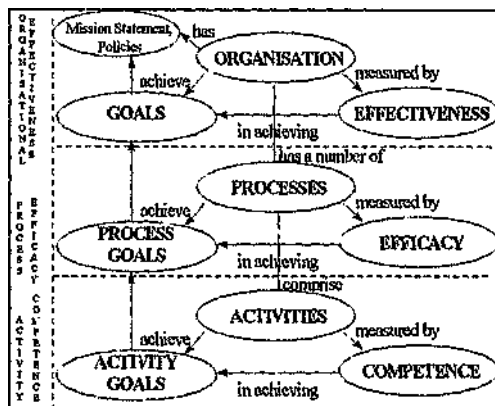


Figure 10 Hierarchical conceptual model for assessment of process effectiveness within organisations [16]

Gasston [17] expands on this, adding STMT (Statements, Tools, Methods, Technologies) below. She goes on to discuss re-engineering/revolution as opposed to evolution and suggests a Process/Product Quality Model (Figure 11). In the model the evaluation of product model uses SPICE, the product profile consists of the product quality attributes identification, the software product quality evaluation consists of Dromey's product quality framework [12] and the process effectiveness evaluation covers a large number of areas. PEP covers the economic factors - the extent of coverage of the other measures is uncertain.

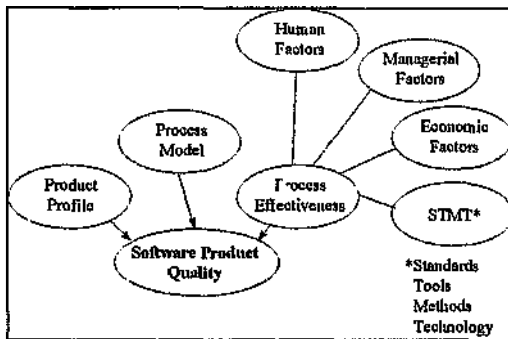


Figure 11 Process/Product Model [17]

6. Discussion

This study covers a number of theories concerning functional size measures (specifically Albrecht function points); performance measures (specifically PEP); software process assessment (specifically ISO/IEC 15504) and the relationship between the three.

7. Reference

- [1] Abran A., *Quality - The Intersection of Product and Process*, Second IEEE International Software Engineering Standards Symposium, p 206, August 21-25, 1995.
- [2] Albrecht A.J., *Measuring Application Development Productivity*, Proceedings of the Application Development Symposium 1979, GUIDE International Inc., SHARE Inc., International Business Machines Corporation, Monterey, CA, pp 83-92.
- [3] Bach, J.T., *Enough about process: What we need are heroes*, IEEE Software, Vol. 12 No. 2, March 1995, pp 96-98.
- [4] Brooks F.P., *Mythical Man Month*, Addison-Wesley Publishing Company, Reading, Mass., ISBN 0-201-83595-9, 1995.
- [5] Comer P. and Chard J., *A Measurement Maturity Model*, Software Quality Journal, Vol. 2, Issue 4, 1993, pp 277-289.
- [6] Craigmyle M. and Fletcher I., *Improving IT effectiveness through software process assessment*, Software Quality Journal, Vol. 2, Issue 4, 1993, pp 257-264.
- [7] CSC Index Research Advisory Services, Peter Hill, 12 Bloomsbury Square, London, WC1A 2LL.
- [8] Curtis B. and Carleton A., *Seven + Two Measurement Conundrums*, Second IEEE International Software Engineering Standards Symposium, pp 96-105, August 21-25, 1995.
- [9] Dekkers C.A., *Outsourcing and Function Point Based Measurement: Mistakes and Recommendations*, The Voice, 1997.
- [10] Deming W.E., *Out of the Crisis*, Cambridge, MIT Centre for Advanced Engineering Study, 1986.
- [11] Dreger J.B., *Function Point Analysis*, Prentice-Hall, Englewood Cliffs, NJ, ISBN 0-13-332321-8, 1989.
- [12] Dromey R., *Cornering the chimera*, IEEE Software, Vol. 13 No. 1, January 1996, pp 33-43.
- [13] El Enam K. and Madhavji N.H., *Does organisational maturity improve quality*, IEEE Software, Vol. 13 No. 5, September 1996, pp 109-110.
- [14] Furey S., *Why we should use function points*, IEEE Software, Vol. 14 No. 2, March/April 1997, pp 28-30.
- [15] Garmus D. and Herron D., *Measuring the Software Process*, Prentice Hall, Upper Saddle River, NJ, ISBN 0-13-349002-5, 1996.
- [16] Gasston J.L. and Rout T.P., *Can the effectiveness of software processes be assessed?*, Software Quality Journal, Vol. 3, Issue 3, 1994, pp 153-166.
- [17] Gasston J.L., *Process improvement: an alternative to BPR for software development organizations*, Software Quality Journal, Vol. 5, Issue 3, 1996, pp 171-183.
- [18] Grady R., *Practical Software Metrics for Project Management and Process Improvement*, Prentice Hall, Englewood Cliffs, N.J., ISBN 0-13-720384-5, 1992.
- [19] Grady R. and Caswell D., *Software Metrics: Establishing a Company-Wide Program*, Prentice-Hall, Englewood Cliffs, N.J., ISBN 0-13-821844-7, 1987.
- [20] Gulezian R., *Software Quality Measurement and Modelling, Maturity, Control and Improvement*, Second IEEE International Software Engineering Standards Symposium, pp 52-59, August 21-25, 1995.
- [21] Humphrey W., *Managing the Software Process*, Addison-Wesley Publishing Company, Reading, Mass., ISBN 0-201-18095-2, 1990.
- [22] IFPUG, Blendonview Office Park, 5008-28 Pine Creek Drive, Westerville, OH 43081-5899.
- [23] IFPUG, *Function Points as Assets - Reporting to Management*, 1992.
- [24] IFPUG, *IFPUG Counting Practices Manual v4.0*, January 1994.
- [25] IFPUG, *IFPUG Guidelines to Software Measurement*, Release 1.1, August 1994.

- [26] ISO/IEC 14143-1. *Information technology - Software measurement - Functional size measurement - Part 1: Definition of concepts*, IS, November 1997.
- [27] ISO/IEC 14143-2. *Information technology - Software measurement - Functional size measurement - Part 2: Compliance assessment of software size measurement methods to ISO/IEC 14143-1:1998*, CD Version 0.36, May 1998.
- [28] ISO/IEC 14143-3. *Information technology - Software measurement - Functional size measurement - Part 3: Verification of functional size measurement methods*, WD Version 22, June 1998.
- [29] ISO/IEC 14143-4. *Information technology - Software measurement - Functional size measurement - Reference Model*, PDTR Version 13, May 1998.
- [30] ISO/IEC 14143-5. *Information technology - Software measurement - Functional size measurement - Determination of Functional Domains for Use with Functional Size Measurement*, PDTR Version 17, June 1998.
- [31] ISO 12207. *Information Technology - Software Life-Cycle Processes*, 1995.
- [32] ISO/IEC 15288. *Information Technology - System Life Cycle Processes*, WD, May 1998.
- [33] ISO/IEC 15504-1. *Software Process assessment Part 1: Concepts and introductory guide*, PDTR, October 1996.
- [34] ISO/IEC 15504-2. *Software Process Assessment Part 2: A Reference Model For Processes And Process Capability*, PDTR, October 1996.
- [35] ISO/IEC 15504-3. *Software Process Assessment: Part 3 : Performing an assessment*, PDTR, October 1996.
- [36] ISO/IEC 15504-4. *Software Process Assessment: Part 4 : Guide to performing assessments*, PDTR, October 1996.
- [37] ISO/IEC 15504-5. *Software Process Assessment: Part 5. An assessment model and indicator guidance*, PDTR, October 1996.
- [38] ISO/IEC 15504-6. *Software Process Assessment: Part 6. Guide To Qualification Of Assessors*, PDTR, October 1996.
- [39] ISO/IEC 15504-7. *Information Technology - Software Process Assessment Part 7: Guide for use in process improvement*, PDTR, October 1996.
- [40] ISO/IEC 15504-9. *Information Technology - Software Process Assessment Part 9: Vocabulary*, PDTR, October 1996.
- [41] ISO/IEC JTC1/SC7. *Information Technology - Software Life Cycle Processes Definition and Application of a Software Process Measurement Framework*, Proposed Draft Technical Report, 30 April 1996.
- [42] Johnson D.L. and Brodman J.G., *Realities and Rewards of Software Process Improvement*, IEEE Software, Vol. 13 No. 6, November 1996, pp 99-101.
- [43] Jones T.C., *Applied Software Measurement*, McGraw-Hill, New York, ISBN 0-07-032826-9, 1996.
- [44] Kemerer C.F., *Reliability of function points measurement: a field experiment*, Communications of the ACM, Vol. 36 No.2, 1993, pp 85-97.
- [45] Kitchenham B., *The Problem with Function Points*, IEEE Software, Vol. 14 No. 2, March/April 1997, pp 29-31.
- [46] Konrad M., *Quality Intersection between Process and Product*, Second IEEE International Software Engineering Standards Symposium, pp 202-203, August 21-25, 1995.
- [47] Laitinen M and Fayad M.E., *Surviving a process performance crash*, Communications of the ACM, Vol. 41 No 2, February 1998, pp 83-86.
- [48] Longstreet, D., *How are function points useful*, American Programmer, Vol. VIII, No. 12, December 1995.
- [49] Meyerson B., *Made to Measure*, Information Technology Review, Vol. 2 No.7, p 8, Computer Society of South Africa, August, 1995.
- [50] Paulish D.J. and Carleton A.D., *Case Studies of Software-Process-Improvement Measurement*, IEEE Computer, Vol. 27 No. 9, September 1994, pp 50-57.
- [51] Pfeleger S.L. and Rombach H.D., *Measurement based process improvement*, IEEE Software, Vol.11, Issue 4, July 1994, pp.8-11.
- [52] Pfeleger S.L., Jeffery R., Curtis B and Kitchenham B., *Status Report on Software Measurement*, IEEE Software, Vol. 14 No. 2, March/April 1997, pp 33-45.
- [53] Pressman R.S., *Software Process Perceptions*, IEEE Software, November 1996, pp 16-18.
- [54] QuantiMetrics and CSC Index Research and Advisory Services Performance Enhancement Programme, *Performance Baseline Charts & Tables for Systems Development for Eskom ITD*, September, 1996.
- [55] QuantiMetrics, Bram Meyerson, PO Box 37010, Birnam Park, 2015.

- [56] QuantiMetrics, *How we shape up*, Information Technology Review, Vol. 4 No 3, Computer Society of South Africa, April, 1997, pp 6-7.
- [57] Reiblein S and Symons S, *SPI: 'I can't get no satisfaction' - directing process improvement to meet business needs*, Software Quality Journal, Vol. 6, Issue 2, 1997, pp 89-98.
- [58] Rosenberg L.H. and Sheppard S.B., *Metrics in Software Process Assessment, Quality Assurance and Risk Assessment*, Second IEEE International Software Engineering Standards Symposium, pp 10-16, August 21-25, 1995.
- [59] SEAL, *SPICE Slides for local Trials Support*, SPAG00, Version 0.01.
- [60] SPICE, *Phase 2 Trials Interim Report*, Version 1.00, March 1998.
- [61] Stelzer D., Mellis W. and Herzwarro G., *A critical look at ISO 9000 for software quality management*, Software Quality Journal, Vol. 6, Issue 2, pp 65-79.
- [62] Symons C., *Function Point Analysis: Difficulties and Improvements*, IEEE Transactions on Software Engineering, Vol. 14 No. 1, January, 1988, pp 2-11.
- [63] Voas J., *Can clean pipes produce dirty water?*, IEEE Software, Vol. 14 No. 4, July/August 1997, pp 93-94.
- [64] Weinberg, G.M., *Quality Software Management Volume 2 - First Order Measurement*, Dorset House Publishing, New York, ISBN 0-932633-24-2, 1993.
- [65] Zahran S., *Software Process Improvement - Practical Guidelines for Business Success*, Addison-Wesley, Reading, Mass., ISBN 0-201-17782-X, 1997.

■

References and Bibliography

T Lang

Information Technology Department, Eskom, South Africa

Summary: A numbered list of papers and useful references in the project.

1. Introduction

This document lists papers from journals, conference proceedings, newsletters, presentations, course notes, books, communications, websites, professional societies, addresses and mailing lists of particular interest.

2. References

The following have been used to compile the papers from this study:

- [1] Abran A., *Quality - The Intersection of Product and Process*, Second IEEE International Software Engineering Standards Symposium, p 206, August 21-25, 1995.
- [2] Albrecht A.J., *Measuring Application Development Productivity*, Proceedings of the Application Development Symposium 1979, GUIDE International Inc., SHARE Inc., International Business Machines Corporation, Monterey, CA, pp 83-92.
- [3] Bach, J.T., *Enough about process: What we need are heroes*, IEEE Software, Vol. 12 No. 2, March 1995, pp 96-98.
- [4] Boehm B., *Anchoring the software process*, IEEE Software, Vol. 13 No.4, July 1996, pp 73-82.
- [5] Brooks F.P., *Mythical Man Month*, Addison-Wesley Publishing Company, Reading, Mass., ISBN 0-201-83595-9, 1995
- [6] Comer P. and Chard J., *A Measurement Maturity Model*, Software Quality Journal, Vol. 2, Issue 4, 1993, pp 277-289.
- [7] Craigmyle M. and Fletcher I., *Improving IT effectiveness through software process assessment*, Software Quality Journal, Vol. 2, Issue 4, 1993, pp 257-264.
- [8] CSC Index Research Advisory Services, Peter Hill, 12 Bloomsbury Square, London, WC1A 2LL.
- [9] Curtis B. and Carleton A., *Seven +/- Two Measurement Conundrums*, Second IEEE International Software Engineering Standards Symposium, pp 96-105, August 21-25, 1995.
- [10] Davis A., *Between Scylla and Charybdis*, IEEE Software, Vol. 14 No. 5, September/October 1997, pp 4-6.
- [11] Dekkers C.A., *Outsourcing and Function Point Based Measurement: Mistakes and Recommendations*, The Voice, 1997.
- [12] Deming W.E., *Out of the Crisis*, Cambridge, MIT Centre for Advanced Engineering Study, 1986.
- [13] Dreger J.B., *Function Point Analysis*, Prentice-Hall, Englewood Cliffs, NJ, ISBN 0-13-332321-8, 1989.
- [14] Dromey R., *Cornering the chimera*, IEEE Software, Vol. 13 No. 1, January 1996, pp 33-43.
- [15] El Emam K. and Madhavji N.H., *Does organisational maturity improve quality*, IEEE Software, Vol. 13 No. 5, September 1996, pp 109-110.
- [16] Function Point Workbench v3.01, CHARISMATEK Software Metrics, 175 Dorcas St, South Melbourne VIC, Australia, 3205
- [17] Furey S., *Why we should use function points*, IEEE Software, Vol. 14 No. 2, March/April 1997, pp 28-30.
- [18] Garbajosa-Sopena J., *Quality Intersection between Process and Product*, Second IEEE International Software Engineering Standards Symposium, pp 204-205, August 21-25, 1995.
- [19] Garmus D. and Herron D., *Measuring the Software Process*, Prentice Hall, Upper Saddle River, NJ, ISBN 0-13-349002-5, 1996.
- [20] Gasston J.L. and Rout T.P., *Can the effectiveness of software processes be assessed?*, Software Quality Journal, Vol. 3, Issue 3, 1994, pp 153-166.
- [21] Gasston J.L., *Process improvement: an alternative to BPR for software development organizations*, Software Quality Journal, Vol. 5, Issue 3, 1996, pp 171-183.
- [22] Grady R., *Practical Software Metrics for Project Management and Process Improvement*, Prentice-Hall, Englewood Cliffs, N.J., ISBN 0-13-720384-5, 1992.
- [23] Grady R. and Caswell D., *Software Metrics: Establishing a Company-Wide Program*, Prentice-Hall, Englewood Cliffs, N.J., ISBN 0-13-821844-7, 1987.
- [24] Gulezian R., *Software Quality Measurement and Modelling, Maturity, Control and Improvement*, Second IEEE International Software Engineering

References and Bibliography

- Standards Symposium, pp 52-59, August 21-25, 1995.
- [25] Humphrey W., *Managing the Software Process*, Addison-Wesley Publishing Company, Reading, Mass., ISBN 0-201-18095-2, 1990.
- [26] IFPUG, Blendonview Office Park, 3008-28 Pine Creek Drive, Westerville, OH 43081-5899.
- [27] IFPUG, *Function Points as Assets - Reporting to Management*, 1992.
- [28] IFPUG, *IFPUG Counting Practices Manual v4.0*, January 1994.
- [29] IFPUG, *IFPUG Guidelines to Software Measurement*, Release 1.1, August 1994.
- [30] ISO 12207, *Information Technology - Software Life-Cycle Processes*, 1995.
- [31] ISO/IEC 14143-1. *Information technology - Software measurement - Functional size measurement - Part 1: Definition of concepts*, IS, November 1997.
- [32] ISO/IEC 14143-2. *Information technology - Software measurement - Functional size measurement - Part 2: Compliance assessment of software size measurement methods to ISO/IEC 14143-1:1998*, CD Version 0.36, May 1998.
- [33] ISO/IEC 14143-3. *Information technology - Software measurement - Functional size measurement - Part 3: Verification of functional size measurement methods*, WD Version 22, June 1998.
- [34] ISO/IEC 14143-4. *Information technology - Software measurement - Functional size measurement - Reference Model*, PDTR Version 13, May 1998.
- [35] ISO/IEC 14143-5. *Information technology - Software measurement - Functional size measurement - Determination of Functional Domains for Use with Functional Size Measurement*, PDTR Version 17, June 1998.
- [36] ISO/IEC 15288: *Information Technology - System Life Cycle Processes*, WD, May 1998.
- [37] ISO/IEC 15504-1. *Software Process assessment - Part 1: Concepts and introductory guide*, PDTR, October 1996.
- [38] ISO/IEC 15504-2. *Software Process Assessment Part 2: A Reference Model For Processes And Process Capability*, PDTR, October 1996.
- [39] ISO/IEC 15504-3. *Software Process Assessment: Part 3 : Performing an assessment*, PDTR, October 1996.
- [40] ISO/IEC 15504-4. *Software Process Assessment: Part 4 : Guide to performing assessments*, PDTR, October 1996.
- [41] ISO/IEC 15504-5. *Software Process Assessment: Part 5. An assessment model and indicator guidance*, PDTR, October 1996.
- [42] ISO/IEC 15504-6. *Software Process Assessment: Part 6. Guide To Qualification Of Assessors*, PDTR, October 1996.
- [43] ISO/IEC 15504-7: *Information Technology - Software Process Assessment Part 7: Guide for use in process improvement*, PDTR, October 1996.
- [44] ISO/IEC 15504-9: *Information Technology - Software Process Assessment Part 9: Vocabulary*, PDTR, October 1996.
- [45] ISO/IEC JTC1/SC7, *Information Technology - Software Life Cycle Processes Definition and Application of a Software Process Measurement Framework*, Proposed Draft Technical Report, 30 April 1996.
- [46] Johnson D.L. and Brodman J.G., *Realities and Rewards of Software Process Improvement*, IEEE Software, Vol. 13 No. 6, November 1996, pp 99-101.
- [47] Jones T.C., *Applied Software Measurement*, McGraw-Hill, New York, ISBN 0-07-032826-9, 1996.
- [48] Kemerer C.F., *Reliability of function points measurement: a field experiment*, Communications of the ACM, Vol. 36 No.2, 1993, pp 85-97.
- [49] Kennedy I.G., *How to do Research* hypertext course, PO Box 32320 Glenstantia 0010 South Africa, 1995.
- [50] Kitchenham B., *The Problem with Function Points*, IEEE Software, Vol. 14 No. 2, March/April 1997, pp 29-31.
- [51] Konrad M., *Quality Intersection between Process and Product*, Second IEEE International Software Engineering Standards Symposium, pp 202-203, August 21-25, 1995.
- [52] Laitinen M and Fayad M.E., *Surviving a process performance crash*, Communications of the ACM, Vol. 41 No 2, February 1998, pp 83-86.
- [53] Longstreet, D., *How are function points useful*, American Programmer, Vol. VIII, No. 12, December 1993.
- [54] Meyerson B., *Made to Measure*, Information Technology Review, Vol 2 No.7, Pg 8, Computer Society of South Africa, August, 1995.

References and Bibliography

- [55] Paulish D.J. and Carleton A.D., *Case Studies of Software-Process-Improvement Measurement*, IEEE Computer, Vol. 27 No. 9, September 1994, pp 50-57.
- [56] Pfleeger S.L. and Rombach H.D., *Measurement based process improvement*, IEEE Software, Vol. 11, Issue 4, July 1994, pp.8-11.
- [57] Pfleeger S.L., Jeffery R., Curtis B and Kitchenham B., *Status Report on Software Measurement*, IEEE Software, Vol. 14 No. 1, March/April 1997, pp 33-43.
- [58] Pressman R.S., *Software Process Perceptions*, IEEE Software, November 1996, pp 16-18.
- [59] Quantimetrix and CSC Index Research and Advisory Services Performance Enhancement Programme, *Performance Baseline Charts & Tables for Systems Development for Eskom LTD*, September, 1996.
- [60] Quantimetrix, Bram Meyerson, PO Box 37010, Birnam Park, 2015.
- [61] Quantimetrix, *How we shape up*, Information Technology Review, Vol. 4 No 3, Computer Society of South Africa, April, 1997, pp 6-7.
- [62] Reiblein S and Symons S, *SPI: 'I can't get no satisfaction' - directing process improvement to meet business needs*, Software Quality Journal, Vol. 6, Issue 2, 1997, pp 89-98.
- [63] Rosenberg L.H. and Sheppard S.B., *Metrics in Software Process Assessment, Quality Assurance and Risk Assessment*, Second IEEE International Software Engineering Standards Symposium, pp 10-16, August 21-25, 1995.
- [64] SEAL process assessment tool, URL http://www.seal.ac.za/1995_45/soq910.htm
- [65] SEAL, Communication with Bram Meyerson, MLA1043.
- [66] SEAL, Communication with Chris Dale, MLA1022-5.
- [67] SEAL, Communication with Mary Fisher, MLA 1026-7.
- [68] SEAL, FPA vs SPICE Comparison, , MLA 352, Revision 1.00.
- [69] SEAL, *Function Point Count for project A*, MLA310, Revision 1.00.
- [70] SEAL, *Function Point Count for project B*, MLA320, Revision 1.00.
- [71] SEAL, *Function Point Count for project C*, MLA330, Revision 1.00.
- [72] SEAL, *Function Point Count for project D*, MLA340, Revision 1.00.
- [73] SEAL, *PEP Profile for project A*, MLA 312 Revision 1.00.
- [74] SEAL, *PEP Profile for project B*, MLA 322 Revision 1.00.
- [75] SEAL, *PEP Profile for project C*, MLA 332 Revision 1.00.
- [76] SEAL, *PEP Profile for project D*, MLA 342 Revision 1.00.
- [77] SEAL, SEAL QMS procedures and tools, Department of Electrical Engineering, University of the Witwatersrand, PO WITS, 2050, Johannesburg, South Africa.
- [78] SEAL, Software Quality and ISO 9000: Concepts course, 96-04.
- [79] SEAL, Software Quality and ISO 9000: Documentation course, 96-05.
- [80] SEAL, Software Quality: Practices course, 96-03.
- [81] SEAL, Software Quality: Principles course, 96-02.
- [82] SEAL, *SPICE Assessment Feedback Summary*, MLA 348, Version 1.00.
- [83] SEAL, SPICE Practices course, 96-09.
- [84] SEAL, SPICE Principles course, 96-08.
- [85] SEAL, *SPICE Slides for local Trials Support*, SPA600, Version 0.01.
- [86] Software Engineering Institute, Carnegie Mellon University, Pittsburgh, PA, USA.
- [87] SPICE, *Phase 2 Trials Interim Report*, Version 1.00, March 1998.
- [88] Stelzer D., Mellis W. and Herzwurm G., *A critical look at ISO 9000 for software quality management*, Software Quality Journal, Vol. 6, Issue 2, 1997, pp 65-79.
- [89] Symons C., *Function Point Analysis: Difficulties and Improvements*, IEEE Transactions on Software Engineering, Vol. 14 No. 1, January, 1988, pp 2-11.
- [90] Voas J., *Can clean pipes produce dirty water?*, IEEE Software, Vol. 14 No. 4, July/August 1997, pp 93-94.
- [91] Weinberg, G.M., *Quality Software Management Volume 2 - First Order Measurement*, Dorset House Publishing, New York, ISBN 0-932633-24-2, 1993.
- [92] Zahran S., *Software Process Improvement - Practical Guidelines for Business Success*, Addison-Wesley, Reading, Mass., ISBN 0-201-17782-X, 1997.

3. Bibliography

The following have been used during this study:

- [1] Abran A. and Robillard P.N., *Function Point Analysis: An Empirical Study of Its Measurement Processes*, IEEE Transactions on Software Engineering, Vol. 22, No. 12, December 1996, pp 895-909.
- [2] ACM website, <http://www.acm.org>.
- [3] Behrens C.A., *Measuring the Productivity of Computer Systems Development Activities with Function Points*, IEEE Transactions on Software Engineering, Vol. SE-9, No. 6, November 1983, pp 648-652.
- [4] Boehm R., *Function Point FAQ*, <http://ourworld.compuserve.com/homepages/sofco/mp/fpfaq.htm>.
- [5] Charismatek website, <http://www.charismatek.com.au>.
- [6] Comp.software-eng newsgroup, Usenet.
- [7] CSC website, http://www.csc.com/80/about/tech_software.html.
- [8] The David Consulting Group website, <http://www.davidconsultinggroup.com>.
- [9] Drummond S., *Measuring Applications Development Performance*, Datamation, pp 103-108.
- [10] ESI website, <http://www.esi.es>.
- [11] Function Point Mailing List, cim@spice.crim.ca.
- [12] IEEE homepage, <http://www.ieee.org>.
- [13] IEEE Software, <http://www.computer.org>.
- [14] IFPUG website, <http://www.ifpug.org>.
- [15] ISBSG website, <http://www.isbsg.org.au>.
- [16] ISO website, <http://www.iso.ch/welcome.html>.
- [17] Longstreet Consulting website, <http://www.SoftwareMetrics.com>.
- [18] Low G.C. and Jeffery D.R., *Function Points in the Estimation and Evaluation of the Software Process*, IEEE Transactions on Software Engineering, Vol. SE-16, No. 1, January 1990, pp 64-71.
- [19] SAICSIT website, <http://www.cs.unp.ac.za/saicsit>.
- [20] SEI website, <http://www.sei.cmu.edu>.
- [21] Software Engineering Management Research Laboratory website, <http://saturne.info.uqam.ca>.
- [22] Software Productivity Research website, <http://www.spr.com>.

[23] SPICE User Group (SUGaR) website, <http://www.iese.fhg.de/SPICE/>.

[24] SPICE website, <http://www-sqi.cit.gu.edu.au/spice/>.

[25] Trillium website, <http://ricis.ci.uh.edu/trillium/>.

[26] The Voice, IFPUG.

The following have been available during this study:

- [1] Albrecht A.J. and Gaffney J.E., *Software Function, Source Lines of Code and Development Effort Prediction: A Software Science Validation*, IEEE Transactions on Software Engineering, Vol. SE-9, No. 6, Nov. 1983, pp 639-648.
- [2] Albrecht A.J., *Art and Science of Estimating*, GUIDE 57, New Orleans, LA, Session No. DP-7234A, 10 November 1983.
- [3] Albrecht A.J., *Measuring Information Processing*, Guide 63, Dallas, Texas, 20 November 1985.
- [4] Albrecht A.J., *Function Points and Measuring Installed Application Support*, Guide 63, Dallas, Texas, Session No. MP-7431, 21 November 1985.
- [5] IEEE Computer Society, *IEEE Standard for Software Productivity Metrics* 1045, 1992.
- [6] IFPUG, *Case Study 1 (ANALYSIS - ERD, Process Hierarchical Model; CONSTRUCTION - DB2 Data Base, Graphical User Interface (GUI) Windows)*, Release 1.0, 1994.
- [7] IFPUG, *Case Study 2 (ANALYSIS - ERD, DFD; CONSTRUCTION - IMS Data Base, Text Base Screen Implementation)*, Release 1.0, 1994.
- [8] Jones T.C., *Measuring programming quality and productivity*, IBM Systems Journal, Vol. 27 No. 1, 1978, pp 39-63.
- [9] Jones T.C., *A Short History of Function Points and Feature Points*, <http://www.spr.com>.
- [10] Jones T.C., *The Role of Function Point Metrics in the 21st Century*, The Voice.
- [11] Kemerer C.F. and Porter B.S., *Improving the Reliability of Function Point Measurement: An Empirical Study*.
- [12] Somerville I., *Software Process Improvement - Practical Guidelines for Business Success*, Addison-Wesley, Reading, Mass., ISBN 0-201-17782-X, 1997.



MLA QMS

Master Document List

Management Product

Version 1.05

Document Status: Approved

Change History.

Configuration Control

Project:	MLA QMS
Title:	Master Document List
Doc. Reference:	C:\MY DOCUMENTS\1996_24\MP\MLA001.105
Created by:	Melanie Lang
Creation Date:	3 May 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	96\04\09	Draft	MT Lang	MLA001.001
1.00	96\05\08	Approved	MT Lang	MLA001.100
1.01	96\10\28	Approved	MT Lang	MLA001.101
1.02	97\01\17	Approved	MT Lang	MLA001.102
1.03	97\03\25	Approved	MT Lang	MLA001.103
1.04	97\05\05	Approved	MT Lang	MLA001.104
1.05	97\05\21	Approved	MT Lang	MLA001.105

Revision History

Version	Date	Changes
0.01	96\04\09	New document created using QST00110.102
0.01	96\04\22	Updated 001, 004, 006, 008, 010, 011. Added 002, 005, 300, 1000, 1001, 1002, 2003, 2004 and 4001.
1.00	96\05\08	Updated 001, 004, 005, 006, 008 and 300. Added 005-10, 009, 009-10, 2005, 2006 and 4002.
1.00	96\06\06	Updated 001, 002, 004, 005, 005-10, 009 and 009-10. Added 2007.
1.00	96\06\07	Updated 001, 002, 004, 005, 006, 300. Added 120, 2008 and 4003.
1.00	96\07\23	Updated 001, 002, 004, 005, 005-10, 006, 300, 1000, 1002 - 1015 and 2000 - 2008. Added 003, 100, 110, 130, 140, 2009, 2010, 3000 and 4004.
1.00	96\08\01	Added 1016

1.01	96\10\26	Updated 001, 004, 005, 005-10, 100, 110, 130, 140. Added 120, 301, 302, 2011, 2012 and 4005
1.02	97\01\17	Updated 001, 002, 003, 004, 005, 006, 110, 120, 300, 301, 302, 1000, 1001, 1002. Added 2013, 2014 and 4006. Modifications with accordance to departmental restructuring.
1.03	97\03\25	Updated 001, 002, 003, 004, 005, 005-10, 006, 009, 100, 110, 120, 300, 301, 302. Added 121, 131, 303, 304, 305, 2015, 2016 and 4007.
1.04	97\05\05	Updated 001, 003, 005-10, 121, 301, 303, 304, 305. Added 122, 306, 307, 310, 312, 313, 314, 315, 316, 317, 320, 322, 323, 324, 325, 326, 327, 330, 332, 2017, 2018, 3001, 4008 and 9000.
1.05	97\05\21	Updated 001, 005-10, 122, 303, 304, 305, 306, 308, 313, 314, 315, 316, 320, 323, 324, 325, 2019 and 4009. Added 311.
1.05	97\05\25	Updated 001, 005-10, 306, 316.
1.05	97\05\27	Updated 001, 005-10, 306, 326.
1.05	97\05\28	Updated 001, 005-10, 303. Added 318, 328.
1.05	97\05\30	Updated 001, 005-10, 308.
1.05	97\06\01	Updated 001, 005-10, 316
1.05	97\06\09	Updated 001, 005-10, 326
1.05	97\06\10	Updated 001, 005-10, 316
1.05	97\06\12	Updated 001, 005-10, 307, 316, 326
1.05	97\06\13	Updated 001, 005-10, 326
1.05	97\06\23	Updated 001, 005-10, 009, 009-10, 306, 316, 326.
1.05	97\07\02	Updated 001, 005-10, 306, 316, 326.
1.05	97\07\03	Updated 001, 005-10, 316.
1.05	97\07\22	Updated 001, 005-10, 008, 122, 1000, 1002, 9000. Added 123, 2020, 3002 and 4010
1.05	97\09\11	Updated 001, 122, 123. Added 2021 and 2022
1.05	97\09\15	Updated 001, 316, 320, 326, 330. Added 340.
1.05	97\09\16	Updated 001, 301, 2022
1.05	97\09\19	Updated 001, 121, 122, 2022. Added 124
1.05	97\09\22	Updated 001, 005-10, 122, 306, 316, 326, 2022. Added 2023

1.05	97\09\23	Updated 001, 005-10, 122, 124, 310, 320, 330, 340, 2023.
1.05	97\09\24	Updated 001, 004, 005-10, 124, 312, 322, 332. Added 342.
1.05	97\09\25	Updated 001, 005-10, 124, 9000. Added 4011.
1.05	97\09\29	Updated 001, 005-10. Added 3003.
1.05	97\09\30	Updated 001, 005-10, 306, 311.
1.05	97\10\08	Updated 001, 005-10, 306, 316. Added 321.
1.05	97\10\12	Updated 001, 005-10, 316 and 326.
1.05	97\10\24	Updated 001, 005-10, 326, 9000. Added 125, 2024
1.05	97\11\02	Updated 001, 005-10, 009, 009-10, 125, 306, 311, 316, 321. Added 126, 2025 and 4012
1.05	97\12\08	Updated 001, 005-10, 125, 307, 317, 327, 9000. Added 337 and 2026.
1.05	97\12\22	Updated 001. Added 2027.
1.05	98\01\14	Updated 001, 005-10, 009-10.
1.05	98\01\19	Updated 001, 005-10, 009, 009-10. Added 3004.
1.05	98\04\05	Updated 001, 005-10, 326
1.05	98\04\21	Updated 001, 005-10, 326
1.05	98\04\23	Updated 001, 005-10, 326
1.05	98\04\27	Updated 001, 005-10, 326
1.05	98\05\04	Updated 001, 005-10. Added 350
1.05	98\05\05	Updated 001, 005-10. Added 308, 331, 341
1.05	98\05\06	Updated 001, 005-10, 308. Added 318, 328.
1.05	98\05\07	Updated 001, 005-10, 308, 318, 328. Added 309.
1.05	98\05\08	Updated 001, 005-10, 304, 308, 309, 318, 328. Added 319.
1.05	98\05\09	Updated 001, 005-10, 318, 319, 328. Added 329.
1.05	98\05\10	Updated 001, 005-10, 328, 329.
1.05	98\05\12	Updated 001, 005-10, 308, 309, 318, 319, 328, 329, 331, 341. Added 348, 349, 351, 352.
1.05	98\05\13	Updated 001, 005-10, 349, 352.
1.05	98\05\14	Updated 001, 005-10, 121, 308, 309, 318, 319, 328, 329, 348, 349, 352.
1.05	98\05\15	Updated 001, 005-10, 121, 352.
1.05	98\05\17	Updated 001, 005-10, 121.

1.05	98\05\18	Updated 001, 005-10, 019, 009-10, 9000.
1.05	98\06\03	Updated 001, 005-10, 353, 1000, 1001, 1002, 2028.
1.05	98\06\13	Updated 001, 005-10, 308, 318, 328, 348. Added 1019, 1020, 1021, 1022, 1023, 1024, 1025, 1026, 1027, 2029.
1.05	98\06\19	Updated 001, 005-10, 308, 318, 328, 348.
1.05	98\06\28	Updated 001, 005-10, 304, 309, 314, 319, 324, 329, 349.
1.05	98\06\29	Added 1028. Updated 001, 005-10, 009, 009-10, 121, 352, 9000.
1.05	98\07\13	Added 3005. Updated 001, 005-10, 120.
1.05	98\07\15	Updated 001, 005-10, 120.
1.05	98\07\19	Updated 001, 005-10, 100, 120.
1.05	98\07\20	Updated 001, 005-10, 120.
1.05	98\07\21	Updated 001, 005-10, 120.
1.05	98\07\22	Updated 001, 005-10, 120.
1.05	98\07\23	Updated 001, 005-10, 120.
1.05	98\07\24	Updated 001, 005-10, 120.
1.05	98\07\25	Updated 001, 005-10, 120.
1.05	98\07\26	Updated 001, 005-10, 120.
1.05	98\07\27	Updated 001, 005-10, 120.
1.05	98\07\28	Updated 001, 005-10, 120.
1.05	98\07\29	Added 1029, 1030, 1031. Updated 001, 005-10, 120.
1.05	98\07\30	Updated 001, 005-10, 120.
1.05	98\08\01	Added 150, 160. Updated 001, 005-10, 120, 130, 140.
1.05	98\08\02	Updated 001, 005-10, 120, 130, 140, 150, 160.
1.05	98\08\03	Updated 001, 005-10, 120, 130, 140, 160.
1.05	98\08\04	Updated 001, 005-10, 120, 130, 140, 160.
1.05	98\08\05	Updated 001, 005-10, 120.
1.05	98\08\06	Updated 001, 005-10, 120, 130, 140, 150, 160.
1.05	98\08\07	Added 2030, 2031. Updated 001, 005-10, 100, 110, 120, 140, 150, 160.
1.05	98\08\08	Updated 001, 005-10, 100, 120.
1.05	98\08\09	Added 1032, 1033, 1034, 1035, 1036, 1037, 1038, 1039. Updated 001, 005-10, 100, 120, 130, 140, 150, 160, 304, 308, 310, 312, 320.

1.05	98\08\10	Updated 001, 005-10, 120, 308, 314, 318, 321, 322, 324, 328, 330, 331, 332, 340, 341, 342, 348, 352.
1.05	98\08\11	Updated 001, 004, 005-10, 120, 130, 140, 150, 160, 352.
1.05	98\08\12	Updated 001, 005-10, 120, 130, 140, 150, 9000.
1.05	98\08\13	Updated 001, 005-10, 100, 120, 130, 140, 150, 160.
1.05	98\08\14	Updated 001, 005-10, 120, 130, 352, 1040, 1041, 1042.
1.05	98\08\15	Updated 001, 005-10, 130, 150.
1.05	98\08\16	Updated 001, 005-10, 008, 009, 009-10, 100, 120, 130, 140, 150, 160, 9000.
1.05	98\08\20	Updated 001, 005-10, 100, 120, 140, 160. Added 1043.
1.05	98\08\23	Updated 001, 005-10, 130..

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	96\05\05	Approved	MLA 2005 section 2.6

Change Forecast

This document will be updated each time a new documented element is added into the MLA QMS.

1 Scope

1.1 Introduction

An essential feature of a quality management system is that it documents the procedures used to implement and maintain the system. This document is the Document Master List which provides a directory of all documents which have the status of Draft, Provisional or Approved.

1.2 Purpose

This Document Master List provides the cross reference to all documents comprising the MLA QMS.

1.3 Applicability

This document is an essential reference to all documents supported in the MLA QMS.

1.4 Definitions

SPICE : Software Process Improvement and Capability dEtermination

FPA: Function Point Analysis

PEP: Performance Enhancement Program

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board
- Head of Department of Electrical Engineering

- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.

1.6 Applicable Documents

1.6.1 Standards

- a. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994.

1.7 Assumptions

It is assumed that the reader is familiar with the ISO 9000 series standard for quality systems management.

1.8 Requirements Traceability

This document addresses the following requirements:

- a) ISO 9001 (1994) 4.5 Document and Data Control
- b) ISO 9001 (1994) 4.16 Quality Records

1.9 Procedures

1.9.1 Entering data in the Summary Information File (Alt F1)

- a) Title: Enter the name of the document being created
- b) Subject: Enter the name of the project or abbreviate the name of the project QMS
- c) Author: The name of the person creating this file
- d) Keywords: The document code and serial number
- e) Comments: The document revision number.

1.9.2 Document Front Page

- a) Document project title: Instantiate from Summary Information File data (SIF) using left mouse button to select field, click on right mouse button to bring up menu, select 'update field' and click on that item. The field selected will then be automatically updated with the data in the SIF.

- b) Document title: Select field and instantiate from SIF.
- c) Management/Technical Product: Edit to read Technical or Management Product.
- d) Version: Select field and instantiate from SIF.
- e) Document Status: Edit to read Draft, provisional or approved.

1.9.3 Using the Configuration Control Table

All elements of the table are instantiated from the SIF.

1.9.4 Using the Document History Table

- a) Version: The revision number of the new document
- b) Date: The date on which the new revision was created.
- c) Status: The status of the created document
- d) Who: The author of the updated revision
- e) Saved as: the file name (only - no path) of the new document

1.9.5 Using Document Revision Table

- a) Version: The revision number of the current document
- b) Date: The date on which this revision was updated.
- c) Changes: A short description of the nature and location of the changes to the document

1.9.6 Entering details in Master Document List Table

The List is used as follows:

- a) Document Name: A descriptive name for the document
- b) Document Number: A unique serial number for the artefact
- c) Revision Date: The date on which the artefact was modified, or entered into the system, as appropriate.

- d) Document Status: For Management and Technical Products this will be Draft, Provisional or Approved. For records this field a '-' is entered since records are not subjected to revision.
- e) Date approved: This will be the date of the Management Review meeting.
- f) Minute reference: The date of the review meeting and the section of the minutes in which approval for the artefact was recorded.
- g) File reference: If the document is in electronic format, the full file path and document name is entered, starting from the SEAL project number as the root. If the document is available in hard copy format only, the term 'Hard copy' is entered.

1.9.7 Revision Control of this document

- a) When this document is created from QST 001-10 it is assigned a Revision of 0.01.
- b) Once it is approved by the appropriate authority it is raised to Rev 1.00
- c) After each internal audit the revision level is raised by a minor point i.e. following the first audit the revision number will be raised to 1.01. (This allows the MDL to be used to record the document baseline to be recorded immediately preceding the audit.)
- d) In a one-person project the Project Initiation Audit is used to raise the document to 1.00 status.
- e) For each revision change a new file is created.
- f) Between document revisions the Change Control element (Revision History) is used to record the changes to the entries in the List, typically in terms of documents (or records) added or updated. These changes will typically refer to new artefacts (records) added in terms of document number, or the identify of which artefacts have been subjected to updates (technical and management products) This list of changed or updated documents is used to create the entries for the project Document Issue Notices, which are issued periodically to advise clients of the QMS of new or updated artefacts available.

2 Master Document List

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
MANAGEMENT PRODUCTS							
Master Document List	MLA 001	1.05	98/08/23	Approved	96/04/26	2.6	\\mp\mla001.105
Document Creation Template	MLA 002	1.02	97/03/25	Approved	96/05/10	2.9	\\mp\mla002.102
Project Quality Plan	MLA 003	1.00	97/05/05	Approved	97/05/05	2.6	\\mp\mla003.100
Product Description	MLA 004	1.05	98/08/11	Approved	96/05/10	2.5	\\mp\mla004.105
Project Management Plan	MLA 005	1.04	97/03/25	Approved	96/05/10	2.6	\\mp\mla005.104
Project Management Plan / Budget / Work Breakdown Structure	MLA 005-10	1.00	98/08/23	Approved	97/10/24	2.3	\\mp\mla00510.100
Configuration Management Plan	MLA 006	1.03	97/03/25	Approved	96/04/26	2.7	\\mp\mla006.103
Contract	MLA 007	-	96/03/01	-	-	-	Hard Copy
Binder Labels	MLA 008	1.02	98/08/16	Approved	96/04/26	2.8	\\mp\mla008.102
Archive Diskette Labels	MLA 009	1.07	98/08/16	Approved	96/05/10	2.8	\\mp\mla009.107
Archive Diskette Labels Database	MLA 009-10	1.07	98/08/16	Approved	96/05/10	2.8	\\mp\mla00910.107

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Minutes of meetings Template	MLA 010	1.00	96/04/12	Approved	96/04/12	2.12	\\p\mla010.100
Document Issue Notice Template	MLA 011	1.00	96/04/17	Approved	96/04/12	2.13	\\p\mla011.100
Call for Review Template	MLA 012						
Project Issue Report Template	MLA 013						
Product Exception Report Template	MLA 014						
Inspection and Review Template	MLA 015						
TECHNICAL PRODUCTS (Project Overview)							
Project: Front Pages	MLA 100	1.02	98/08/21	Approved	98/08/07	2.3	\\p\mla100.102
Project Summary/ Overview	MLA 110	0.04	98/08/07	Draft			\\p\mla110.004
Project Technical Paper	MLA 120	1.02	98/08/21	Approved	98/08/07	2.5	\\p\mla120.102
FPA and SPICE Information Sources	MLA 121	0.04	98/06/29	Draft			\\p\mla121.004

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Product Description: Technical Paper for SAISCIT 1997	MLA 122	0.05	97/09/23	Draft			\\p\mla122.006
Abstract: Technical Paper for SAISCIT 1997	MLA 123	0.20	97/08/13	Draft			\\p\mla123.020
Technical Paper for SAISCIT 1997	MLA 124	0.02	97/09/25	Draft			\\p\mla124.002
Presentation for SAISCIT 1997	MLA 125	1.00	97/11/13	Draft	97/10/24	2.4	\\p\mla125.100
Updated Technical Paper	MLA 126	0.01	97/11/02	Draft			\\p\mla126.001
Project: Discussion and Conclusions	MLA 130	1.00	98/08/23	Approved	98/08/07	2.6	\\p\mla130.100
Plan: Project: Discussion and Conclusions	MLA 131	0.01	97/03/25	Draft			\\p\mla131.001
Project: Bibliography and references	MLA 140	1.02	98/08/21	Approved	98/08/07	2.7	\\p\mla140.102
Project: Learning from the project	MLA 150	1.00	98/08/16	Approved	98/08/07	2.8	\\p\mla150.100
Project: Literature Survey	MLA 160	1.02	98/08/21	Approved	98/08/07	2.9	\\p\mla160.102
TECHNICAL PRODUCTS (Project specific)							
Requirements Specification	MLA 300	1.02	97/03/25	Approved	98/04/26	2.11	\\p\mla300.102

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Stakeholder Needs and Expectations	MLA 301	1.01	97/09/16	Draft	97/05/05	2.19	\\p\mla301.101
Communication Plan	MLA 302	0.03	97/03/25	Draft			\\p\mla302.003
Feasibility Study for Project A	MLA 303	1.01	97/05/28	Approved	97/05/05	2.21	\\p\mla303.101
Work Breakdown Structure for Project A	MLA 304	1.03	98/08/09	Approved	97/05/05	2.22	\\p\mla304.103
Quality Plan for Project A	MLA 305	1.01	97/05/16	Approved	97/05/05	2.23	\\p\mla305.101
Working Document for Project A	MLA 306	1.00	97/11/02	Approved	97/10/24	2.5	\\p\mla306.100
SPICE Assessment Trials Questionnaire for Project A	MLA 307	0.03	97/01/17	Draft			\\p\mla307.003
SPICE Assessment Feedback Report for Project A	MLA 308	1.01	98/08/10	Approved	98/06/18		\\p\mla308.101
SPICE Assessment Feedback Presentation for Project A	MLA 309	0.01	98/06/28	Draft			\\p\mla309.001
FPA Count for Project A	MLA 310	1.00	98/08/09	Approved	97/09/23	2.10	\\p\mla310.100
SPICE Profile for Project A	MLA 311	1.00	97/11/02	Approved	97/10/24	2.5	\\p\mla311.100
PEP Footprint for Project A	MLA 312	1.00	98/08/09	Approved	98/08/07	2.9	\\p\mla312.100

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Feasibility Study for Project B	MLA 313	0.02	97/05/09	Draft			\\p\mla313.002
Work Breakdown Structure for Project B	MLA 314	1.00	98/08/10	Approved	98/08/07	2.9	\\p\mla314.100
Quality Plan for Project B	MLA 315	0.02	97/05/16	Draft			\\p\mla315.002
Working Document for Project B	MLA 316	1.00	97/11/02	Approved	97/10/24	2.5	\\p\mla316.100
SPICE Assessment Trials Questionnaire for Project B	MLA 317	0.02	97/01/17	Draft			\\p\mla317.002
SPICE Assessment Feedback Report for Project B	MLA 318	1.01	98/03/10	Approved	98/06/18		\\p\mla318.101
SPICE Assessment Feedback Presentation for Project B	MLA 319	0.01	98/06/28	Draft			\\p\mla319.001
FPA Count for Project B	MLA 320	1.00	98/08/09	Approved	97/09/23	2.10	\\p\mla320.100
SPICE Profile for Project B	MLA 321	1.00	98/08/09	Approved	97/10/24	2.5	\\p\mla321.100
PEP Footprint for Project B	MLA 322	1.00	98/08/10	Approved	98/08/07	2.9	\\p\mla322.100
Feasibility Study for Project C	MLA 323	0.02	97/05/09	Draft			\\p\mla323.002
Work Breakdown Structure for Project C	MLA 324	1.00	98/08/10	Approved	98/08/07	2.9	\\p\mla324.100

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Quality Plan for Project C	MLA 325	0.02	97/05/16	Draft			\\p\mla325.002
Working Document for Project C	MLA 326	0.09	98/05/06	Draft			\\p\mla326.009
SPICE Assessment Trials Questionnaire for Project C	MLA 327	0.02	97/01/17	Draft			\\p\mla327.002
SPICE Assessment Feedback Report for Projects C and D	MLA 328	1.01	98/08/10	Approved	98/06/18		\\p\mla328.101
SPICE Assessment Feedback Presentation for Projects C and D	MLA 329	0.01	98/06/28	Draft			\\p\mla329.001
FPA Count for Project C	MLA 330	1.00	98/08/10	Approved	97/09/23	2.10	\\p\mla330.100
SPICE Profile for Project C	MLA 331	1.00	98/08/10	Approved	98/08/07	2.9	\\p\mla331.100
PEP Footprint for Project C	MLA 332	1.00	98/08/10	Approved	98/08/07	2.9	\\p\mla332.100
SPICE Assessment Trials Questionnaire for Project D	MLA 337	0.02	97/01/17	Draft			\\p\mla337.002
FPA Count for Project D	MLA 340	1.00	98/08/10	Approved	97/09/23	2.10	\\p\mla340.100
SPICE Profile for Project D	MLA 341	1.00	98/08/10	Approved	98/08/07	2.9	\\p\mla341.100
PEP Footprint for Project D	MLA 342	1.00	98/08/10	Approved	98/08/07	2.9	\\p\mla342.100
SPICE Assessment Management Summary	MLA 348	1.00	98/08/10	Approved	98/06/18		\\p\mla348.100

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
SPICE Assessment Management Summary Presentation	MLA 349	0.01	98/06/28	Draft			\\p\mla349.001
Product Description: MLA SPICE Reports	MLA 350	0.01	98/05/07	Draft			\\p\mla350.001
SPICE Assessment Feedback Questionnaire	MLA 351	0.01	98/05/12	Draft			\\p\mla351.001
FPA vs SPICE Comparison	MLA 352	1.00	98/08/14	Approved	98/08/07	2.9	\\p\mla352.100
Product Description: MLA SPICE Reports	MLA 353	0.01	98/06/03	Draft			\\p\mla353.001
QUALITY ASSURANCE PRODUCTS (Correspondence)							
E-mail distribution list for all core group members	MLA 1000	-	98/06/03	-	-	-	\\qa\mla_agm.pml
E-mail distribution list for core group members	MLA 1001	-	98/06/03	-	-	-	\\qa\mla_cgm.pml
E-mail distribution list for extended core group members	MLA 1002	-	98/06/03	-	-	-	\\qa\mla_egm.pml
Note from AJW re: Information about GDE	MLA 1003	-	95/04/04	-	-	-	\\qa\corres\950404aw.mtl
Note from AJW re: Further Studies	MLA 1004	-	95/04/24	-	-	-	\\qa\corres\950424aw.mtl

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Note from AJW re: Meeting	MLA 1005	-	95/05/16	-	-	-	\\qa\corres\950516aw.mtl
Note from AJW re: Confirmation of venue	MLA 1006	-	95/05/24	-	-	-	\\qa\corres\950524aw.mtl
Note from AJW re: Follow-up on SPICE	MLA 1007	-	95/09/28	-	-	-	\\qa\corres\950928aw.mtl
Note from AJW re: Masters Topics and other questions	MLA 1008	-	95/10/11	-	-	-	\\qa\corres\951011aw.mtl
Note from AJW re: Masters Topics and other questions 2	MLA 1009	-	95/10/16	-	-	-	\\qa\corres\951016aw.mtl
Note from AJW re: Masters Topics and other questions 3	MLA 1010	-	95/10/19	-	-	-	\\qa\corres\951019aw.mtl
Note from AJW re: Masters degree	MLA 1011	-	95/10/23	-	-	-	\\qa\corres\951023aw.mtl
Note from AJW re: SPICE and Masters	MLA 1012	-	96/01/08	-	-	-	\\qa\corres\960108aw.mtl
Note from AJW re: Masters Research Proposal	MLA 1013	-	96/01/11	-	-	-	\\qa\corres\960111aw.mtl
Note from AJW re: Masters Proposal	MLA 1014	-	96/03/01	-	-	-	\\qa\corres\960301aw.mtl
Note from AJW re: Meeting on Friday, 19 July 1996	MLA 1015	-	96/07/15	-	-	-	\\qa\corres\960715aw.mtl

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Note from AJW re: Project Initiation Audit Report, 23 July 1996	MLA 1016	-	96/07/23	-	-	-	\\qa\corres\960723aw.mtl
Note from AJW re: Change in meeting date, 27 May 1997	MLA 1017	-	97/06/23	-	-	-	\\qa\corres\970527aw.mtl
Note from AJW re: Call for papers SAISCIT 97, 17 June 1997	MLA 1018	-	96/06/23	-	-	-	\\qa\corres\960617aw.mtl
Note from Bram Meyerson re: Receipt of fax	MLA 1019	-	98/06/13	-	-	-	\\qa\corres\970926bm.mtl
Note from Bram Meyerson re: First pass reading of SAICSIT paper	MLA 1020	-	98/06/13	-	-	-	\\qa\corres\970930bm.mtl
Note from Bram Meyerson re: Correlation between SPICE and PEP	MLA 1021	-	98/06/13	-	-	-	\\qa\corres\971009bm.mtl
Note from Chris Dale re: Receipt of paper	MLA 1022	-	98/06/13	-	-	-	\\qa\corres\971010cd.mtl
Note from Chris Dale re: First comments about SAICSIT paper	MLA 1023	-	98/06/13	-	-	-	\\qa\corres\971027cd.mtl
Note from Chris Dale re: Second comments about SAICSIT paper	MLA 1024	-	98/06/13	-	-	-	\\qa\corres\971107cd.mtl

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Note from Chris Dale re: Contact for another company using both methods	MLA 1025	-	98/06/13	-	-	-	\\qa\corres\971111cd.mtl
Note from Mary Fisher re: Experience with usage of both methods and possible correlations	MLA 1026	-	98/06/13	-	-	-	\\qa\corres\980114mf.mtl
Note from Mary Fisher re: response to second note about continual usage of both methods	MLA 1027	-	98/06/13	-	-	-	\\qa\corres\980202mf.mtl
Note from Jay van Zyl re: response to enquiry about usage of PEP	MLA 1028	-	98/06/25	-	-	-	\\qa\corres\980625jz.mtl
Note from AJW re: Final Technical Paper (MLA) - Reply	MLA 1029	-	98/07/29	-	-	-	\\qa\corres\980727aw.mtl
Note from AJW re: Review Comments Overall in WW6	MLA 1030	-	98/07/29	-	-	-	\\qa\corres\980728aw.mtl
Note from AJW re: Research Paper 2 - comments	MLA 1031	-	98/07/29	-	-	-	\\qa\corres\980729aw.mtl
Note from AJW re: January meeting	MLA 1032	-	98/08/09	-	-	-	\\qa\corres\980127aw.mtl

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Note from AJW re: Reply to response to review comments	MLA 1033	-	98/08/09	-	-	-	\\qa\corres\980731aw.mtl
Note from AJW re: Second review	MLA 1034	-	98/08/09	-	-	-	\\qa\corres\980803aw.mtl
Note from Bram Meyerson re: Review of technical paper	MLA 1035	-	98/08/09	-	-	-	\\qa\corres\980804bm.mtl
Note from AJW re: Comments on second review	MLA 1036	-	98/08/09	-	-	-	\\qa\corres\980805aw.mtl
Note from AJW re: Meeting	MLA 1037	-	98/08/09	-	-	-	\\qa\corres\980805aw.mt2
Note from AJW re: Meeting Date	MLA 1038	-	98/08/09	-	-	-	\\qa\corres\980806aw.mtl
Note from AJW re: Meeting Agenda	MLA 1039	-	98/08/09	-	-	-	\\qa\corres\980806aw.mt2
Note from AJW re: MLA Research Cover Pages et al	MLA 1040	-	98/08/14	-	-	-	\\qa\corres\980812aw.mtl
Note from AJW re: MLA Cover Pages (2) - Reply	MLA 1041	-	98/08/14	-	-	-	\\qa\corres\980812aw.mt2
Note from AJW re: Comments on 100, 140 and 160	MLA 1042	-	98/08/14	-	-	-	\\qa\corres\980813aw.mtl

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Note from BM re: Paper review comments	MLA 1043	-	98/08/21	-	-	-	\\qa\corres\980821bm.mtl
Correspondence items	MLA 10						\\qa\corres\
QUALITY ASSURANCE PRODUCTS (Agenda's and Minutes)							
Minutes of meeting held on 15 March 1996	MLA 2000	0.01	96/03/28	Approved	96/03/29	2.1	\\qa\minutes\960315.min
Minutes of meeting held on 29 March 1996	MLA 2001	0.01	96/04/09	Approved	96/04/12	2.2	\\qa\minutes\960315.min
Agenda of meeting to be held on 12 April 1996	MLA 2002	0.01	96/04/12	Approved	96/04/12	2.1	\\qa\minutes\960412.agd
Minutes of meeting held on 12 April 1996	MLA 2003	0.01	96/04/19	Approved	96/04/26	2.2	\\qa\minutes\960412.min
Agenda of meeting to be held on 26 April 1996	MLA 2004	0.01	96/04/19	Approved	96/04/26	2.1	\\qa\minutes\960426.agd
Minutes of meeting held on 26 April 1996	MLA 2005	0.01	96/05/08	Approved	96/05/10	2.2	\\qa\minutes\960426.min
Agenda of meeting to be held on 10 May 1996	MLA 2006	0.01	96/05/08	Approved	96/05/10	2.1	\\qa\minutes\960510.agd
Minutes of meeting held on 10 May 1996	MLA 2007	0.01	96/06/03	Approved	96/06/07	2.2	\\qa\minutes\960510.min

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Agenda of meeting to be held on 7 June 1996	MLA 2008	0.01	96/06/07	Approved	96/06/07	2.1	\\qa\minutes\960603.agd
Minutes of meeting held on 7 June 1996	MLA 2009	0.01	96/06/14	Approved	96/07/23	2.1	\\qa\minutes\960503.min
Agenda of meeting to be held on 2 August 1996	MLA 2010	0.01	96/07/23	Approved	96/07/23	2.1	\\qa\minutes\960802.agd
Minutes of meeting held on 2 August 1996	MLA 2011	0.01	96/10/28	Approved	96/10/28	2.1	\\qa\minutes\960802.min
Agenda of meeting to be held on 28 October 1996	MLA 2012	0.01	96/10/28	Approved	96/10/28	2.1	\\qa\minutes\961028.agd
Minutes of meeting held on 28 October 1996	MLA 2013	0.01	96/11/11	Approved	97/01/17	2.1	\\qa\minutes\961028.min
Agenda of meeting to be held on 17 January 1997	MLA 2014	0.01	97/01/17	Approved	97/01/17	2.1	\\qa\minutes\970117.agd
Minutes of meeting held on 17 January 1997	MLA 2015	0.01	97/03/25	Approved	97/03/26	2.1	\\qa\minutes\970117.min
Agenda of meeting to be held on 26 March 1997	MLA 2016	0.01	97/03/25	Approved	97/03/26	2.1	\\qa\minutes\970326.agd
Minutes of meeting held on 26 March 1997	MLA 2017	0.01	97/05/05	Approved	97/05/06	2.1	\\qa\minutes\970326.min
Agenda of meeting to be held on 6 May 1997	MLA 2018	0.01	97/05/06	Approved	97/05/06		\\qa\minutes\970506.agd

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Minutes of meeting held on 6 May 1997	MLA 2019	0.01	97/05/18	Approved	97/07/24		\\qa\minutes\970506.min
Agenda of meeting to be held on 24 July 1997	MLA 2020	0.01	97/07/22	Approved	97/07/24		\\qa\minutes\970724.agd
Minutes of meeting held on 24 July 1997	MLA 2021	0.01	97/09/11	Approved	97/09/19		\\qa\minutes\970724.min
Agenda of meeting to be held on 19 September 1997	MLA 2022	0.02	97/09/22	Approved	97/09/19		\\qa\minutes\970919.agd
Minutes of meeting held on 19 September 1997	MLA 2023	0.01	97/09/23	Approved	97/10/24		\\qa\minutes\970919.min
Agenda of meeting to be held on 24 October 1997	MLA 2024	0.01	97/10/24	Approved	97/10/24		\\qa\minutes\971024.agd
Minutes of meeting held on 24 October 1997	MLA 2025	0.01	97/11/02	Approved	97/12/09		\\qa\minutes\971024.min
Agenda of meeting to be held on 9 December 1997	MLA 2026	0.01	97/12/08	Approved	97/12/09		\\qa\minutes\971209.agd
Minutes of meeting held on 9 December 1997	MLA 2027	0.01	97/12/22	Approved	98/06/03		\\qa\minutes\971209.min
Agenda of meeting to be held on 3 June 1998	MLA 2028	0.01	98/06/03	Approved	98/06/03		\\qa\minutes\970603.agd
Minutes of meeting held on 3 June 1998	MLA 2029	0.01	98/06/13	Approved	98/08/07		\\qa\minutes\970603.min

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Agenda of meeting to be held on 7 August 1998	MLA 2030	0.01	98/08/07	Approved	98/08/07		\\qa\minutes\980807.agd
Minutes of meeting held on 7 August 1998	MLA 2031	0.01	98/08/07	-	98/ /		\\qa\minutes\970807.min
Minutes of meeting held on 1998	MLA 20	0.01	98/ /		98/ /		\\qa\minutes\97 .min
Agenda of meeting to be held on 1998	MLA 20	0.01	98/ /		98/ /		\\qa\minutes\97 .agd
QUALITY ASSURANCE PRODUCTS (Audit reports)							
Project Initiation Audit Report	MLA 3000	0.01	96/07/23	Draft	-	-	\\qa\auditrep\9624pi.par
Project In Progress Audit Report 1	MLA 3001	0.01	97/05/05	Draft	-	-	\\qa\auditrep\9624ip01.par
Project In Progress Audit Report 2	MLA 3002	0.01	97/07/22	Draft	-	-	\\qa\auditrep\9624ip02.par
Project In Progress Audit Report 3	MLA 3003	0.01	97/09/29	Draft	-	-	\\qa\auditrep\9624ip03.par
Project In Progress Audit Report 4	MLA 3004	0.01	98/01/19	Draft	-	-	\\qa\auditrep\9624ip04.par
Project In Progress Audit Report 5	MLA 3005	0.01	98/07/13	Draft	-	-	\\qa\auditrep\9624ip05.par

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
	MLA 3006						\qa\auditrep
QUALITY ASSURANCE PRODUCTS (Document Issue Notices)							
Document Issue Notice 1996-01	MLA 4000	-	96/04/09	-	-	-	\qa\notices\960409-1.din
Document Issue Notice 1996-02	MLA 4001	-	96/04/19	-	-	-	\qa\notices\960419-1.din
Document Issue Notice 1996-03	MLA 4002	-	96/05/08	-	-	-	\qa\notices\960508-1.din
Document Issue Notice 1996-04	MLA 4003	-	96/06/07	-	-	-	\qa\notices\960607-1.din
Document Issue Notice 1996-05	MLA 4004	-	96/07/23	-	-	-	\qa\notices\960723-1.din
Document Issue Notice 1996-06	MLA 4005	-	96/10/28	-	-	-	\qa\notices\961028-1.din
Document Issue Notice 1997-01	MLA 4006	-	97/01/17	-	-	-	\qa\notices\970117-1.din
Document Issue Notice 1997-02	MLA 4007	-	97/03/25	-	-	-	\qa\notices\970325-1.din
Document Issue Notice 1997-03	MLA 4008	-	97/05/06	-	-	-	\qa\notices\970505-1.din

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
Document Issue Notice 1997-04	MLA 4009	-	97/05/21	-	-	-	\\qa\notices\970521-1.din
Document Issue Notice 1997-05	MLA 4010	-	97/07/22	-	-	-	\\qa\notices\970724-1.din
Document Issue Notice 1997-06	MLA 4011	-	97/09/25	-	-	-	\\qa\notices\970925-1.din
Document Issue Notice 1997-07	MLA 4012	-	97/11/02	-	-	-	\\qa\notices\971103-1.din
QUALITY ASSURANCE PRODUCTS (Call for Review)							
	MLA 5000						\\qa\reviews\
QUALITY ASSURANCE PRODUCTS (Project Issue reports)							
	MLA 6000						\\qa\issuerepl
QUALITY ASSURANCE PRODUCTS (Product Problem Reports)							
	MLA 7000						\\qa\problems\

Document Name	Document Number	Revision Number	Revision Date	Document Status	Date approved	Minute Reference	File Reference
QUALITY ASSURANCE PRODUCTS (Inspection and Review Records)							
	MLA 8000						\\qa\inspectns\
QUALITY ASSURANCE PRODUCTS (Backups)							
Disk(ette)/Tape Backup / Archive Register	MLA 9000	-	98/08/16	-	-	-	\\qa\backups\mla9000.001



MLA QMS

Quality Plan

Management Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iv
Configuration Control	iv
Document History	iv
Revision History	iv
Management Authorisation	iv
Change Forecast	iv
1 Scope	1
1.1 Introduction	1
1.2 Product Overview	1
1.3 Audience	1
1.4 Applicable Documents	2
1.5 Requirements Traceability	2
2 Quality Objectives	3
3 Quality Requirements	4
3.1 Responsibility for Organisation and management of Quality Activities	4
3.2 Contract Arrangements	4
3.3 Design Management	4
3.4 Document and Data Control	4
3.5 Supplier Control	4
3.6 Control of Customer Product	5
3.7 Configuration Management	5
3.8 Process Management	5

3.9 Test Environment.....	5
3.10 Test Records	5
3.11 Corrective and Preventive Action.....	5
3.12 Media Control	6
3.13 Records.....	6
3.14 Project Audits.....	6
3.15 Training Needs	6

Change History

Configuration Control

Project:	MLA QMS
Title:	Quality Plan
Doc. Reference:	C:\MY DOCUMENTS\1996_24\MP\MLA003.100
Created by:	Melanie Lang
Creation Date:	3 May 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	96\07\23	Draft	MT Lang	MLA003.001
0.02	97\01\17	Draft	MT Lang	MLA003.002
0.03	97\03\25	Draft	MT Lang	MLA003.003
1.00	97\05\05	Approved	MT Lang	MLA003.100

Revision History

Version	Date	Changes
0.01	96\07\23	New document created using QST 122-10
0.02	97\01\17	Modifications with accordance to departmental restructuring.
0.03	97\03\25	Modifications according to additions from QST130-10
1.00	97\05\05	Modifications to document re: MLA2017 section 2.6

Management Authorisation

Version	Date	Status	Project Minute Reference
1.00	97\05\05	Approved	MLA 2017 section 2.6

Change Forecast

1 Scope

1.1 Introduction

This document defines the contents and format of a Quality Plan for this project, in terms of the quality requirements of the SEAL Quality Management system, as defined in QS 122 SEAL QMS Quality Policy.

This document specifies management tasks and responsibilities related to quality, and describes the tools and/or systems that will be used to maintain product quality.

1.2 Product Overview

This project is an investigation into software process improvement in the software development facility of a large electricity utility. Methods currently used include a Metrics programme with links to function point analysis and the CSC Performance Enhancement Programme, as well as the more recent SPICE trials.

1.3 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Manager, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board
- Head of Department of Electrical Engineering
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.

1.4 Applicable Documents

1.4.1 Standards

SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

1.5 Requirements Traceability

a. ISO 9001 (1994) Clause 4.2

2 **Quality Objectives**

This quality objective of this project are:

- to produce a reliable document in terms of listed references accurately portraying current trends,
- to give reliable results in terms of the assessments and counts undertaken and the analysis of these results.
- to meet the requirements defined by the stakeholder needs analysis (MLA301), and the product description (MLA004), unless not possible, and then to manage expectations accordingly.
- to give usable output in the form of recommendations, and future research or work.
- to be efficient in terms of spending a minimal amount of time necessary with assessment resources.
- to produce a maintainable document, which is easily updateable if future research or work and latest trends are documented and included.
- to create a technical paper which meets the audit checklist requirements in terms of suitability, adequacy, balance, emphasis and product quality

3 Quality Requirements

The quality plan shall have as a minimum requirement the following format and content as described in each section. If additional sections are required these shall follow the sections listed.

Where a section is not used it shall be marked as 'Not Applicable'.

3.1 Responsibility for Organisation and management of Quality Activities

This is defined in the Project Management Plan for the project, MLA 005 as derived from QST124-10.

3.2 Contract Arrangements

By clause 8.1b of QSP 123-10, the SEAL QMS Contract Review Procedure:

'If the project requires only an informal commitment of effort i.e. participation in the work of a committee which is non-remunerative, then no contract is required.'

contract arrangements as per MLA 007 and TR 302 are defined.

3.3 Design Management

This project will be managed as a software development project in accordance with the SEAL QMS Design Control Procedures: QS124, QS 224 and QS 324. However a software product 'in a machine executable format' will not be delivered, but rather a document. The level of quality management undertaken in this project is full.

3.4 Document and Data Control

Document and data control will follow the requirements set out in QS 125. and will comply with QS195.

3.5 Supplier Control

Purchase of product and services will comply with the requirements of QS126, QSP126-10 and will source product and services using the list of Preferred Suppliers given in QS190.

3.6 Control of Customer Product

Not applicable.

3.7 Configuration Management

The requirements for product identification and traceability as defined in QS128 and QSP 128-10 will be followed using the template QST128-70 for developing the Configuration Management Plan for this project.

3.8 Process Management**3.8.1 Documentation Management**

The standard required for documentation management will be applied as defined in QS 195.

3.8.2 For Education and Training

100-series provides process for managing research development.

3.8.3 Test Procedures, Reviews and Inspections

All acceptance points, acceptances and releases required for the project, together are identified in the Project Management Plan for this project.

3.9 Test Environment**3.9.1 Education and Training**

M.Sc. is examinable and subject to usual university reviews and procedures

3.10 Test Records**3.10.1 Education and Training**

Examiner reports from 2 people

3.11 Corrective and Preventive Action

In two-person projects, problems shall be reported in minutes of meetings. The student will act as liaison to the interested parties in Eskom, and any exceptions in terms of company procedure or otherwise will be brought up at the management meetings and listed in the minutes.

3.12 Media Control

Procedures for software development as applied to a research project as listed in QS128, QS135, and QSP 128-10 will be used to control the media for the project.

3.13 Records

With reference to QS 136, all records emanating from this project, may include:

- a. Agendas and minutes of review meetings - MLA 2000 - MLA 2999
- b. Audit reports - MLA 3000 - MLA 3999
- c. SPICE Assessment Outputs
- d. Document Issue Notices - MLA 4000 - MLA 4999
- e. Correspondance - MLA 1003 - MLA 1999

3.14 Project Audits

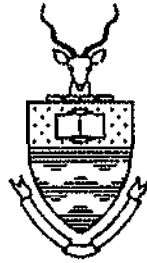
These will be conducted in terms of the requirements of

- a. QS137 - Internal Quality Audit Policy
- b. QS137-10 Internal Quality Audits Procedure
- c. QST137-10 Templates for Internal Quality Audits.

3.15 Training Needs

Specific training needs will be identified as per QS 138 SEAL QMS Training Policy, and conducted accordingly.

■



MLA QMS

Product Description

Management Product

Version 1.04

Document Status: Approved

Table of Contents

Table of Contents.....	ii
Change History.....	iv
Configuration Control.....	iv
Document History	iv
Revision History.....	iv
Management Authorisation.....	v
Change Forecast.....	v
1 Scope	1
1.1 Introduction	1
1.2 Applicability.....	1
1.3 Definitions	1
1.4 Audience.....	2
1.5 Applicable Documents	2
1.6 Assumptions	3
1.7 ISO 9001 Requirements Traceability	3
2 Dependencies.....	4
3 Requirements to be Addressed	5
3.1 Functional Requirements to be met.....	5
3.2 Non-functional requirements to be met.....	5
4 Compliance to Standards.....	6
4.1 Compliance required to ISO 9001 Clauses	6
4.2 Compliance required to other Standards\Guides	6
5 Product Review	7

5.1 Purpose.....	7
5.2 Responsibility	7
5.3 Review Procedure	7
6 Structure of this project	8
6.1 Purpose.....	8
6.2 Scope	8
6.3 Field of Application.....	8
6.4 Limitations.....	8
6.5 How this project will be structured	8
Task List	10

Change History

Configuration Control

Project:	MLA QMS
Title:	Product Description
Doc. Reference:	C:\MY DOCUMENTS\1996_24\MP\MLA004.105
Created by:	Melanie Lang
Creation Date:	11 August 1998

Document History

Version	Date	Status	Who	Saved as:
0.01	96/03/29	Draft	MT Lang	MLA004.001
0.02	96/04/17	Draft	MT Lang	MLA004.002
0.03	96/05/08	Draft	MT Lang	MLA004.003
1.00	96/06/03	Approved	MT Lang	MLA004.100
1.01	96/10/28	Approved	MT Lang	MLA004.101
1.02	97/01/17	Approved	MT Lang	MLA004.102
1.03	97/03/25	Approved	MT Lang	MLA004.103
1.04	97/09/24	Approved	MT Lang	MLA004.104

Revision History

Version	Date	Changes
0.01	96/03/29	New Document created using QST 12420.102
0.02	96/04/17	Modifications to document re: MLA 2003 section 2.3
0.02	96/04/22	Continuation of modifications to document re: MLA 2003 section 2.3
0.03	96/05/08	Modifications to document re: MLA 2005 section 2.5
1.00	96/06/03	Modifications to document re: MLA 2007 section 2.5
1.00	96/06/07	Modifications to document after review by Christine Griesel
1.00	96/06/14	Modifications to document re: MLA 2009 section 2.5
1.01	96/10/28	Addition of new resource
1.02	97/01/17	Update of resource

1.03	97/03/25	Update of resource
1.04	97/09/24	Update of resource and alignment with 301
1.05	98/08/11	Update of resource

Management Authorisation

Version	Date	Status	Project Manager Reference
1.00	96/06/03	Approved	MLA 2007 section 2.3

Change Forecast

1 Scope

1.1 Introduction

The main purpose of this document is to define a framework for the development of the project to investigate software process improvement in the software development facility of a large electricity utility.

1.2 Applicability

This document provides a description of a new project undertaken within Eskom IT for the purpose of obtaining a Masters degree for the project developer and for investigation into the SPICE and FPA domains for Eskom IT.

Process improvement techniques as well as metrics have just recently been implemented in the software development department in this organisation. Lack of these tools has resulted in projects being over-budget, overdue or not satisfying customer requirements, if not all three. This transpires in many other organisations regardless of size or industry sector. The techniques implemented are the more widely known and controversial Function Point Analysis (FPA) and the international follow-up to ISO9000 - Software Process Improvement and Capability dEtermination (SPICE), which has not yet been released as an international standard and as such not gathered any reputation or widespread recognition.

1.3 Definitions

Function Point: The standard unit of measure for software size.

Function Point Analysis (FPA): may be performed as part of PEP programme. This data is stored in a history database which is used for benchmarking across industries and across project size. This creates a common base from which better estimates and thus better planning can be done on future projects.

IFPUG: International Function Point User Group

Performance Enhancement Programme (PEP): CSC Research and Advisory Services Performance Enhancement Programme to collect baselining and measurement data on various projects

SPICE is an international initiative by ISO/IEC JTC1/SC7 WG10 - the working group on software process assessment - to incorporate all the positive issues of the existing process improvement or capability evaluation models and standards i.e. STD from Compita, the Capability Maturity Model from the Software Engineering Institute, Trillium from Bell SYGMA TeleCom, SQPA from HP, Bootstrap from Esprit, HealthCheck from BT, ISO9001 and SAM from BT. It deals with development, management, customer support and quality.

1.4 Audience

The following comprise the audience for this document:

- a. The student undertaking this M.Sc. project.
- b. Interested members of Eskom IT, including my team leader, IT Application Systems Quality Team and the IT Application Systems Manager.
- c. The supervisor of this M.Sc. project.
- d. Members of the SEAL Management Board
- e. Head of Department of Electrical Engineering
- f. Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.

1.5 Applicable Documents

1.5.1 Specifications

1.5.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 1.00, 11 Feb. 1995
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 11 Feb. 1995

1.5.3 Procedures

- a. SEAL QMS Product Review Procedure, QS 004, Revision 1.00, 11 Feb. 1995

- b. SEAL QMS Exception Reporting Procedure, QS 006, Revision 1.00, 11 Feb. 1995

1.5.4 Guidelines

1.5.5 Other Documents

- a. FPA Documentation references will be provided where they suitably fit.
- b. SPICE Documentation references will be provided where they suitably fit.

1.6 Assumptions

1.7 ISO 9001 Requirements Traceability

- a. ISO 9001 (1994) 4.4 Design Control
- b. ISO 9001 (1994) 4.5 Document Control
- c. ISO 9001 (1994) 4.8 Product Identification and Traceability
- d. ISO 9001 (1994) 4.9 Process Control
- e. ISO 9001 (1994) 4.16 Quality Records

2 Dependencies

- a. Availability of Eskom IT documentation and staff to conduct SPICE assessments. {Plan B: select projects with sufficient documentation. Management support should ensure staff availability}
- b. Availability of PEP and FPA information. {Plan B: select projects which already have been designated for the PEP project}
- c. Availability of the SPICE tools and techniques. {Plan B: not a problem at the moment, since contract exists until the end of the year. If there are problems thereafter, then the Masters will have to include only those Eskom projects assessed before the end of the year}
- d. Permission to publish PEP information. {Plan B: may need to re-focus project on function points alone}
- e. Availability of hardware and software to run the tools for FPA and SPICE. {Plan B: not a problem, since Eskom should provide for this, as the project is internal}
- f. Changes in the SPICE document set. {Plan B: take these into account when writing up the report}
- g. Lack of planned versus actual information to record nonconformances. {Plan B: all new projects taking part in the PEP programme are required to record this information - not a problem}
- h. Termination of subscription to Quantimetrix for PEP and FPA. {Plan B: should not be a problem, since there is management commitment to the Metrics program, but if this occurs, the Masters will have to include only those Eskom projects assessed before this transpires}
- i. Termination / expiration of SPICE contract. {Plan B: not a problem at the moment, since contract exists until the end of the year. If there are problems thereafter, then the Masters will have to include only those Eskom projects assessed before the end of the year}

3 Requirements to be Addressed

3.1 Functional Requirements to be met

- i. FPA Counts and PEP baselining to be performed on selected projects in Eskom IT.
- b. SPICE Assessments to be performed on the selected projects of a) above in Eskom IT.
- c. Analysis of FPA counts, PEP footprints and SPICE assessments leading to documented comparisons and limitations i.e. the intersections, unions and areas on their own.
- d. Correlation between FPA elements and SPICE capability levels in the context of the projects selected (in a).
- e. Determine whether specific FPA elements or PEP graph points can be used as compliance indicators to specific SPICE capability levels and / or vice versa.
- f. Recommendations for going forward in Eskom IT and for further research outside Eskom ITD.
- g. Determine how the PEP Footprint corresponds to the SPICE profile.
- h. Meet requirements for a higher degree project.

3.2 Non-functional requirements to be met

- a. Determine criteria for recognition of champions of good software engineering practices, which can become the foundation of better practices in Eskom.
- b. Identify practices needing special attention.
- c. Compare the effectiveness of PEP and FPA against SPICE as improvement tools.

4 Compliance to Standards

4.1 Compliance required to ISO 9001 Clauses

- a. This project is developed within the framework of the documented procedures of the SEAL Quality Management System.

4.2 Compliance required to other Standards\Guides

- a. The draft international standard, SPICE. (ISO/IEC JTC1\SC7 WG10 standard in preparation)
- b. IFPUG standards (Guidelines to Software Measurement Release 1.0 by the International Function Point Users Group August 1994).

5 Product Review

5.1 Purpose

To define the requirements by which this project is to be validated.

5.2 Responsibility

Responsibility will be divided between two teams, known as core and extended core.

Core will comprise the following members:

- a. Prof. Alastair Walker, M.Sc. Supervisor
- b. Melanie Lang, M.Sc. Student

Extended core will comprise the following members:

- a. Christine Griese' Eskom IT Quality Advisor
- b. Bernie Barnard, Acting Eskom IT Application Systems Manager

5.3 Review Procedure

- a. New or revised product stored on SEAL server and mirrored on Eskom server.
- b. Document Issue Notice and Call for Review sent to responsible persons.
- c. Core and extended core members will then have a week to inspect the document and report any comments or changes via email to the M.Sc. student.
- d. The updated product will be tabled at the next meeting for core members.

6 Structure of this project

6.1 Purpose

An investigation in software process improvement by means of comparison of Function Point Analysis and SPICE.

FPA and SPICE provide profiles as deliverables, although not of the same format. Compatibility and comparability of these models has not been established.

This study should provide insight into guidelines for implementing one or both techniques; the method of implementation for an organisation and the influences that they have on each other, et al. FPA appears to focus at the project level, rather than the wider organisational view, although it does give a summary profile of all the projects, which serves as the organisational view. SPICE looks at the project level at the Planned-and-Tracked Level and at the process and organisational views in the higher levels of Well-Defined, Quantitatively-Controlled and Continuously-Improving. It is also expected that organisations on the higher levels may not find FPA helpful if their process has been well-defined, but will possibly need SPICE to continue assessing themselves in the higher maturity levels. This may not be provable, if the suspected low capability level of the organisation is shown by the assessments.

6.2 Scope

The scope will be within projects undertaken by Eskom IT.

6.3 Field of Application

Compatibility and comparability of these models will be verified by carrying out Function Point Analysis and SPICE assessments on a selected number of software development projects underway. These will be new projects with a variety of technologies, sizes and developers. There will be no impact on electricity distribution by the implementation of this project.

6.4 Limitations

6.5 How this project will be structured

Profiles from these projects will be collected and the results will be analysed separately to establish to what degree of detail each one will

provide insight into process improvement, by identifying problem areas and providing possible solutions. It is expected that there will be a large degree of correlation between the two techniques.

It may be possible after performing several assessments and gathering some information to establish a suitable hypothesis to prove in further assessments.

Task List

- 6.5.1 Ongoing selection of one or more projects for performing SPICE assessments and Function Point Analysis.
- 6.5.2 Submit proposal for Masters.
- 6.5.3 Create and refine management products for project.
- 6.5.4 Literature Surveys:
 - 6.5.4.1 FPA
 - 6.5.4.2 SPICE
- 6.5.5 Meetings with SA SPICE User Group to discuss initial experiences.
- 6.5.6 Collection and analysis of data:
 - 6.5.6.1 Select project.
 - 6.5.6.2 Perform SPICE assessment.
 - 6.5.6.3 Perform Function Point Count.
 - 6.5.6.4 Analyse PEP Profile.
 - 6.5.6.5 Analyse SPICE profile.
- 6.5.7 Report on intermediate comparisons and contrasts and general and specific observations.
- 6.5.8 Report on software process improvements found in analysis of both profiles.
- 6.5.9 Draw up hypotheses from analysis results.
- 6.5.10 Collect statistical data to accept or reject hypothesis.
- 6.5.11 Write and refine Masters technical paper and support documentation.



MLA QMS

Project Management Plan

Management Product

Version 1.04

Document Status: Approved

Table of Contents

1 Scope	1
1.1 Introduction	1
1.2 Purpose.....	1
1.3 Definitions	1
1.4 Audience.....	1
1.5 Applicable Documents	2
1.6 Assumptions	2
1.7 ISO 9001 Requirements Traceability	2
2 Product Quality Plan.....	4
3 Project Management Plan	5
3.1 Overview	5
3.2 Product Development Team.....	5
3.3 Roles and Responsibilities	5
4 Product Development Plan	7
4.1 Work Breakdown Structure	7
4.2 Dependencies.....	7
4.3 Required Human Resources	7
4.4 Available Human Resources	8
4.5 Human Resource allocation.....	9
4.6 Hardware and Software Resources.....	9
4.7 Training Needs Identification.....	10
5 Project Control	12
5.1 Planning.....	12

5.2 Reviewing	12
5.3 Reporting	13
5.4 Document control	13
5.5 Change Control	13

Change History

Configuration Control

Project:	MLA QMS
Title:	Project Management Plan
Doc. Reference:	C:\MY DOCUMENTS\1996_24\MP\MLA005.104
Created by:	Melanie Lang
Creation Date:	25 March 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	96\04\19	Draft	MT Lang	MLA005.001
0.02	96\05\08	Draft	MT Lang	MLA005.002
1.00	96\06\03	Approved	MT Lang	MLA005.100
1.01	96\06\14	Approved	MT Lang	MLA005.101
1.02	96\10\28	Approved	MT Lang	MLA005.102
1.03	97\01\17	Approved	MT Lang	MLA005.103
1.04	97\03\25	Approved	MT Lang	MLA005.104

Revision History

Version	Date	Changes
0.01	96\04\19	New document created using QST12410.100 and based on table under Product Description (MLA 004) Section 6.5 How this project will be structured.
0.02	96\05\08	Modifications of document as per MLA 2005 section 2.10
1.00	96\06\03	Modifications of document as per MLA 2007 section 2.6
1.00	96\06\07	Modifications of document after review by Christine Griesel
1.01	96\06\14	Modifications to document re: MLA 2009 section 2.5
1.02	96\10\28	Addition of resource
1.03	97\01\17	Modifications to document re: MLA 2013 section 2.7 Update to resource
1.04	97\03\25	Update to resource

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	96\06\03	Approved	MLA 2007 section 2.6

Change Forecast

This document will be updated each time there is a change to one of the tables in this Plan i.e. resources, task element, or schedule.

1 Scope

1.1 Introduction

This Plan provides an overview of the required resources to produce the research dissertation. It will form the terms of reference for all contributing parties during the project.

- This Plan outlines the human resources requirements.
- It provides a list of tasks to be performed and a time scale.
- It provides a means for capturing important project metrics regarding estimated and actual effort to perform allocated tasks.

The costs associated with the development of the product are outside the scope of this Plan.

1.2 Purpose

The purpose of this Plan is to:

- Present a clear statement of all deliverables.
- Present a clear statement of work allocation and responsibilities to be undertaken by all parties.

Present details of resources associated with this product.

1.3 Definitions

1.4 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- full-time staff members of the SEAL
- All full-time and part-time post-graduate students associated with the SEAL
- Members of the SEAL Management Board

- Head of the Department, Electrical Engineering
- Individuals who will perform internal and external surveillance audits of the SEAL Quality Management System.
- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the Eskom IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.

1.5 Applicable Documents

1.5.1 Specifications

1.5.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.01, 5 April 1994.
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 0.01, 1 April 1994.

1.5.3 Procedures

1.5.4 Guidelines

1.5.5 Other Documents

1.6 Assumptions

1.7 ISO 9001 Requirements Traceability

- a. ISO 9001 (1994) 4.1 Management Responsibility
- b. ISO 9001 (1994) 4.2 Quality System
- c. ISO 9001 (1994) 4.3 Contract Review
- d. ISO 9001 (1994) 4.4 Design Control
- e. ISO 9001 (1994) 4.5 Document and Data Control
- f. ISO 9001 (1994) 4.8 Product Identification and Traceability

- g. ISO 9001 (1994) 4.9 Process Control
- h. ISO 9001 (1994) 4.10 Inspection and Testing
- i. ISO 9001 (1994) 4.13 Control of Non-conforming Product
- j. ISO 9001 (1994) 4.14 Corrective Action
- k. ISO 9001 (1994) 4.16 Quality Records
- l. ISO 9001 (1994) 4.18 Training

2 Product Quality Plan

The team associated with this project is totally committed to quality and all system documentation produced as part of the product will be reviewed internally by the Review team and produced in accordance with the standards and formats associated with the SEAL QMS.

The Quality Plan associated with this project is identified as M⁰⁰³, as defined in QS 195 SEAL QMS Project Documentation and Support Standard.

3 Project Management Plan

3.1 Overview

The aim of this Project Management Plan is to define the structure of this project and to create the technical products.

This resource plan must be formally approved by the M.Sc. Supervisor before work on the Technical products is undertaken.

3.2 Product Development Team

The development team comprises:

- The student undertaking this M.Sc. project.
- The supervisor of this M.Sc. project.
- Eskom IT Application Systems Quality & Metrics Advisor.
- Eskom IT Application Systems Manager.

3.3 Roles and Responsibilities

3.3.1 M.Sc. Student

- Establish and maintain a product plan for developing this product/service.
- Ensure all Technical Exceptions are properly reported.
- Prepare Detailed Work Plans as necessary.
- Prepare and present regular Checkpoint Reports to the M.Sc. Supervisor.
- Take direction from the M.Sc. Supervisor for matters related to the project.
- Act as the Project Editor for the product.

3.3.2 M.Sc. Supervisor

- Monitor progress and resource utilisation of the Product Team, and initiate corrective action where necessary.

- Identify required resources and make these available to the team.
- Act as the focal reporting point for the product
- Ensure that Product Reviews are held as planned..
- Interface to the SEAL Management board.
- Be responsible for the timely delivery of the product.
- Give direction to the Product development team.

4 Product Development Plan

4.1 Work Breakdown Structure

4.2 Dependencies

4.2.1 Internal dependencies

- Availability of Eskom IT documentation and staff to conduct SPICE assessments.
- Availability of PEP and FPA information.
- Availability of the SPICE tools and techniques.
- Availability of hardware and software to run the tools for FPA and SPICE.
- Changes in the SPICE document set.
- Lack of planned versus actual information to record nonconformances.
- Approval of SPICE as an international standard after the Phase 2 Trials.
- Termination of subscription to Quantimetrix for PEP and FPA.
- Termination / expiration of SPICE contract.

4.2.2 External dependencies

4.3 Required Human Resources

The following resources are required to develop the product:

Number	Resource	Commitment
1	M.Sc. Supervisor	2.5% throughout the project
2	M.Sc. Student	50% throughout the project
3	Eskom IT Application Systems Quality & Metrics Advisor	2% throughout the project
4	Eskom IT Application Systems Manager	1% throughout the project

4.4 Available Human Resources

The following human resources are available as on 96/03/01:

Who	Contact Details(postal address, phone, fax, e-mail addresses)	MLA QMS role
Prof. Alastair Walker	Director: Software Engineering Applications Laboratory Department of Electrical Engineering University of the Witwatersrand Private Bag 3, P O Wits, 2050 Johannesburg, SOUTH AFRICA Tel: +27 11 716-5469 Fax: +27 11 403-1929 Cell: 082-452-0933 Internet E-mail: walker@odie.ee.wits.ac.za	M.Sc. Supervisor
Melanie Lang	Eskom IT Application Systems Department Megawatt Park, Sunninghill PO Box 1091 Johannesburg 2000 Tel: (W) +27 11 800-3259 Tel: (H) +27 11 835-2437 Fax: +27 11 800-5996 Internet E mail: langmt@mwp.eskom.co.za	M.Sc. Student
Ian Campbell	Eskom IT Application Systems Department Megawatt Park, Sunninghill	Eskom IT Application Systems Quality Manager

Who	Contact Details(postal address, phone, fax, e-mail addresses)	MLA QMS role
	PO Box 1091 Johannesburg 2000 Tel: +27 11 800-3572 Fax: +27 11 800-2197 Internet E mail: campbeli@mwp.eskom.co.za	
Erich Roberts	Eskom IT Application Systems Manager Megawatt Park, Sunninghill PO Box 1091 Johannesburg 2000 Tel: +27 11 800-3007 Fax: +27 11 800-2197 Internet E mail: robertef@mwp.eskom.co.za	Eskom IT Application Systems Manager

4.5 Human Resource allocation

The allocation of individuals to specific tasks is given in WBS and Schedule.

4.6 Hardware and Software Resources.

The following hardware and software resources are required:

Hardware/software items	Quantity	Date required	Date supplied
Function Point Workbench software version 2.02F	1	96\04\16	96\04\11
SEAL of Quality SPICE Assessment Instrument version 0.70	1	96\06\01	96\02\09
CSC Performance Enhancement Programme Software Windows	1	96\06\01	96\04\24

Hardware/software items	Quantity	Date required	Date supplied
Version 3.10			
Compatible PC to run Function Point Workbench software	1	96\04\03	96\03\01
Compatible PC to run SEAL Of Quality software	1	96\06\01	96\03\01
Compatible PC to run PEP software	1	96\06\01	96\03\01

4.7 Training Needs Identification.

The following training is required for this project:

Project Member	Course Title	Offered by	Course date / performed	Attended?
Melanie Lang	SEAL Summer School: 96-02 Software Quality: Principles 96-03 Software Quality: Practices 96-04 Software Quality and ISO 9000: Concepts 96-05 Software Quality and ISO 9000: Documentation 96-08 SPICE Principles 96-09 SPICE Practices	SEAL	96\01\29 - 96\02\09	Yes
Melanie Lang	Function Point Analysis	Quantimetrics and IFPUG	95\09\01	Yes
Melanie Lang	Function Point Workbench software	Nonformal		N/A
Melanie Lang	PEP software	Nonformal		N/A
Melanie Lang	SEAL of Quality software	SEAL 96-09	96\02\09	Yes
Melanie Lang	Research Course Hypertext Version	Nonformal	-	N/A
Christine Griesel	SEAL Summer School: 96-02 Software Quality: Principles 96-03 Software Quality: Practices	SEAL	96\01\29 - 96\02\09	Yes

Project Member	Course Title	Offered by	Course date / performed	Attended?
	96-08 SPICE Principles 96-09 SPICE Practices			
Jessica van Wyk	Function Point Analysis	Quantimetric s and IFPUG	96\04\03	Yes
Jessica van Wyk	Function Point Workbench software	Nonformal		N/A
Jessica van Wyk	PEP software	Nonformal		N/A
Ian Campbell	SEAL Summer School: 97-05 SPICE Principles & Practices	SEAL	97\02\06 - 97\02\07	Yes

5 Project Control

5.1 Planning

The planning of different tasks of this project will be performed by the M.Sc. Student under the approval of the M.Sc. Supervisor.

Any detailed plan will not be executed without the approval of the M.Sc. Supervisor.

5.2 Reviewing

- All draft versions of the product will be reviewed by the M.Sc. Supervisor.
- In addition, certain versions which are so specified in the Work Breakdown Structure will be reviewed by the members of other product groups.

5.2.1 Planned Arrangements for Reviews

All project artefacts (i.e. Management, Technical, and Quality Assurance Products) are subject to review. Management and Technical Products may be subject to a number of revisions before a product is approved by the M.Sc. Supervisor. QA Products are not normally changed after being produced and are simply approved by the M.Sc. Supervisor. (Changes are only made if there are factual errors in the first revision.)

The obligations of M.Sc. Supervisor and M.Sc. Student associated with each review activity are listed in the Work Breakdown Structure, Obligations and Schedule (Section 7).

5.2.2 Scheduling of Reviews

Each Management and Technical Product identified in the Work Breakdown Structure (Section 7) will be reviewed by the M.Sc. Supervisor. This will normally take place in a review meeting. These meetings will be listed in the Project Schedule, and typically identified with the product(s) (or WBS item(s)) under review.

5.2.3 Records of Reviews

Records of review meetings are maintained as minutes taken at the meetings. These review meeting minutes will be listed as entries in the QA Products in the Project Master Document List (MLA 001).

5.3 Reporting

Control is affected by both monitoring and reporting upon progress to management and members of the team.

5.3.1 Responsibilities of the M.Sc. Student

The M.Sc. Student(s) will report to the M.Sc. Supervisor at intervals defined in the Minutes of Product Review Meetings detailing:

- Progress to date
- Effort required to complete
- Problems encountered and action taken

5.3.2 Responsibilities of the M.Sc. Supervisor

- The M.Sc. Supervisor will initiate corrective action as necessary to keep the project on schedule.
- The M.Sc. Supervisor will report the progress of the project to the SEAL Management Board.

5.4 Document control

Document control will be performed as per SEAL QMS policy and procedures:

- QS125 SEAL QMS Document and Data Control
- QS 195 SEAL QMS Project Documentation Standard
- In accordance the requirements of QS 195, this document will be numbered as MLA 005.
- The Management and Technical products identified in the WBS in Section 7 will be reflected in the the Master Document List for this project (MLA 001).

5.5 Change Control

- I. Any work outside of the Product Description (MLA004) will be formally approved by the M.Sc. Supervisor.

2 Budget

WBS Task	Description	Labour Cost	Equip Cost	Material Cost	Office Space	Support Staff	Training Cost	Total
FPA								
6.1.	IFPUG Subscription							
6.2.	Function Point Workbench software							
6.3.	FPA Counts							
SPICE								
6.4.	SPICE Licence Fee							
6.5.	SEAL of Quality Software (included in 6.4 price)							
6.6.	SPICE Assessments							
PEP								
6.7.	PEP Subscription							
6.8.	PEP Software							
6.9.	PEP Data Capture							
Totals								

3 Work Breakdown Structure, Obligations and Schedule

Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
1.MANAGEMENT PRODUCTS										
1.1.Master Document List	MLA001	ML, AW	Create and maintain document	Review & approve		95	96\04\09	96\04\09	-	96\04\26
1.2.Document Creation Template	MLA002	ML, AW	Create and maintain document	Review & approve		6	96\04\18	96\04\18	-	96\05\10
1.3.Quality Plan	MLA003	ML, AW	Create and maintain document	Review & approve		4	96\07\23	96\07\23	-	97\05\05
1.4.Product Description	MLA004	ML, AW	Create and maintain document	Review & approve		12	96\03\29	96\03\29	-	96\05\10
1.5.Project Management Plan	MLA 005	ML, AW	Create and maintain document	Review & approve		9	96\04\19	96\04\19	-	96\05\10
1.6.Project Management Plan part 2	MLA 005- 10	ML, AW	Create and maintain document	Review & approve		83	96\04\19	96\04\19	-	97\10\24

Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
1.7.Configuration Management Plan	MLA006	ML, AW	Create and maintain document	Review & approve		8	96\04\09	96\04\09	-	96\04\26
1.8.Contract	MLA007	ML, AW	Create and maintain document	Review & approve			96\02	96\02	-	96\03\01
1.9.Binder Labels	MLA008	ML, AW	Create and maintain document	Review & approve		7	96\04\10	96\04\10	-	96\04\26
1.10.Archive Diskette Labels & Database	MLA009, MLA009-10	ML, AW	Create and maintain document	Review & approve		10	96\05\08	96\05\08	-	96\05\10
1.11.Minutes of Meetings Template	MLA010	ML, AW	Create and maintain document	Review & approve		2	96\04\09	96\04\09	-	96\04\12
1.12.Document Issue Notice Template	MLA011	ML, AW	Create and maintain document	Review & approve		3	96\04\09	96\04\09	-	96\04\12
1.13.Email Distribution list for all core group members	MLA1000	ML, JW, AW	Create and update	Review & approve		5	96\04\19	96\04\19	-	96\04\26

Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
1.14.Email Distribution list for core group members	MLA1001	ML, AW	Search for existing sources of information in the library, or Internet.	Advise where existing 'classic' literature could be found.		4	96\04\19	96\04\19	-	96\04\26
1.15.Email Distribution list for extended core group members	MLA1002	ML, AW	Create and update	Review & approve		5	96\04\19	96\04\19	-	96\04\26
2.TECHNICAL PRODUCTS										
2.1.Front Pages	MLA100	ML, AW	Create and maintain document	Review & approve		11	96\07\09	96\07\09	98\02\01	98\08\07
2.2.Summary & Overview	MLA110	ML, AW	Create and maintain document	Review & approve		4	96\07\09	96\07\09	98\02\01	98\08\07
2.3.Final Paper	MLA 120	ML, AW	Create and maintain document	Review & approve		32	96\07\09	96\07\09	98\02\01	98\08\07
2.4.FPA and SPICE Information Sources	MLA 121	ML, JW AW	Search for existing sources of information in the library, or Internet.	Advise where existing 'classic' literature could be found.		8	97\03\25	97\03\25	98\02\01	98\08\07

Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
2.5.Product Description: Technical Paper for SAISCIT 97	MLA 122	ML, AW	Create and maintain document	Review & approve		6	97\05\05	97\05\05		97\09\23
2.6.Abstract: Technical Paper for SAISCIT 97	MLA 123	ML, AW	Create and maintain document	Review & approve		2		97\07\22		97\08\13
2.7.Technical Paper for SAISCIT 97	MLA 124	ML, AW	Create and maintain document	Review & approve		11	97\07\25	97\07\25	97\09\30	97\10\04
2.8.Presentation for SAISCIT 97	MLA 125	ML, AW	Create and maintain document	Review & approve		3	97\09\30	97\09\30	97\10\12	97\10\24
2.9.Updated Technical Paper	MLA 126	ML, AW	Create and maintain document	Review & approve		1		97\11\02		97\11\02
2.10.Research Assessment	MLA130	ML, AW	Create and maintain document	Review & approve		16	96\07\09	96\07\09	98\02\01	98\08\07
2.11.Bibliography & References	MLA 140	ML, AW	Create and maintain document	Review & approve		15	96\07\09	96\07\09	98\02\01	98\08\07

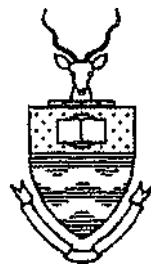
Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
2.12.Learning from the project	MLA 150	ML, AW	Create and maintain document	Review & approve		10	97\05\30	98\08\01	98\02\01	98\08\07
2.13.Literature Survey	MLA 160	ML, AW	Create and maintain document	Review & approve		12	97\05\30	98\08\01	98\02\01	98\08\07
2.14.Requirements Specification	MLA300	ML, AW	Create and update	Review & approve		6	96\04\18	96\04\18	-	96\04\26
2.15.Stakeholder Needs Analysis	MLA301	ML, AW	Create and update	Review & approve		5	97\01\16	97\01\16	-	97\05\05
2.16.Communication Plan	MLA302	ML, AW	Create and update	Review & approve		3	97\01\17	97\01\17	-	97\03\25
2.17.Feasibility Study for Project A	MLA303	ML, AW	Create and update	Review & approve		4	97\03\25	97\03\25	-	97\05\05
2.18.Work Breakdown Structure for Project A	MLA304	ML, AW	Create and update	Review & approve		6	97\03\25	97\03\25	-	97\05\05
2.19.Quality Plan for Project A	MLA305	ML, AW	Create and update	Review & approve		4	97\03\25	97\03\25	-	97\05\05
2.20.SPICE Assessment Working Document for Project A	MLA306	ML, AW	Create and update	Review & approve		14	97\04\20	97\04\20	97\05\06	97\10\24
2.21.SPICE Assessment Trials Questionnaire for Project A	MLA307	ML, AW	Create and update	Review & approve	1	3	97\05\06	97\05\05	97\12\01	97\01\17

Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
2.22.SPICE Assessment Feedback Report for Project A	MLA308	ML, AW	Create and update	Review & approve	1	11	97\05\06	97\05\21	97\12\01	98\06\18
2.23 SPICE Assessment Feedback Presentation for Project A	MLA309	ML, AW	Create and update	Review & approve	1	7	97\05\06	98\05\06	97\12\01	98\06\18
2.24.FPA Count for Project A	MLA310	ML, AW	Create and maintain document	Review & approve		4	96\04\01	97\05\05	96\06\30	97\09\22
2.25.SPICE Profile for Project A	MLA311	ML, AW	Create and maintain document	Review & approve		3	97\05\12	97\05\19	97\06\01	97\10\24
2.26.PEP Footprint for Project A	MLA312	ML, AW	Create and maintain document	Review & approve		3	96\04\01	97\05\05	96\12\30	97\09\19
2.27.Feasibility Study for Project B	MLA313	ML, AW	Create and update	Review & approve	2	2	97\05\05	97\05\05	97\06\06	97\05\09
2.28.Work Breakdown Structure for Project B	MLA314	ML, AW	Create and update	Review & approve	2	4	97\05\05	97\05\05	97\06\06	97\05\16
2.29.Quality Plan for Project B	MLA315	ML, AW	Create and update	Review & approve	2	3	97\05\05	97\05\05	97\06\06	97\05\16
2.30.SPICE Assessment Working Document for Project B	MLA316	ML, AW	Create and update	Review & approve	5	23	97\05\05	97\05\05	97\06\06	97\10\24

Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
2.31.SPICE Assessment Trials Questionnaire for Project B	MLA317	ML, AW	Create and update	Review & approve	1	2	97\05\23	97\05\05	97\12\01	97\01\17
2.32.SPICE Assessment Feedback Report for Project B	MLA318	ML, AW	Create and update	Review & approve	1	8	97\05\26	97\05\28	97\12\01	98\06\18
2.33.SPICE Assessment Feedback Presentation for Project B	MLA319	ML, AW	Create and update	Review & approve	1	5	97\05\26	98\05\08	97\12\01	98\06\18
2.34.FPA Count for Project B	MLA320	ML, AW	Create and maintain document	Review & approve		6	96\04\01	97\05\05	96\06\30	97\09\22
2.35.SPICE Profile for Project B	MLA321	ML, AW	Create and maintain document	Review & approve		2	96\04\01		97\06\01	97\10\24
2.36.PEP Footprint for Project B	MLA322	ML, AW	Create and maintain document	Review & approve		3	96\04\01	97\05\05	96\12\30	97\09\19
2.37.Feasibility Study for Project C	MLA323	ML, AW	Create and update	Review & approve	1	2	97\05\05	97\05\05	97\06\06	97\05\09
2.38.Work Breakdown Structure for Project C	MLA324	ML, AW	Create and update	Review & approve	1	4	97\05\05	97\05\05	97\06\06	97\05\16
2.39.Quality Plan for Project C	MLA325	ML, AW	Create and update	Review & approve	1	3	97\05\05	97\05\05	97\06\06	97\05\16

Project Artefact (WBS item)	Doc. No	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
2.40.SPICE Assessment Working Document for Project C	MLA326	ML, AW	Create and update	Review & approve	5	16	97\05\05	97\05\05	97\12\01	98\05\06
2.41.SPICE Assessment Trials Questionnaire for Project C	MLA327	ML, AW	Create and update	Review & approve	1	2	97\05\23	97\05\05	97\12\01	97\01\17
2.42.SPICE Assessment Feedback Report for Project C and D	MLA328	ML, AW	Create and update	Review & approve	1	7	97\05\26	97\05\28	97\12\01	98\06\18
2.43.SPICE Assessment Feedback Presentation for Projects C and D	MLA329	ML, AW	Create and update	Review & approve	1	5	97\05\26	97\05\08	97\12\01	98\06\18
2.44.FPA Count for Project C	MLA330	ML, AW	Create and maintain document	Review & approve		5	96\04\01	97\05\05	96\06\30	97\09\22
2.45.SPICE Profile for Project C	MLA331	ML, AW	Create and maintain document	Review & approve		3	96\04\01	98\05\05	97\06\01	98\05\05
2.46.PEP Footprint for Project C	MLA332	ML, AW	Create and maintain document	Review & approve		3	96\04\01	97\05\05	96\12\30	97\09\19
2.47.SPICE Assessment Trials Questionnaire for Project D	MLA337	ML, AW	Create and update	Review & approve	1	1	97\05\23	97\05\05	97\12\01	97\01\17
2.48.FPA Count for Project D	MLA340	ML, AW	Create and maintain document	Review & approve		4	96\04\01	97\05\05	96\06\30	97\09\22

Project Artefact (WBS item)	Doc. No.	Who	Obligations		Effort (days)		Start Date		End Date	
			Developer	Manager	Est.	Act	Sched- uled	Actual	Sched- uled	Actual
2.49.SPICE Profile for Project D	MLA341	ML, AW	Create and maintain document	Review & approve		3	96\04\01	98\05\05	97\06\01	98\05\05
2.50.PEP Footprint for Project D	MLA342	ML, AW	Create and maintain document	Review & approve		2	96\04\01	97\05\05	96\12\30	97\09\19
2.51.SPICE Assessment Feedback Summary	MLA348	ML, AW	Create and update	Review & approve	1	5		98\05\12		98\06\18
2.52.SPICE Assessment Feedback Summary Presentation	MLA349	ML, AW	Create and update	Review & approve	1	4		98\05\12		98\06\18
2.53.Product Description: SPICE Assessment Report	MLA350	ML, AW	Create and maintain document	Review & approve		1		98\05\05		98\05\05
2.54.SPICE Assessment Feedback Questionnaire	MLA351	ML, AW	Create and maintain document	Review & approve		1		98\05\12		98\05\12
2.55.Comparisons of outputs	MLA352	ML, AW	Create and maintain document	Review & approve		12	98\05\11	98\05\12	98\05\15	98\08\07
2.56.Product Description: Higher Degree Technical Paper	MLA353	ML, AW	Create and maintain document	Review & approve		1		98\06\03		98\06\03



MLA QMS

Configuration Management Plan

Management Product

Version 1.03

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iv
Configuration Control	iv
Document History	iv
Revision History	iv
Management Authorisation	v
Change Forecast	v
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Audience	1
1.5 Applicable Documents	2
1.6 Requirements Traceability	2
1.7 Procedures for document updates	2
2 Documentation Structure	3
3 Artefact Identification	4
3.1 File Naming Convention	4
3.2 Project document and record sequence numbering	7
4 Artefact Management	8
4.1 Development Computer used for creating the files	8
4.2 Directory Structure of the Development Computer	8

4.3 Directory Structure of files supported on the Eskom mirror server of SEAL	9
4.4 Directory Structure of files supported on the SEAL File Server.....	9
5 Archiving of Artefacts.....	11
5.1 Electronic Artefacts.....	11
5.2 Backup procedure on development computer in Eskom.....	11
5.3 Backup procedure of Eskom Infrastructure server.....	11
5.4 Backup of files to the SEAL FILE Server	11
5.5 Hardcopy Records	12
6 Configuration Status Accounting.....	13

Change History

Configuration Control

Project:	MLA QMS
Title:	Configuration Management Plan
Doc. Reference:	C:\MY DOCUMENTS\1996_24\MP\MLA006.103
Created by:	Melanie Lang
Creation Date:	25 March 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	96\04\09	Draft	MT Lang	MLA006.001
1.00	96\04\17	Approved	MT Lang	MLA006.100
1.01	96\05\08	Approved	MT Lang	MLA006.101
1.02	97\01\17	Approved	MT Lang	MLA006.102
1.03	97\03\25	Approved	MT Lang	MLA006.103

Revision History

Version	Date	Changes
0.01	96\04\09	New document created using QST12870.102
0.01	96\04\10	Addition of Eskom Infrastructure server backup procedure as given telephonically by Hannes van Heerden
1.00	96\04\17	Modifications of document as per MLA 2003 section 2.5
1.01	96\05\08	Modifications of document as per MLA 2005 section 2.7
1.01	96\06\07	Modifications of document after review by Christine Griesel
1.01	96\06\14	Modifications to document re: MLA 2003 section 2.5
1.02	97\01\17	Modifications with accordance to departmental restructuring. Update of location.
1.03	97\03\25	Modifications with accordance to departmental restructuring, and change of directory structure on PC due to Windows 95

Management Authorisation

Version	Date	Status	Project Minute Reference
1.00	96\04\17	Approved	MLA 2003 section 2.5
1.01	96\05\08	Approved	MLA 2005 section 2.7

Change Forecast

1 Scope

1.1 Introduction

This document describes the configuration management plan applying to all artefacts supporting this project.

Such artefacts will include hardcopy and electronic representations of documents.

This document reviews the procedure which applies to the management and storage of these artefacts.

1.2 Purpose

Configuration items are individual documents and forms in electronic and hardcopy format. They comprise:

- management products and procedures
- technical products, and
- quality products

1.3 Applicability

To be referenced by all individuals who engage in product development for this project.

1.4 Audience

The following comprise the audience for this document:

- a. The student undertaking this M.Sc. project.
- b. Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- c. The supervisor of this M.Sc. project.
- d. Members of the SEAL Management Board
- e. Head of Department of Electrical Engineering

- f. Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.

1.5 Applicable Documents

1.5.1 Standards

- a. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994.

1.6 Requirements Traceability

- a. ISO9001 (1994) 4.5 Document Control
- b. ISO9001 (1994) 4.8 Product Identification and Traceability
- c. ISO9001 (1994) 4.13 Control of Non-conforming Product
- d. ISO9001 (1994) 4.16 Quality Records

1.7 Procedures for document updates

See MLA 001 Section 1.9 for details on the use of the Change Control elements of this document.

2 **Documentation Structure**

The documents are categorised to reflect the nature of their content. The key categories of documents include:

- management products,
- technical products, and
- quality assurance products.

3 Artefact Identification

This section defines a consistent referencing system that shall be used for all artefacts. All artefacts are identified by both an artefact filename followed by a artefact file extension in the following format, as described in the following paragraphs.

<name>.<extension>

3.1 File Naming Convention

3.1.1 Project Products

The file name will be structured as follows:

MLAXXXYY.ZZZ

Where MLA is the 3-letter acronym for this project,

XXX is the 3 digit sequence number of this document,

YY is a file type identifier as follows:

- WS - Wordstar
- WP - Word Perfect
- AS - pure ascii text
- HC - hard copy file (no source present)
- PS - postscript file
- nothing - default Word for Windows 6.0 file

ZZZ is the version number, starting from 001 as the initial version.

Example: QSM001AS.001, and interpreted as the document QSM001 of type Ascii and the first version in the sequence.

3.1.2 Code\ line art\ image files

The file name will be structured as follows:

MLAXXXYY.BBB

where

XXX is a 3digit serial number

YY is a two digit version number, in the range 01 to 99, and starting from 01.

BBB is the file extension and will be whatever the particular compiler/tool demands.

3.1.3 Records - Naming Conventions

3.1.3.1 Correspondence

The file naming convention is as follows:

<YYMMDD><SS>.<RRR>

Where YYMMDD is the date on which the correspondence items were received,

SS - two characters are allowed for the initials of the sender, and

RRR - up to three characters are allowed for the receivers initials.

3.1.3.2 Minutes of Project Meetings

The application of MLA 010 results in records of which the filename conventions are as follows:

<YYMMDD>-<N>.AGD, or MIN

where YYMMDD is the date on which the meeting was held,

N is a serial number between 1 and 9, and

AGD identifies Agenda's, and MIN identifies Minutes.

3.1.3.3 Audit Reports

The file naming convention of the SEAL QMS is used when the SEAL QMS templates (QST 137-20 QST 137-30, QST 137-40) are applied:

<Project Year Serial Number><Audit Type><Audit serial number>.PAR

where Project Year and Serial number for this project is 9547 (i.e. SEAL Project 47 registered in 1995),

Audit type - can be PI (Project Initiation) IP (Project in Progress) and PC (Project Closure).

If the audit is an IP type, then the serial number will be in the range 01 to 99.

The filename extension PAR refers to Project Audit Report.

3.1.3.4 Document Issue Notices

The application of MLA 011 generates records which have the naming convention of:

<YYMMDD>-<N>.DIN, where

<YYMMDD> is the date on which the notice was generated,

N is a serial number, allowing for multiple notices to be issued on one date, and

DIN refers to Document Issue Notice.

3.1.3.5 Call for Reviews

When MLA 012 is applied, the quality records generated have the filename conventions of:

<YYMMDD>-<N>.CFR, where

YYMMDD is the date on which the Call for Review was issued,

N is a serial number in the range 1 - 9, and

CFR - Call for Review.

Response to Call for Reviews are stored as:

<YYMMDD>-<N>.RCR

where YYMMDD is the date on which the response to the Call for Review was received,

N is a serial number of the responses received on a particular date, and

RCR refers to Response to Call for Review.

3.1.3.6 Project Issue Reports

Responses to the application of MLA 013 have the naming convention of:

<YYMMDD>-<N>.PIR, where

<YYMMDD> is the date on which the report was received,

N is a serial number, allowing for multiple reports to be received on one date, and

PIR refers to Project Issue Report.

3.1.3.7 Product Exception Reports

Responses to the application of MLA 014 have the naming convention of:

<YYMMDD>-<N>.PER, where

<YYMMDD> is the date on which the report was received,

N is a serial number, allowing for multiple reports to be received on one date, and

PER refers to Product Exception Report.

3.1.3.8 Inspections and Review records

The application of MLA 015 generates records which have the naming convention of:

<YYMMDD>-<N>.IRR, where

<YYMMDD> is the date on which the review record was received,

N is a serial number, allowing for multiple reports to be received on one date, and

IRR refers to Inspection and Review record.

3.2 Project document and record sequence numbering

- The MP series will be from 001 to 099
- The TP series will be from 100 - 999
- The QA series will be from 1000 ->

4 Artefact Management

The controls adopted for this project are as follows:

4.1 Development Computer used for creating the files

Eskom Computer System ZGRU (MP) is the resident computer.

4.2 Directory Structure of the Development Computer

4.2.1 Drive Partition

The c Drive partition is used.

4.2.2 Project Directory of files on the Development Computer

- *c:\My Documents\1996_24\MP* - for the storage of the management series documents
- *c:\My Documents\1996_24\TP* - used for the storage of technical product
- *c:\My Documents\1996_24\QA* - used for the storage of quality assurance products including minutes of review meetings, audits of the system, and correspondence.
- The sub-directories of the QA directory are as follows:
 - * CORRES - storage for correspondence items
 - * MINUTES - storage of agendas and minutes of Core Group meetings
 - * AUDITREP - storage for project audit reports
 - * NOTICES - Storage for Document Issue Notices
 - * REVIEWS - storage for Call for Review Notices and responses
 - * ISSUEREP - storage for Project Issue Reports
 - * PROBLEMS - storage for Product Exception Reports
 - * INSPECTN - Storage inspections and review records.

4.3 Directory Structure of files supported on the Eskom mirror server of SEAL

4.3.1 Project Directory

The *h:/spice/1996_24* directory is used.

4.3.2 Project Directory Structure

- 1996_24/mp - for the storage of the management series documents
- 1996_24/tp - used for the storage of technical product
- 1996_24/qa - used for the storage of quality assurance products including minutes of review meetings, audits of the system, and correspondence.
- The sub-directories of the QA directory are as follows:
 - * corres - storage for correspondence items
 - * minutes - storage of agendas and minutes of Core Group meetings
 - * auditrep - storage for project audit reports
 - * notices - Storage for Document Issue Notices
 - * reviews - storage for Call for Review Notices and responses
 - * issuerep - storage for Project Issue Reports
 - * problems - storage for Product Exception Reports
 - * inspectn - storage inspections and review records

4.4 Directory Structure of files supported on the SEAL File Server

4.4.1 Project Directory

The 1996_24 directory is used.

4.4.2 Project Directory Structure

- 1996_24/mp - for the storage of the management series documents
- 1996_24/tp - used for the storage of technical product

- 1996_24/qa - used for the storage of quality assurance products including minutes of review meetings, audits of the system, and correspondence.
- The sub-directories of the QA directory are as follows:
 - * corres - storage for correspondence items
 - * minutes - storage of agendas and minutes of Core Group meetings
 - * auditrep - storage for project audit reports
 - * notices - Storage for Document Issue Notices
 - * reviews - storage for Call for Review Notices and responses
 - * issuerep - storage for Project Issue Reports
 - * problems - storage for Product Exception Reports
 - * inspectn - storage inspections and review records

5 Archiving of Artefacts

5.1 Electronic Artefacts

On project completion an archive copy of all electronic artefacts supporting this projects will be supplied on one or more stiffy diskettes using the ARJ.EXE utility. These diskettes will be kept in the official SEAL plastic folders immediately inside the SEAL Project Binder.

5.2 Backup procedure on development computer in Eskom

The development computer in Eskom is subject to the following back-up procedure:

Daily Backup: Project files are archived to the Eskom Infrastructure server. This action ensures that these project artefacts are archived to a site outside the Eskom applications development department.

5.3 Backup procedure of Eskom Infrastructure server

The Eskom infrastructure server is subject to the following back-up procedure:

- a. **Incremental Backup:** Modified project files are backed up to tape during the week. This action ensures that these project artefacts are archived to a site outside of Eskom Megawatt Park.
- b. **Weekly Backup:** Full back up to tape every Saturday. This action ensures that these project artefacts are archived to a site outside of Eskom Megawatt Park.

5.4 Backup of files to the SEAL FILE Server

All projects associated with the SEAL are required to archive project files to the SEAL Server project directory on a regular basis.

- a. **Backup Frequency to SEAL Server:** The frequency of backups from this project to the SEAL File Server will be *weekly*.
- b. **Back to the File Server:** All project files are archived to the SEAL Project Directory. This action ensures that these project artefacts are archived to a offsite from the Development Computer.

5.5 Hardcopy Records

- a. **Project in progress:** Hardcopy records are maintained in an official SEAL Project Documentation Binder in the Project File in *Workstation L-7Block D1 Pillar Z44 at Megawatt Park*.
- b. **Project closed:** Hardcopy records are retained in an official SEAL Project Documentation Binder in *CM 3-232, Chamber of Mines Building*.

6 Configuration Status Accounting

The Project Manager is responsible for ensuring that status of artefacts recorded in the Master Document List corresponds to the:

- identity of the artefacts in the file directories, and
 - The revision numbers are correct.
- 



MLA QMS

FPA Count For Project A

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iii
Configuration Control	iii
Document History	iii
Revision History	iii
Management Authorisation	iii
Change Forecast	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Definitions	1
1.5 Audience	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 Summary	3
3 Data Function Types	4
4 Transactional Function Types	5
5 Value Adjustment Factor	7

Change History

Configuration Control

Project:	MLA QMS
Title:	FPA Count for Project A
Doc. Reference:	C:\MY DOC\MENTS\1996_24\TP\MLA310.100
Created by:	Melanie Lang
Creation Date:	23 September 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\05	Draft	Melanie Lang	MLA310.001
1.00	97\09\23	Approved	Melanie Lang	MLA310.100

Revision History

Version	Date	Changes
0.01	97\05\05	New document created from MLA002.102
1.00	97\09\22	Document approved
1.00	98\08\09	Document checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	97\09\23	Approved	MLA 2023 section 2.10.1

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the analysis and implementation function point counts done on Project A on 3 June 1996.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

2 Summary

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Function Type	Complexity Rating	Number of Functions		Function Points Awarded	Total Function Points	
EXTERNAL INPUTS	Low	20	23	3	60	69
	Average	3	3	4	12	12
	High	0	0	6	0	0
EXTERNAL OUTPUTS	Low	6	7	4	24	28
	Average	0	0	5	0	0
	High	0	0	7	0	0
EXTERNAL INQUIRIES	Low	6	9	3	18	27
	Average	0	0	4	0	0
	High	0	0	6	0	0
INTERNAL LOGICAL FILES	Low	3	3	7	21	21
	Average	1	0	10	10	0
	High	0	1	15	0	15
EXTERNAL INTERFACE FILES	Low	1	1	5	5	5
	Average	0	0	7	0	0
	High	0	0	10	0	0
TOTAL Number of UN-ADJUSTED Function Points					150	177
VALUE ADJUSTMENT FACTOR					0.97	0.97
TOTAL Number of ADJUSTED Function Points					146	172
Development Work Product					146	172

3 Data Function Types

Internal Logical Files = ILF

External Interface File = EIF

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Data	Type	Record Element Types	Data Element Types	Complexity	Multiplier	Function Points
1. Card	ILF	1	1-19	Low	1	7
	ILF	1	1-19	Low	1	7
2. CMS Interface	ILF	1	1-19	Low	1	7
	ILF	1	1-19	Low	1	7
3. Meter	ILF	Manufacturer Security Area Supply Group Token Technology Algorithm Type Matrix	1-19	Average	1	10
	ILF	Manufacturer Security Area Supply Group Token Technology Algorithm Type Matrix	20-50	High	1	15
4. Card Reader	EIF	1	1-19	Low	1	5
	EIF	1	1-19	Low	1	5
5. Actual Meter Card	ILF	1	1-19	Low	1	7
	ILF	1	1-19	Low	1	7

4 Transactional Function Types

External Input = EI

External Output = EO

External Inquiry = EQ

Complexity = Com

Low = L

Average = A

High = H

Multiplier = Mult.

Function Points = FPs

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Transaction	Type	File Types Referenced		Data Element Types		Com	Mult		FPs	
1.Report Files										
1.1.Report Input	EI	[1]	[1]	5-15	5-15	L	1	1	3	3
1.2.Report Output	EO	[1]	[1]	6-19	6-19	L	1	1	4	4
1.3.Report Output - Summary	EO	[1]	[1]	6-19	6-19	L	1	1	4	4
1.4.Mods to existing reports										
1.4.1.Customer List	EO		[1]		1-5	L		1		4
2.Card Reader Info	EQ		[4]		1-4,6-19	L		1		3
3.Maintain Cards										
3.1.Add Card	EI	[1],[3]	[1],[3]	5-15	5-15	A	1	1	4	4
3.2.Modify Card	EI	[1],[3]	[1],[3]	5-15	5-15	A	1	1	4	4
3.3.Delete Card	EI	[1]	[1]	1-4	1-4	L	1	1	3	3
3.4.Make Card	EI	[1],[5]	[1],[5]	5-15	5-15	A	1	1	4	4
3.5.Find Card	EQ		[1],[5]		1-4,6-19	L		1		3
3.6.Inquiry	EQ	[1]	[1]	1-4,1-5	1-4,1-5	L	1	1	3	3
4.Show Card Info	EQ	[5]	[5]	1-4,1-5	1-4,1-5	L	1	1	3	3
5.Lookup Tables										
5.1.1.Add Meter Files	EI	[3]	[3]	1-4	1-4	L	4	5	12	15

5.1.2.Modify Meter Files	EI	[3]	[3]	1-4	1-4	L	L	4	5	12	15
5.1.3.Delete Meter Files	EI	[3]	[3]	1-4	1-4	L	L	4	5	12	15
5.1.4.Inquiry Meter Files	EQ	[3]	[3]	1-4,1-5	1-4,1-5	L	L	4	5	12	15
6.Import											
6.1.Input	EI	[2]	[2]	5-15	5-15	L	L	1	1	3	3
6.2.Output	EO	[1]	[1]	6-19	6-19	L	L	1	1	4	4
7.Export											
7.1.Input	EI	[1]	[1]	5-15	5-15	L	L	1	1	3	3
7.2.Output	EO	[2]	[2]	6-19	6-19	L	L	1	1	4	4
8.Messages	EI			1-4	1-4	L	L	1	1	3	3
9.Validation	EI			1-4	1-4	L	L	1	1	3	3
10.Download											
10.1.Input	EI	[3]	[3]	5-15	5-15	L	L	1	1	3	3
10.2.Output	EO	[1]	[1]	6-19	6-19	L	L	1	1	4	4
11.Upload											
11.1.Input	EI	[1]		5-15		L	L	1	1	3	3
11.2.Output	EO	[3]		6-19		L	L	1	1	4	4

5 Value Adjustment Factor

This remained the same for both the analysis and implementation counts.

General System Characteristic	Rating
1.Data Communication	5
2.Distributed Processing	2
3.Performance	1
4.Heavily Used Configuration	3
5.Transaction Rates	0
6.On-line Data Entry	5
7.Design for Enduser Efficiency	3
8.On-line update	4
9.Complex Processing	2
10.Usable in other Applications	0
11.Installation Ease	2
12.Operational Ease	2
13.Multiple Sites	2
14.Facilitate Change	1
Total Degree of Influence (TDI)	32

$$\text{Value Adjustment Factor} = (\text{TDI} * 0.01) + 0.65$$

$$= (32 * 0.01) + 0.65$$

$$= 0.32 + 0.65$$

$$= 0.97$$



MLA QMS

PEP Footprint For Project A

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History.....	iii
Configuration Control.....	iii
Document History	iii
Revision History.....	iii
Management Authorisation	iii
Change Forecast.....	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose.....	1
1.3 Applicability.....	1
1.4 Definitions	1
1.5 Audience.....	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 PEP Footprint	3
3 Details	4

Change History

Configuration Control

Project:	MLA QMS
Title:	PEP Footprint for Project A
Document Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA312.100
Created by:	Melanie Lang
Creation Date:	9 August 1998

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\05	Draft	Melanie Lang	MLA312.001
1.00	98\08\09	Approved	Melanie Lang	MLA312.100

Revision History

Version	Date	Changes
0.01	97\05\05	New document created from MLA002.102
1.00	98\08\09	Document Checked and Approved

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	98\08\09	Approved	MLA 2031 section 2.10

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the PEP footprint received from Quantimetrix and CSC for project A.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

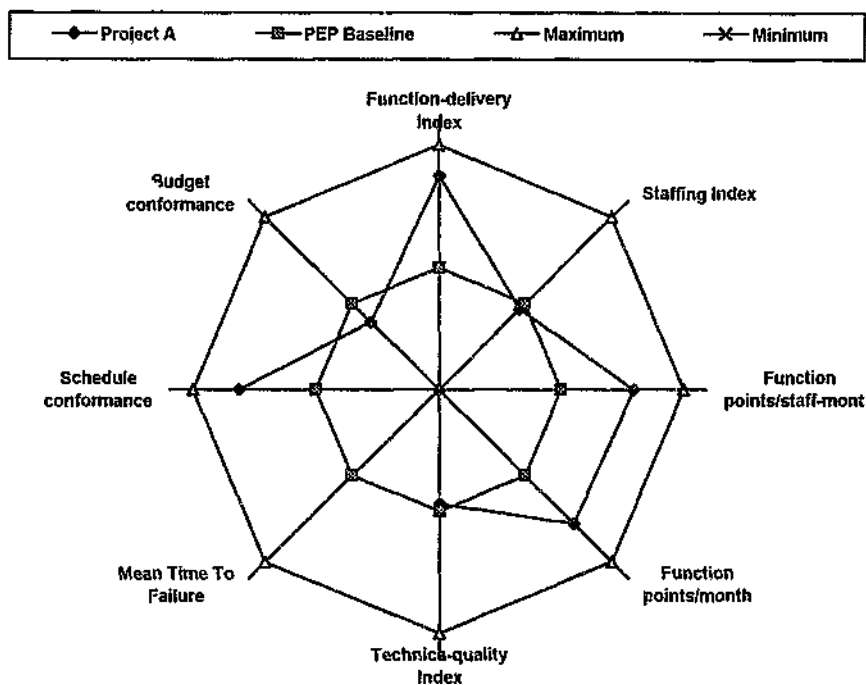
1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

2 PEP Footprint



3 Details

	Actual	Baseline	Difference / Multiple
Fdi (AB)	21.6	14	7.6
SI (AB)	8.6	7.2	1.4
fp/sm	60	15	4.0
fp/mo	101	25	4.0
Time Slippage %	-7%	25%	-0.3
Effort overrun %	58%	20%	2.9
Tql	9.2	10.0	-0.8
MTTF	1.0	13.4	0.1



MLA QMS

Work Breakdown Structure For Project A

Management Product

Version 1.03

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History.....	iii
Configuration Control.....	iii
Document History	iii
Revision History.....	iii
Management Authorisation.....	iii
Change Forecast.....	iii
1 Scope	4
1.1 Introduction.....	4
1.2 Purpose.....	4
1.3 Applicability.....	4
1.4 Definitions	4
1.5 Audience	4
1.6 Applicable Documents	4
1.7 Assumptions	5
1.8 Requirements Traceability	5
2 Proposed Project approach	6
2.1 Key for table below:.....	6
2.2 Phase 1: Preparation and planning	1
2.3 Phase 2: Assessment and analysis.....	2
2.4 Phase 3: Reporting and close-out.....	3

Change History**Configuration Control**

Project:	MLA QMS
Title:	Work Breakdown Structure for Project A
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TPW\MLA304.103
Created by:	Melanie Lang
Creation Date:	8 August 1998

Document History

Version	Date	Status	Who	Saved as:
0.01	97\03\25	Draft	Melanie Lang	MLA304.001
1.00	97\05\05	Approved	Melanie Lang	MLA304.100
1.01	97\05\16	Approved	Melanie Lang	MLA304.101
1.02	98\05\08	Approved	Melanie Lang	MLA304.102
1.03	98\08\09	Approved	Melanie Lang	MLA304.103

Revision History

Version	Date	Changes
0.01	97\03\25	New document created from MLA002.102
1.00	97\05\05	Modifications to document re: MLA 2017 section 2.22
1.01	97\05\16	Additions of actual schedule.
1.02	98\05\08	Additions of actual schedule and outputs.
1.02	98\06\28	Additions of actual schedule and outputs.
1.03	98\08\09	Document Checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	97\05\05	Approved	MLA 2017 section 2.22

Change Forecast

1 Scope**1.1 Introduction**

This document goes into the detail in section 10 of MLA303.

1.2 Purpose

To manage the subproject of a SPICE assessment on a process instance which has been part of the previous PEP project cycle.

1.3 Applicability**1.4 Definitions****1.5 Audience**

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents**1.6.1 Specifications****1.6.2 Standards**

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 **Assumptions**
- 1.8 **Requirements Traceability**

2 Proposed Project approach

The high level proposed project approach from the feasibility study document has been expanded below:

2.1 Key for table below:

Under the actual person-hours column, numbers which appear in brackets indicate tasks which have already been integrated with another, indicated firstly by the heading number, and then the number of the row in square brackets.

All dates are for 1997, unless otherwise recorded.

Where estimates differ from actuals, the actuals are placed in [] after the estimate.

2.2 Phase 1: Preparation and planning

TASK		OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
1.	Assessment Initiation	ML	Complete		18/03	18/03	1
1.1.	Initiate assessment - secure project and agreement or contract	ML	Complete				
1.2.	Establish processes and area to be assessed, as well as work products	ML	Complete				
2.	Define and document process	ML	Complete		25/03	05/05	9
2.1.	Preparing the Assessment Input	ML	Complete	MLA 303			
2.2.	Develop Feasibility Study	ML	Complete	MLA 303			
2.3.	Develop Work Breakdown	ML	Complete	MLA 304			
2.4.	Develop Quality Plan	ML	Complete	MLA 305			
3.	Conduct training	ML	Complete				
3.1.	Assessor training in use of SPICE, instrument and tool	ML	Complete		07/02/1996	08/02	16
3.2.	Prepare training material	ML	None	-	-	-	-
3.3.	Briefing the sponsor and/or OU staff about the methodology to be used	ML	Complete		18/03	18/03	(2.2[1])
4.	Preparation	ML	Complete				
4.1.	Schedule assessment interviews	ML	Complete		26/03	30/04	1
4.2.	Review input with assessment sponsor, obtain approval and validate assessor qualifications.	ML	Complete		01/04	01/04	(2.2[1])
4.3.	Informal site visits to get the 'feel' for the processes and products - this was part of the function point count.	ML	Complete		1996	1996	?

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
4.4. Select compatible model, method and instrument	ML	Complete		25/03	25/03	(2.2{1})

2.3 Phase 2: Assessment and analysis

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
1. Conduct assessment	ML	Complete	Sealq.db	18/04	06/05 [24/06]	12
1.1. Record a rating for each process attribute for each process instance	ML	Complete				
1.2. Collect objective evidence to substantiate the ratings, based on indicators, including:	ML	Complete				
1.2.1. practices examined	ML	Complete				
1.2.2. work products examined	ML	Complete				
1.2.3. people interviewed	ML	Complete				
1.2.4. rating justification	ML	Complete				
2. Analyse Findings	ML	Complete	MLA 306	18/04	06/05 [30/09]	13
2.1. Verify and validate the ratings and evidence and correct assessment accordingly	ML	Complete	MLA 306	18/04	06/05 [30/09]	
2.2. Manage risks and quality of ratings and evidence and correct plan accordingly	ML	Complete	MLA 306	18/04	06/05 [30/09]	
2.3. Record set of process attribute ratings as a process profile	ML	Complete	MLA 306	18/04	06/05 [30/09]	

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
2.4. Record evidence to verify compliance with the requirements from:	ML	Complete	MLA 303	25/03	05/05	(2.2[2.1])
2.4.1. reference model part 2 and exemplar model part 5	ML	Complete				
2.4.2. conducting an assessment part 3, including defined indicators	ML	Complete				
2.4.3. documented process	ML	Complete				
2.4.4. assessor guidance and competence part 5	ML	Complete				
2.4.5. choice of assessment instrument part 4.	ML	Complete				
2.5. Negotiate modifications to the assessment input with the sponsor	ML	Complete	MLA 305	18/04	06/05	
2.6. Review the assessment results with independent internal and correct assessment accordingly	ML	Complete		06/05	06/05 [30/09]	

2.4 Phase 3: Reporting and close-out

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
1. Prepare assessment results	ML	Complete	MLA 308	06/05	13/05 [20/06/1998]	19
1.1. Document general findings, conclusion and recommendations	ML	Complete				
1.2. Generate report	ML	Complete				
2. Prepare assessment presentation	ML	Complete		06/05	13/05	

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
2.1. Prepare presentation, including venue, attendees and barco	ML	In Progress	MLA 309	06/05	13/05 [28/06/1998]	18
2.2. Present results to assessment participants	ML	In Progress				
2.3. Distribute assessment output for review	ML	In Progress				
3. Prepare assessment presentation to assessment owner and immediate stakeholders	ML			06/05	13/05	
3.1. Prepare presentation, including venue, attendees and barco	ML	Complete	MLA 349	06/05	13/05 [28/06/1998]	18
3.2. Present results to stakeholders	ML	Complete				
3.3. Distribute assessment output to stakeholders	ML	Complete				
4. Close out project	ML			06/05	13/05	
4.1. Complete trials questionnaires with interviewees	ML	No longer required				
4.2. Complete trials questionnaires with sponsor	ML	No longer required				
4.3. Assessor to complete trials questionnaires	ML	No longer required				
4.4. Prepare lessons learned and presentation comments document	ML	Complete	MLA 309	06/05	13/05 [28/06/1998]	18



MLA QMS

SPICE Profile For Project A

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iii
Configuration Control	iii
Document History	iii
Revision History	iii
Management Authorisation	iii
Change Forecast	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Definitions	1
1.5 Audience	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 SPICE Profile	3

Change History

Configuration Control

Project:	MLA QMS
Title:	SPICE Profile for Project A
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA311.100
Created by:	Melanie Lang
Creation Date:	19 May 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\18	Draft	Melanie Lang	MLA311.001
1.00	97\11\02	Approved	Melanie Lang	MLA311.100

Revision History

Version	Date	Changes
0.01	97\05\18	New document created from MLA002.102
0.01	97\09\30	Update of profile after final review
1.00	97\11\02	Document Approved

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	97\10\24	Approved	2.5

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from SPICE profile for project A.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

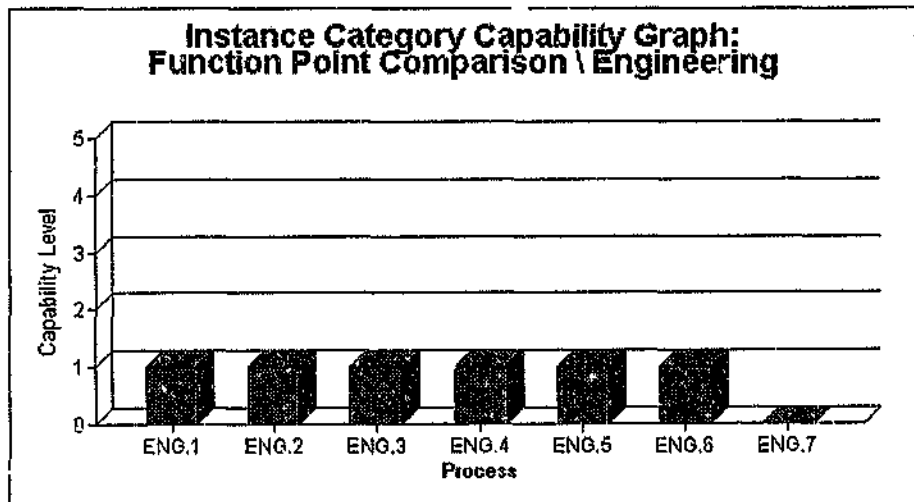
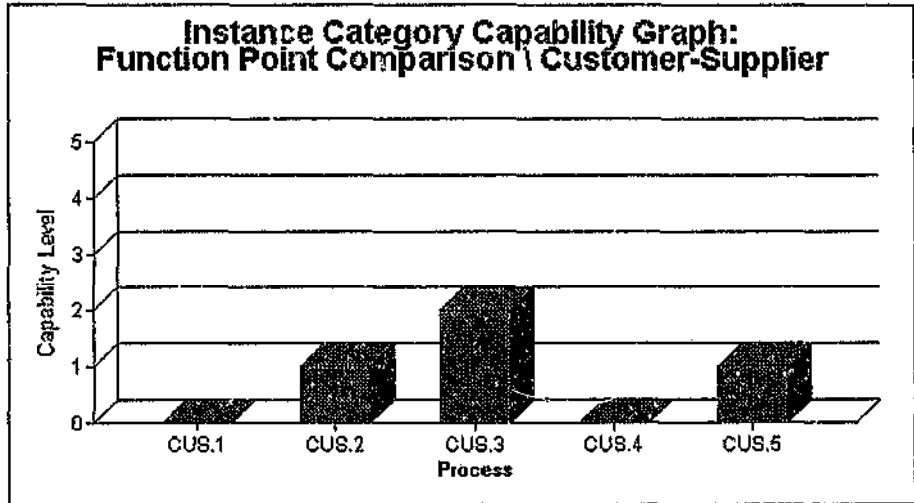
1.6.1 Specifications

1.6.2 Standards

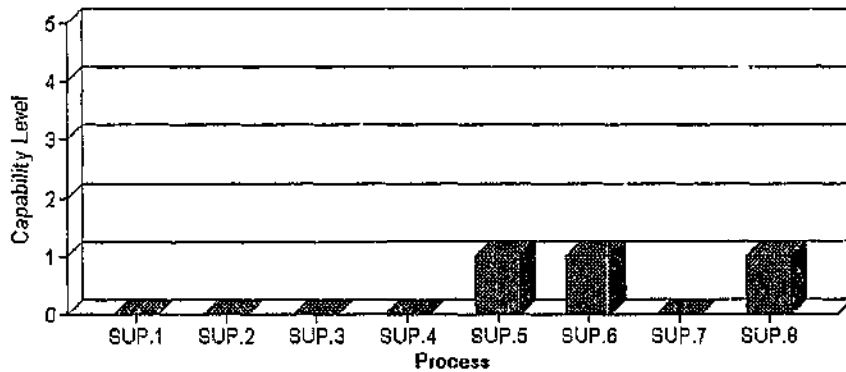
- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

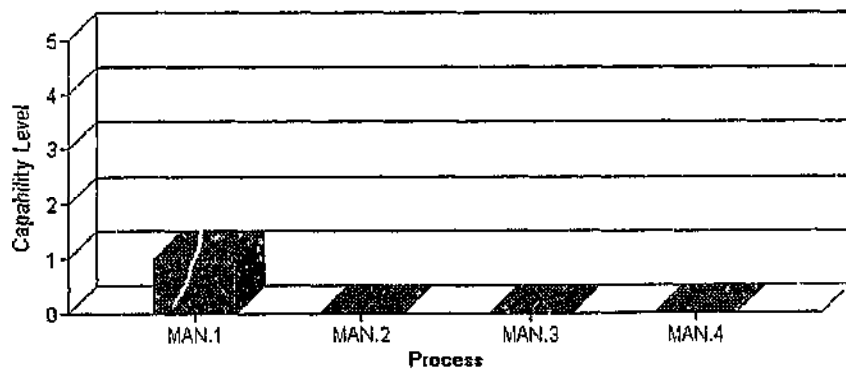
2 SPICE Profile



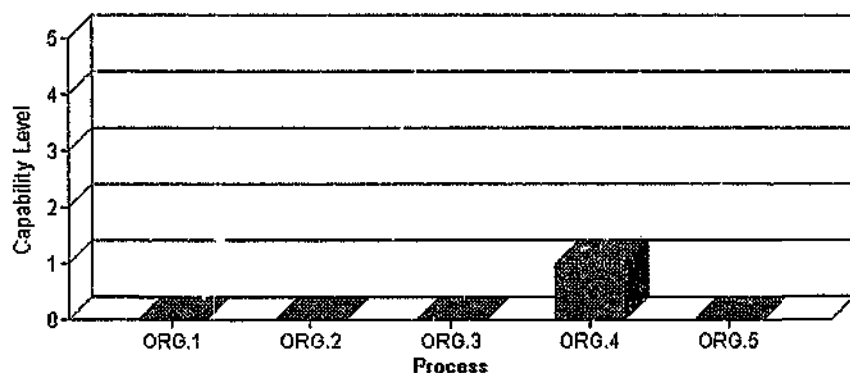
**Instance Category Capability Graph:
Function Point Comparison \ Support**



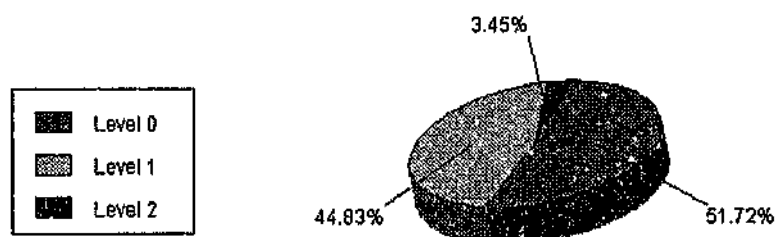
**Instance Category Capability Graph:
Function Point Comparison \ Management**



**Instance Category Capability Graph:
Function Point Comparison \ Organization**



**Instance Capability Level Distribution Summary Report:
Function Point Comparison**



SPICE Assessment Feedback for Project A

MT Lang

Eskom IT Application Systems Quality Team

ESKOM, P O Box 1091, Johannesburg, 2001, South Africa.

Melanie.Lang@eskom.co.za.

1 Introduction

The project was a new 3-month development project used to develop a system in support of one of the group business processes by the in-house IT department consisting of a project team of 5. The system was developed in predominantly fourth generation languages to use hardware developed and provided by an external contractor. Rapid Application Development methodology was used.

The SPICE assessment was performed as this project met the requirements for the assessor's MLA Masters research project i.e. it was assessed in the CSC PEP Programme Cycle 2, and therefore had both function point counts and a PEP footprint available, as well as being used by a core Eskom business function and had no major problems regarding resource availability for interviews. A point of significance is that the project was on a fixed cost contract. Also, resources were unavailable in the area of IT which serviced this business. As a result, a number of resources had to be brought together across the department.

The product involved no risk to people in terms of safety, negligible economic loss to the company, no identified risks in terms of security of data and services, no risk in terms of environmental impact by extent and significance.

In function point and lines of code(LOC) terms it was a small project.

The importance of the product quality characteristics was listed as: functionality (essential), usability (substantial), efficiency and performance (moderate), maintainability and portability (negligible).

The technical environment was PC/Workstation and the target use of the product was as an information system. A moderate level of code reuse was achieved, but mainly as a result of the programmer's own personal software process, rather than out of any significant organizational unit(OU) processes.

This document provides a summary of SPICE, the assessment methodology, the actual assessment, results obtained from the assessment and proposed enhancements to the existing processes.

2 Abbreviations

The following abbreviations are used throughout this document:

ATACC:	Advanced Test and Change Control
CASE:	Computer Aided Software Engineering
EDM:	Eskom Development Methodology
ITD:	Information Technology Department
MPO:	Macro Project Office
OU:	Organizational Unit
PEP:	CSC Performance Enhancement Programme
SPICE:	Software Process Improvement and Capability Evaluation

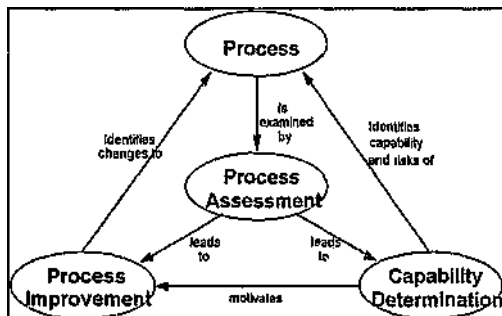
3 Software Process Improvement and Capability Determination

ISO/IEC 15504, also known as Software Process Improvement and Capability Determination or by the acronym SPICE is an international standard developed by ISO/IEC JTC1/SC7 WG10 to provide a structured approach for the assessment of software processes.

3.1 The SPICE Model

The model adopted by ISO/IEC 15504 is shown in Figure 1. Fundamental to the model is the concept of a process, which is described as a set of interrelated activities, which transform inputs into outputs.

Figure 1: The Assessment Process

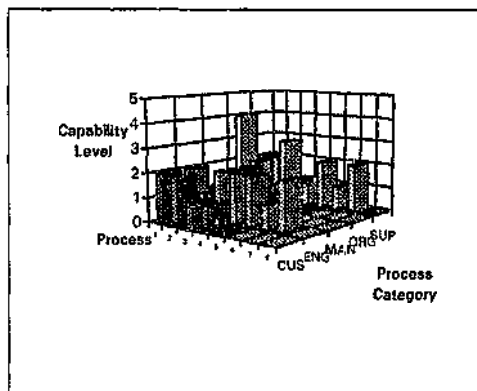


Processes are examined using the mechanism of process assessment, defined as a disciplined evaluation of an organisation's software processes. The output of the assessment exercise is a profile, which can be used variously for process improvement (Action taken to change an organisation's processes so that they meet the organisation's business needs and achieve its business goals more effectively) and/or for determination of process capability - a systematic assessment and analysis of selected software processes within an organisation against a target capability, carried out with the aim of identifying the strengths, weaknesses and risks associated with deploying the processes to meet a particular specified requirement.

The two key components of the standard are a process model and guidance on conducting assessments.

The process model is made up of a framework of attributes in two dimensions: The Process dimension contains process categories, processes and base practices, and the Capability dimension contains capability levels, process attributes and management practices. Input and output work products are used as indicators of level of achievement of base and management practice.

Figure 2: The Dimensions of the SPICE Model



3.2 The SPICE Process Categories

Processes are grouped into general areas of activity called process categories:

1. Customer-Supplier (CUS)
2. Engineering (ENG)
3. Support (SUP)
4. Management (MAN)
5. Organization (ORG)

The processes in Figure 2 are enumerated for illustrative purposes, but they are not the same across all the process categories.

3.3 The SPICE Capability Levels

A capability level is a set of process and management attribute(s) that work together to provide a major enhancement in the capability of a Supplier to perform a process.

Each level provides a major enhancement of capability in the performance of a process. The levels constitute a rational way of progressing through improvement of the capability of any process.

There are six capability levels in the reference model.

As you progress up the capability maturity scale, you transform from not performing the process (level 0) to solely performing the process (level 1) to managing it at a team-based level (level 2) to using a defined organisation-wide process (level 3) to measuring it, and using it for effective prediction and process control (level 4) and then finally to optimising it (level 5).

The capability level of each process is independently assessed, by an assessor making a judgement supported by documented objective evidence. This may be based on practice attributes (by interviewing process practitioners and managers) or work product characteristics (by examining documents, plans etc.) provided by the SPICE embedded model. This leads to a collection of profiles which represent the assessment output, as seen in Figure 2.

A first assessment can form part of a baseline and then using the Guidelines for Process Improvement, improvements can be prioritised and implemented in accordance with organisational goals.

SPICE is a relatively new standard and is still undergoing development and phase 2 trials.

4 SPICE Assessment Methodology

This section details information additional to the standard SPICE Methodology as represented by the SEAL Of Quality v0.82 tool. Both the instrument and the methodology are SPICE compatible.

4.1 Assessment Input

The following people were involved in the assessment:

1. The sponsor and owner, who was internal to the OU.
2. The qualified assessor responsible for the assessment.
3. Available process and project resources were the interviewees.
4. The internal auditor.
5. The external auditor.

Refer to the Assessment Quality Plan (MLA305) for further detail on their responsibilities.

The purpose of the assessment was to provide a profile for comparison against the function point count and PEP footprint, providing additional insight into processes in other words a process assessment rather than for capability determination.

The assessment approach was self (performed by a member of the organisational unit), discrete (a 'snapshot at a point in time') and team-based (no automated tool was used, but a group was involved).

The assessment type was full (covering all processes), basic (without adding additional processes to the

SPICE set) and initial (no previous assessment had taken place).

The scope of the assessment was all the processes, excluding Acquire Software, Operate Software, Maintain Software and Manage Subcontractors, up to capability level 3 (Established Process) where applicable within Eskom IT Application Systems (about 200 people). Reasons for limiting this scope is that as a result of this being an assessment with an internal sponsor, the sponsor would only have control of those areas he managed and very few processes were expected to be at level 2 and even less at level 3.

Main constraints included:

- the availability of key resource and maximum amount of time to be used for the assessment. This was restricted to +1 hour for 7 days for the main interviewee;
- confidentiality agreements protected the identity of an interviewee outside the SPICE Assessment Team.

4.2 Assessment Approach

The assessment schedule involved Preparation and planning (of the assessment input and project and quality plans); Assessment and Analysis (with the identified resources and auditing with identified experts); and Close-Out and Reporting (Presentation to all involved).

4.3 Assessment Assumptions

The following assumptions were made during the assessment:

1. The assessment was conducted as far as possible with the project leader, and the assessment ratings were validated by reviewing the available documentation and cross-checking certain practices with other resources.
2. Most of the Organisation process category focussed on a much higher level, and was covered by the upper managerial roles, rather than the junior ones.
3. The main focus of the assessment was the Engineering and Customer-Supplier categories, but with the additional time, it was decided to complete the entire profile.
4. As this was a discrete assessment, it was essentially a snapshot of the processes at a point in time after the function point count had been done, and which

SPICE Assessment Feedback for Project A

was covered by the information in the PEP data capture forms. This meant that processes which may have been used later on in the year, were not assessed.

5. Due to the informal nature of the project, base practices were examined mainly on the basis of trust, rather than expected documented evidence, however, where documents were available, they were informally examined, although not rated, and listed in the Assessment Working Document (MLA306).
6. Main project members were available for interviews, but rather than them being 100% available for a week, the assessor had to be available to accommodate them. As a result of the time and this resource constraint, only the developer, project manager, MPO project leader, IT training manager, group systems application manager and applications manager were interviewed, and problems arose where areas were covered strictly by other project roles, although the project managers view was taken as objectively as possible. It was thus assumed that the project manager was aware of most of the procedures followed, and problems encountered during the project, and could provide the most accurate view of the processes.

4.4 Assessment Risks

The following risks were considered throughout the assessment:

Table 1: Assessment risks and planned approaches

Risk	Management
The assessment may cross boundaries into areas which are not covered by the scope i.e. IT Application Systems.	Where possible, these processes were omitted from the assessment, as they were processes which were not under the control of the sponsor, and no changes to them could have been made. This meant that the next level of the assessment e.g. for the base practices, the process ratings would be adjusted to exclude that practice aggregation.
The size of the group of project resources, who each work on several areas, may cause problems in terms of coverage of the processes and capability levels.	The major source of information for doing the assessment was the project manager, supported by the documents in the project folder.
The assessment team made use of the existing documentation that has been created to confirm the assessment rating. There was insufficient time to review every document that has been created.	A combination of interviews and investigation of the documents were used to do the assessment. It will be taken on trust that what has been stated and submitted by the assessment participants is true and correct.

5 SPICE Assessment Findings and Analysis

This section presents the profiles of each process category and summarises findings. For detailed evidence and ratings, consult the Assessment Working Document (MLA306) This section is in the following format:

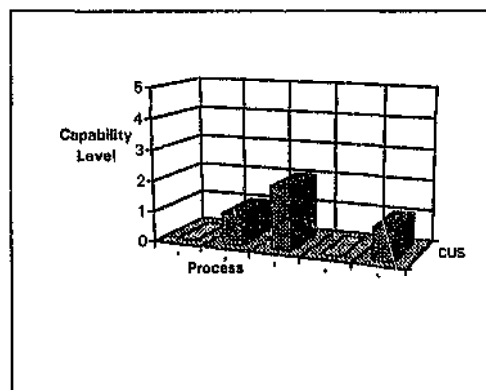
- For each process category,
 - Description
 - Graph of process category

- Summary of supporting evidence and findings
- Summary of findings
 - Summary graph
 - Summary of assessment findings

5.1 Customer-Supplier Process Category

These are processes that directly impact the customer, support development and transition of the product to the customer, and provide for its correct operation and use. They include: (1) Acquire software, (2) Manage customer needs, (3) Supply software, (4) Operate software and (5) Provide customer service.

Figure 3: Customer-Supplier Process Category



1. Acquire Software was excluded from the assessment, as it was assumed that the customer had defined the need, business case and then approached IT with high level requirements, as one of the possible suppliers to produce a suitable contract.
2. A technical specification was developed, informal walkthrough validation sessions were minuted and project manager and customer communicated fairly often telephonically, but this was still too informal to make the Manage Customer Needs process of a higher capability level.
3. As Software was only supplied to a single customer who was not the end user, and only one resource was required to be involved in the installation, the processes from contract to delivery which needed to be followed, managed and used were very simple. Contract was managed by the business manager and the customer handled the relationship

with the hardware agent. The rest of this process fell outside the assessment and project scope.

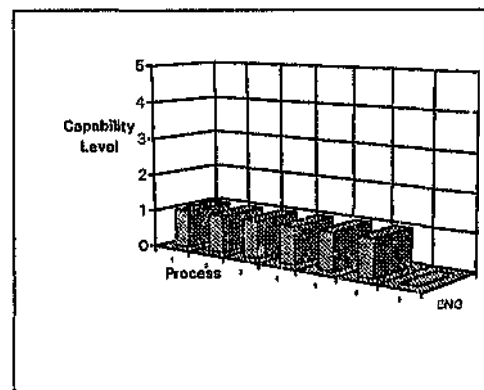
4. Software Operation was excluded from the assessment, since the initial requirement was just to provide it to a single customer, who was not the end user.
5. Training, support and customer service was fairly well managed, however monitoring performance and benchmarking were not really formally done. Resources and scheduling had been done, but no standard process was followed and communication was completely informal.

Most base practices are performed with the supply software quality being managed too. The achievement of this category is mainly as a result of the customer's relationship with the team and the management of the project from the customer's perspective, however lack of configuration management would make it difficult to repeat.

5.2 Engineering Process Category

These are processes that directly specify, implement, or maintain a system and product and its user documentation. They include: (1) Develop system requirements and design; (2) Develop software requirements; (3) Develop software design; (4) Implement software design; (5) Integrate and test software; (6) Integrate and test system; and (7) Maintain system and software.

Figure 4: Engineering Process Category



1. As the project was so small and standalone, system and software were treated as the same and there was no need for a large infrastructure or architecture to be defined. Also, these did not exist to be built on. The existence of these would have obviously accelerated the project, as it has done for the Phoenix subprojects, but if this project was

used to define the infrastructure and architecture, it would have slowed down the project but may have provided the foundation for other projects.

2. A formal product configuration document was not developed. The customer's original specification formed the main work product of the system requirements and the technical specification developed by ITD formed the software requirements and design. The latter document was maintained following changes and reviews. Informal prioritisation and communication took place for the requirements definition.
3. Other interfaces were documented in minutes and the hardware manufacturer's user manual. There was no explicit establishment of traceability, however the same document was used for requirements and design.
4. Code units with comments were implemented, however time had not been allocated for additional documentation, and although code units were verified, these procedures were not documented.
5. Although (no comma needed here ?) a small testing document was developed, there was no formal test plan with acceptance criteria, test conditions and regression test strategy, although it was stated that everything was thoroughly re-tested after changes. The user provided some test cases as notes, but these were never documented. System size meant that little integration was necessary.
6. The system had not needed maintenance during the scope of the assessment, and the Maintain System and Software process could therefore not be assessed.

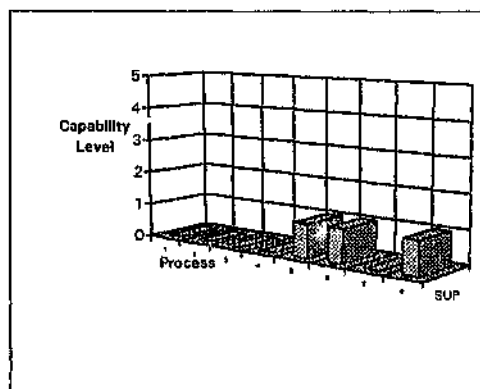
The Engineering process category is performed; placing all of the assessed processes on level one. Processes were dependent on the team. The standard process consisted of (EDM) customised for Financial Systems and technical environment (which included the programming language). The strengths of this process are the well-defined requirements whose changes are managed. The weaknesses of this process are the lack of configuration management, quality management on work products apart from the software code units (no standard formats, minimal verification and validation; no version control).

5.3 Support Process Category

These are processes that may be employed by any of the other processes (including other supporting processes) at various points in the product development life cycle. They include: (1) Develop documentation;

- (2) Perform configuration management; (3) Perform quality assurance; (4) Perform work product verification; (5) Perform work product validation; (6) Perform joint reviews; (7) Perform audits; and (8) Perform problem resolution.

Figure 5: Support Process Category



1. No time had been budgeted for documents to be developed, other than the technical specification. Documents were informally reviewed but no procedures or requirements defined. There were no document templates prescribed and no guidelines exist for maintaining and distributing documents.
2. There is no configuration management system in place. There is no master list of documents available, no version control is done on documents, change requests are not managed. There is some limited configuration management performed on software units.
3. Quality assurance was mainly performed on the code units, but not on the software engineering activities. Quality criteria and records were not identified and no independent QA resources were requested.
4. Code units underwent work product verification and validation, but testing was the only technique used without verification or validation criteria being defined. Unit testing was performed, but action items were not documented and were only informally tracked. A user performed user acceptance testing based on test cases (which were not documented for future reference). One formal anomaly was found and tracked as a KP29 (Change request as defined in Eskom's change process).

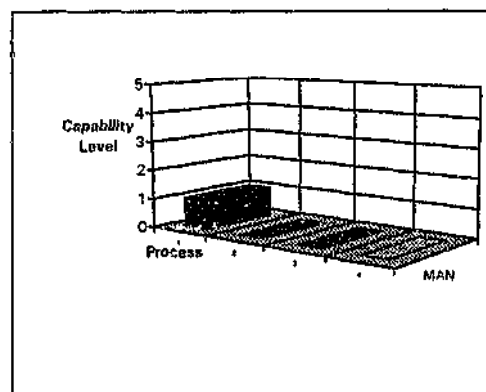
5. Management and technical reviews were done, without a formal agenda, however software process assessments were not done.
6. No audits were identified, prepared for, conducted or corrective actions taken.
7. Problem resolution was also fairly mature as the customer was in direct contact with the project team and problem details, prioritisation, resolution and tracking was done informally. Defect correction and distribution was performed, however no defect analysis was performed.

The results of the assessment for this process category was relatively poor with the base practices not fully performed. The strengths of this area consist mostly of the fact that customer communications enhanced testing, joint reviews and problem resolution. The major weaknesses are that most of the base practices of the other processes are not performed and thus, do not provide a minimum level of quality support.

5.4 Management Process Category

These are processes that contain practices of a generic nature which may be used by anyone who manages any sort of project. They include: (1) Manage the project; (2) Manage quality; (3) Manage risks; and (4) Manage subcontractors.

Figure 6: Management Process Category



1. Scope of work, project estimates, work breakdown structure, project schedule, infrastructure requirements, allocation of responsibilities and tracking were fully performed, using MS Project project plan at various levels, however evaluating the project performance was only informally performed.
2. Quality and risk management was not performed.

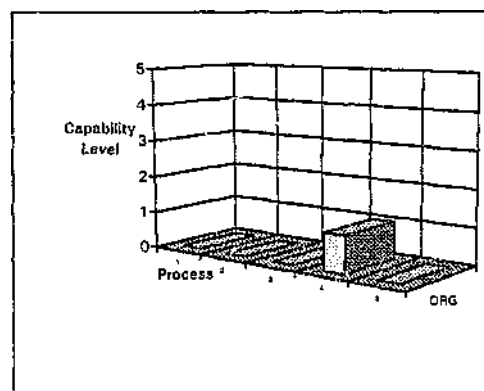
3. No subcontractors were managed.

The basic project management practices are mostly all fully adequate, except for the evaluation of project performance. The weak areas are those of quality management and risk management.

5.5 Organization Process Category

These are processes that establish the business goals of the organisation and develop process, product, and resource assets which, when used by the projects in the organisation, will help the organisation achieve its business goals. They include: (1) Engineer the business; (2) Define the process; (3) Improve the process; (4) Provide skilled human resources; and (5) Provide software engineering infrastructure.

Figure 7: Organization Process Category



1. A strategic vision was established for the organisational unit, but not many people seemed to be aware of it, indicating a problem with deployment. The appointment of a quality advisor and subscription to an international benchmarking programme was considered to be the starting point of establishing a quality culture. Formal incentives for the project were not provided, other than the existing ones. Recognition / rewards are based on end product rather than process outputs (End product is usually considered to be a working system - process outputs are intermediate deliverables, which would indicate a well-documented system which is easily maintainable and possibly contributes to future projects). For those who chose to participate, there was a Personal Development Plan (PDP) for career development.
2. This project was not used specifically to either define or improve existing OU processes, although it (among others) could have been one of the contributing factors to future process definition.

Processes which were being defined at this time was Advanced Test and Change Control (ATACC) for Eskom's standard test and change control process and Macro Project Office (MPO) for Eskom's standard project management process. The base practices were mostly partially to largely performed with no policy for its use and no performance expectations. Process measures took the form of PEP Baseline and function point counting. Human resources for supporting process definition were informally defined and provided through the MPO resources and the Quality Advisor.

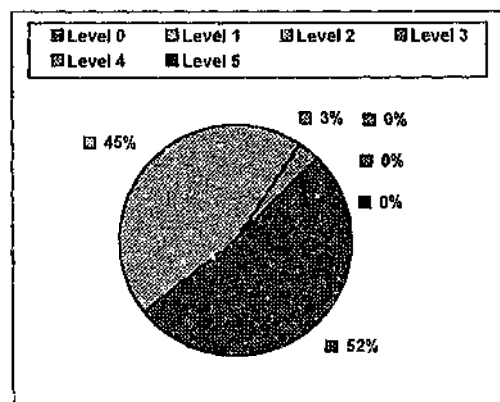
- As the processes for MPO and ATACC were currently undergoing definition in the timeframe assessed, these processes would improve the current practices. However, for the Eskom Development Methodology (EDM) which had been defined prior to this timeframe, improving the process would mean improving the EDM itself. There were no formal plans, resourcing, standards or process infrastructure for future process improvements i.e. it appears to be ad hoc, and not a direct result of organisational goals.
- PDP's and business plans were used to identify human resource needs. These were used by the training department to acquire training courses. Project teams are defined and available resources with the necessary skills are selected, otherwise the recruitment process is started. The Personal Performance Contract, Job Output Models and Performance Appraisals are used to evaluate staff performance and feedback then given. Good personnel records are kept, no formal training records are kept and skills information was previously kept in the EDCO system but is now outdated. Empowerment and team interactions are not formally defined.
- Software engineering infrastructure are limited to technology specific issues and physical infrastructure but do not extend further than that to standards and do not always involve those it is required to support. A reuse library in the form of the use of EOS, Natural Construct and the code pool is partially in place, however not organization wide or as a formal part of the life cycle.

This process category was sometimes difficult to assess on a project level, and was taken on a much broader view. For the Provide Skilled Human Resources process, SPICE suggests that training and skilling is the responsibility of managers, however the OU took a human-centred approach, where each individual is responsible for him/herself and empowered to make their own decisions. This may also be the reason that it

performed better than the others. This may be the reason for unsuccessful deployment of other processes. The fact that people are empowered, means they manage and control their own decisions and their subordinates, so instead of having to obtain commitment from 1 manager, the process deployment teams have to obtain commitment from 200 'managers'. Although processes are defined, there are no arrangements for future improvements. Infrastructure by means of organisation-wide standards and resource libraries (of all configuration items) did not exist, but was provided for the physical and language software engineering environments.

5.6 Summary

Figure 8: Derived SPICE Profile



- Capability:** This project is mainly at capability level 0, performing a large number of the base practices. As a result of processes not existing, or the ones being used on the project not being documented, the project would not be repeatable. Most of the teams making use of the processes will never achieve higher than level 2. The crux of level 1 is that processes are not dependent on individuals, i.e. if someone else in the team had to be given the same project, they would be able to achieve the same level, apart from several individualistic areas where they may be stronger or weaker. Level 3 is dependent on the fact that anyone in the department would be able to take on the project and not specifically the team involved. This of course would take into consideration management practice 2.1 that an individual with the required skills was chosen. However, the fact that the Engineering processes had the most highly skilled resources may indicate that individuals have to acquire skills in the other SE processes (eg. manage quality, develop documentation). This would also mean that it would not make difference if anyone else in the OU had been

SPICE Assessment Feedback for Project A

- managing eg. quality instead, since they would have had as much skill as another person.
- 2. Experienced Resources:** The projects assessed definitely had highly proficient and skilled resources who did not necessarily need processes to ensure best practices, but the lack of correct documentation would make it difficult in future for maintenance. The nature and experience of the team made them inadvertently follow basic software engineering practices, but nothing formalised, or documented, which would lead to a repeatable process. These software engineering practices were also more easily planned, tracked and managed than the support and management category practices.
 - 3. Service Provision:** Eskom projects appear to be highly pressurised, where customer requests are often satisfied without regard for what may be 'healthy' for the OU. OU members seem to be condemned to a service provider role (except in one-off projects). This situation is a hindrance to proper planning, tracking and management since unplanned for emergencies interfere with work which cannot be rescheduled. This forces project resources to work long hours, often with no additional reward. This could have an effect on employee (dis)satisfaction.
 - 4. Size Control:** The fact that the systems are rather small has a positive impact, since they appear to be easier to plan and manage, although constraints remain severe.
 - 5. Process Owner:** A major problem is that there is no clear definition of who owns / is responsible for which part of most processes.
 - 6. Existing Procedures and Libraries:** The fact that there are a number of procedures and even resource libraries that have been defined was a pleasant surprise. Unfortunately, they are not widely enough available or in some cases, are rejected by process users as being too broad to be applicable. Standalone projects are usually thought to be fairly simple and not requiring processes, however existence of standard departmental processes, architecture and various libraries of resources would not only speed up development, but also assist in maintenance. Engineering process category standards are centralised in the 'Blue Book' (Phoenix programme's database standards).
 - 7. Feedback Loop:** For the existing standard processes, there is currently no mechanism in place for those who use it (and possibly tailor it) to provide feedback to the owners, so that they can be modified, or the tailoring can be noted as a possibility. Although the processes state that they should be re-looked at every half-year, this does not happen, as there is no responsibility assigned for this.
 - 8. Pilot Process Projects:** Different requirements of each site makes using a pilot project to test a process difficult. It is important to take the pilot site's problems into account in context with the influence and requirements of the rest of the OU. Processes could be beta tested where responsible parties within all (development and maintenance) teams gather observations from within their programmes or their functional areas and communicate these to the process definition and improvement change control administrator. This would then be incorporated into each project's plan.
 - 9. Intangible System:** Prototyping is used as the excuse when requirements cannot be gathered for a system, but if a system is supposed to fulfil a business function regardless of the technology or the interface, this should be able to be gathered during analysis and design and during detail design, interface and other issues may be considered. This is a problem with both user and development teams, since the user is usually unable to visualise and developers are unable to explain a virtual system. It is important that "visionary" users and business analysts be involved at the requirements level and that "visionary" users, business and system analysts be involved at the detail design level. This will mean that a project can move through a waterfall model and not require as much rework as continual re-development will require.
 - 10. Maintenance of Work Products:** In general, projects are fairly well done and documented as far as allowed i.e. if a customer demands a delivery date, the resources do as much as possible by that date, but documentation is often not considered to be of as high a priority, particularly when a project is timeboxed. There is a tendency after moving to the next phase to ignore maintenance of output work products or deliverables from previous phases (e.g. changes noted in minutes, must be recorded as change requests, and updated in code, test data, design, analysis and specifications). This leads to re-analysis and re-design if (the inevitable) additional maintenance or enhancements are required, and even if the original resources are involved, they will not remember the workarounds and changes from the old system. Even worse, if there is re-development or conversion of a system,

SPICE Assessment Feedback for Project A

then the analysis and design has to be re-worked, instead of just new requirements added on.

11. **OU Scope:** As a result of the fact that our projects are not really standalone projects, but are part of a larger programme, this means that the assessment extends further into group information management, where IT's customer is actually a part of the development team, and the business managers, as well as the programme managers manage customer needs. The difficulty with this is that there needs to be complete communication between all parties involved. Often responsibilities and roles are not clarified and process execution is duplicated or not performed at all.

Although assessments were performed on specific process instances, they seem to be typical of the entire OU. So, the individuals which are part of the projects are not to blame (except if personal professionalism was an issue), but rather the system of which they are a part - there is no means of seeing the whole picture. You need to define EVERYTHING as a part of a system and process in order to do that.

6 Significance

This section discusses lessons learned and suggestions for improvement from all the assessments performed as part of the study.

6.1 Lessons Learned

Questions and problems were directed to the local trials co-ordinator and discussed at some of the meetings of WG10. The following were experiences from the SPICE assessment:

1. **Assessment Management:** Like any project, an assessment should be carefully planned, resourced, managed and tracked. Although most of this assessment was performed last year the fact that all documentation had been kept up to date, meant that it was fairly easy to continue from where one had left off.
2. **Accuracy vs. Time:** In the ideal world you would want to interview every practice/process "user" and review every work product, but taking the Pareto Principle (to only perform 80% of the work, since the additional 20% will require as much effort, with little benefit) into account, you should be able to get a fairly accurate view from a good sample of people and work products. Further time reduction can take place if interviews are audio- or video taped and the assessor consolidates and reviews together with work products simultaneously later.

Reviews are very tiring and should not exceed 3 hours a day. Timeboxing may be a good technique.

3. **Habits:** Interestingly, although projects vary, processes are like habits and most people remember how they performed a specific process.
4. **Honesty:** Interviewees appeared to be fairly honest (although some discrepancies were found, as a result of misunderstanding and/or miscommunication, rather than intentional misleading). It is expected that for an internal assessment, interviewees would continue to be honest as long as the results were not to be used for personal measure. Generating accurate documented evidence (unless an ISO certificate depends on it) would be counterproductive, but for any assessment / test there is likely to be a way of cheating if interviewees are trained to answer in a specific way, but like all tests, the best way to pass is the honest and legal way.
5. **Capability Level Assessment.** At the higher levels, the assessment becomes more difficult, since evidence of management practice performance must be found. These were not assessed in detail, since it was limited to (usually) an outdated project plan, which had some activities on it, and then the main interviewee was usually able to say which were and were not implemented.
6. **Record Availability:** Difficult to perform post assessment if records from that point in time are unavailable e.g. correct version of Blue Book, rather than current version.
7. **SPICE Assessor Skills:** Recommended that a SPICE assessor have basic system knowledge i.e. analysis, design and construction, so that they are able to recognise dishonesty from an interviewee based on documented evidence. Also, auditing and software engineering skills are an advantage. A recommended skill set as you assess each process attribute level for capability levels is project management, quality and configuration management, standards (both international and OU) and resource and infrastructure management.
8. **SPICE Assessment Difficulties:** were experienced when assessing related or dependent practices. The large amount of time is spent on validation. Also, resource availability influences scheduling, and even advance planning does not ensure that interviewees or auditors will be available when required. A useful tool would be cross-check matrix between some of the practices and capability levels, although if you do the assessment

SPICE Assessment Feedback for Project A

within a short time frame, it should not be very hard to establish.

9. **SPICE Assessment Process:** Recommended to perform in the following order: For all interviewees: (1) Conduct interview and collect ALL work products, (2) Review interview and work products and assign ratings, (3) Confirm with interviewee, (4) Audit and confirm with external auditor.

6.2 Recommendations

The following general approaches can be taken:

1. **Action Plan with Approval:** The next process improvement step should be taken, but not in terms of this individual project, but rather as a larger initiative across the department. Management should approve the areas for improvement, goals and targets and thereby actively commit the OU to the process improvement. An action plan should be put together describing the set and priority of actions to improve software processes.
2. **Root Cause Analysis:** A complete impact analysis could be done to determine the main root causes of the problems. They not only have a negative effect on the process, but so on the people and technology too. Elimination of these should become a priority and would derive the greatest benefit.
3. **By Osmosis:** Use some of the lessons learned and techniques within the Phoenix Architecture team to introduce changes to the entire OU.
4. **Increased Capability Levels:** In order to achieve level 2 and higher, base practices must be documented in a common process framework, with individual and team tailoring also being noted in a commonly identified document. Also, all work products must be under configuration management. We then run into the difficulty that you will no longer be able to maintain the speed of delivery, since you have additional work products to be delivered to your OU and not to your customer. However, eventually these work products should have standard templates and should influence later work which would require less planning and more implementation time, as the standard plan templates should exist and just require minor tailoring. Also, resources will have the required process experience to understand what needs to be done when, and will almost execute out of habit, without requiring a defined plan (although the project manager must still track this). If a workshop is supposed to cover managing

customer needs, QA, verification and developing system requirements, then there should be a standard checklist, so that it will meet all those requirements. Such a project requires at least a 2-year commitment.

As a start, one or more of the following actions could be taken, taking the OU's business goals and objectives into consideration:

1. **Process Roles:** Define process owners and process stakeholders.
2. **Process Deployment:** Identifying an integrated, standard set of processes, which are available in a standard format in a standard area. Existing processes should be deployed and training or standards on related tools (e.g. timesheets) should be given to all process users. SPICE could be used as the common framework. These should then be monitored, controlled, audited and continually improved.
3. **Process Change Management:** Define change management process and roles and responsibilities for standard processes i.e. ATACC, EDM, MPO.
4. **Process Tracking:** Accurate record keeping from timesheets would assist in future planning and estimation efforts and impact analysis.
5. **Maintenance Process:** Alternately, change focus, use Phoenix as basis, and then re-define process for 'small developments' or maintenance (similar to micro function points) i.e. investigate and establish a common process framework.
6. **A Work Product Archive:** should be defined and created, where deliverables of each software development phase of a project including source code, project history and categorised lessons learned are stored for future reference. Project plans should also be submitted and consolidated across the OU, giving a good resource usage and availability tracking mechanism. These must be all under strict configuration management including auditing.
7. **Requirements Specification:** Using EDM with the requirements specification document template for capturing functional and non-functional specs (under review for inclusion in MPO), all requirements can be captured and used for auditing purposes. This will allow project managers to focus only on contractual obligations and enforce better requirements definition and change control, not only in terms of functionality, but 'quality' too.

8. **Change Control:** Although the template mentioned in the previous point would try to assist by listing all possible considerations, requirements will always change as a result of some omissions or ignorance. These changes will always need to be controlled i.e. a good change control methodology must be in place. This would assist with contract re-negotiation.
9. **Eskom Supplier Standards:** would greatly improve development and testing, as it is clearly impossible to test for endless possibilities and limiting hardware/software to some preferred suppliers would allow one to set up a test lab in which all performance testing could be properly run.
10. **Intermediate Deliverables:** Process outputs should be additional product outputs i.e. define that we require actuals to be recorded correctly for future planning, require lessons learned to be documented for input into other projects, require contributions to reuse libraries etc.
11. **Professionalism:** People should be professional enough to recognise the impact of their actions on the rest of the system. System being supervisor, team members (any number of teams - programmes, technical, customer etc.), customer, subordinates. This is a personal responsibility and is not a skill which can be taught.
12. **Communication Procedures:** The large number of roles and parties involved in processes are not distinctly modelled in SPICE, but creates a considerable communication overhead. There may be a need to set up proper communication procedures within and external to the department, so that a single consistent message (under configuration management) is always sent out.
13. **Training:** Due to the nature of the skilling process, is important that all OU members use a mechanism such as the PDP to ensure that they continually renew their skills and are assigned to new projects to gain experience. There should be a minimum standard of education for each process role (e.g. systems analyst). Education will either be formal instructor-led, vendor-provided training or CBT training from IT Training. Self-study is not bad, but there is no way of seeing at what standard the knowledge is.
14. **Knowledge Sharing:** There must be a realisation that one is not being employed because of personal project knowledge, but rather the personal knowledge they can contribute to their peers, the department, their customers and Eskom. Continual

re-work is the result of being unable to or refusing to share information. This has to be a conscious effort from management, team leaders and team members, but should probably start where it is most visible. Knowledge sharing groups should be set up, and each person should be expected (as a personal KPI) to contribute. Registers (e.g. contact persons for function point measurement) and procedures (e.g. how to setup Windows 95 on a notebook) could be documented.

15. **SPICE Assessment Embedded Model:** Recommended to re-define or add to base practices, work products, resource and infrastructure to use Eskom terminology and/or create common process framework using SPICE model (or ISO 12207).

7 Conclusion

On a final note, suggestions have been made and it is up to the process owners and assessment sponsor to decide on the actions to be taken. Individuals may also choose to improve their personal software process. This is a medium term initial commitment with long term benefits. Individuals may also choose to improve their personal software process.

As this is part of a larger study, the next step for the study is to establish, in conjunction with the other SPICE assessments:

1. insight provided by the footprint performance indicators into the capability level of an OU.
2. insight provided by the footprint performance indicators into the capability level of a process.
3. insight provided by the footprint performance indicators into the capability level of a process category.
4. insight provided by the capability level of an OU into the footprint performance indicators.
5. insight provided by the capability level of a process into the footprint performance indicators.
6. insight provided by the capability level of a process category into the footprint performance indicators.
7. limitations of SPICE covered by PEP.
8. limitations of PEP covered by SPICE.
9. limitations of both PEP and SPICE.

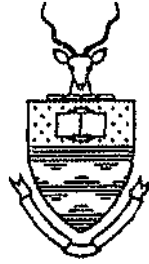
8 Acknowledgements

Thanks to all the people who participated and contributed to the assessment.

9 References

1. ISO/IEC 15504 Parts 1-9 v2.00
2. MLA306 SPICE Assessment Working Document for Project A
3. MLA305 SPICE Assessment Quality Plan for Project A

■



MLA QMS

FPA Count For Project B

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iii
Configuration Control	iii
Document History	iii
Revision History	iii
Management Authorisation	iii
Change Forecast	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Definitions	1
1.5 Audience	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 Summary	3
3 Data Function Types	4
4 Transactional Function Types	6
5 Value Adjustment Factor	9

Change History

Configuration Control

Project:	MLA QMS
Title:	FPA Count for Project B
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA320.100
Created by:	Melanie Lang
Creation Date:	23 September 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\05	Draft	Melanie Lang	MLA320.001
0.02	97\05\21	Draft	Melanie Lang	MLA320.002
0.03	97\09\14	Draft	Melanie Lang	MLA320.003
1.00	97\09\23	Approved	Melanie Lang	MLA320.100

Revision History

Version	Date	Changes
0.01	97\05\05	New document created from MLA002.102
0.02	97\05\21	Information added to all sections.
0.03	97\09\14	Information added to all sections.
1.00	97\09\23	Document approved.
1.00	98\08\09	Document checked.

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	97\09\23	Approved	MLA 2023 section 2.10.1

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the analysis and implementation function point counts done on the project B. An analysis count could not be done as the requirements were gathered through prototyping.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

2 Summary

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Function Type	Complexity Rating	Number of Functions		Function Points Awarded	Total Function Points
EXTERNAL INPUTS	Low		32	3	96
	Average		5	4	20
	High		6	6	36
EXTERNAL OUTPUTS	Low		5	4	20
	Average		0	5	0
	High		6	7	42
EXTERNAL INQUIRIES	Low		2	3	6
	Average		1	4	4
	High		1	6	6
INTERNAL LOGICAL FILES	Low		4	7	28
	Average		1	10	10
	High		3	15	45
EXTERNAL INTERFACE FILES	Low		0	5	0
	Average		0	7	0
	High		0	10	0
TOTAL Number of UN-ADJUSTED Function Points					313
VALUE ADJUSTMENT FACTOR					0.98
TOTAL Number of ADJUSTED Function Points					307
Development Work Product					307

3 Data Function Types

Internal Logical Files = ILF

External Interface File = EIF

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Data	Type	Record Element Types	Data Element Types	Complexity	Multiplier	Function Points
1. Allocations						
	ILF	Finance Allocation Combes Cost Centres DAC's SUB's GRP SAC's Jobs	20-50	High	1	15
2. Archive						
	ILF	Payment Activity Log Banking Batches Sessions	>=51	High	1	15
3. Audit Trail						
	ILF	Activity Log	1-19	Low	1	7
4. Banks						
	ILF	Banks Credit Card Types	1-19	Low	1	7
5. Error (Mainframe)						
	ILF	1	1-19	Low	1	7
6. Payment Collection Point						
	ILF	Payment Collection Point Registration Master	>=51	Average	1	10

7. Payment						
	ILF	Payment Payment Types Payment Methods Multi-pay groups Sessions Batch	>=51	High	1	15
8. User Master						
	ILF	1	20-50	Low	1	7

4 Transactional Function Types

External Input = EI

External Output = EO

External Inquiry = EQ

Complexity = Com

Low = L

Average = A

High = H

Multiplier = Mult.

Function Points = FPs

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Transaction	Type	File Types Referenced	Data Element Types	Com	Mult	FPs
1.Validation	EI		1-4	L	1	3
2.Session/Batch						
2.1.Open session/batch	EI	[7],[8]	5-15	A	2	8
2.2.Link/Delink	EI	[7],[8]	1-4	L	1	3
2.3.Close session/batch	EI	[7],[8]	>= 16	H	2	12
3.Catalogs						
3.1.Banks / card types						
3.1.1.Add/modify bank	EI	[4]	1-4	L	4	12
3.1.2.Delete bank	EI	[4]	1-4	L	2	6
3.2.GRP/SAC/DAC\S UB/CC/JC&/spec						
3.2.1.Add/modify	EI	[1]	5-15	L	10	30
3.2.2.Delete	EI	[1]	1-4	L	5	15
3.3.Update internal system tables	EI	[7]	>= 16	A	1	4
3.4.Payment Types Resequencer						

3.4.1.Modify	EI		[7]		1-4	L	1	3
3.5.List current payments	EQ		[1],[4],[7]		1-4	H	1	6
3.6.View sessions / batches	EO		[7]		6-19	L	2	8
4.User Maintenance								
4.1.Add/modify	EI		[8]		5-15	L	2	6
4.2.Delete	EI		[8]		1-4	L	1	3
5 View Activity Log	EO		[3]		1-5	L	1	4
6.Browse Activity Log	EQ		[3]		1-4,1-5	L	1	3
7.Modify PCP details	EI		[6]		5-16	L	1	3
8.Single Payments								
8.1.Add	EI		[1],[4],[8],[7]		>=16	H	1	6
8.2.Reverse-untransmitted	EI		[7]		1-4	L	2	6
8.3.Reverse-transmitted	EI		[7]		>= 16	A	1	4
8.4.Receipt	EO		[1],[4],[8],[7],[8]		>=20	H	1	7
9.Multi Payments								
9.1.Add	EI		[1],[4],[8],[7]		>=16	H	1	6
9.2.Totals Output	EO				1-5	L	1	4
10.Combination Payments								
10.1.Add	EI		[1],[4],[8],[7]		>=16	H	1	6
11.Create Export file (upload)	EO		[1],[4],[6],[7],[8]		>=20	H	1	7
12.Acknowledge data transfer	EI				1-4	L	1	3
13.Archive procedure	EO		[2],[3],[7]		>=20	H	1	7
14.Reports								
14.1.Session/Batch Totals	EO		[1],[4],[7],[8]		>=20	H	2	14
14.2.Transaction Details	EO		[1],[4],[8],[7],[8]		>=20	H	1	7
15.Mainframe								

Component									
15.1.Upload mainframe payment file	EI		[6]		>=15	A	1		4
15.2.Mainframe validation on payments	EI		[6],[7]		>=16	H	1		6
15.3.Error report	EQ		[5]		1-4,1-5	L	1		3
15.4.Payment Inquiry	EQ		[6],[7]		1-4,6-10	A	1		4
15.5.Maintain PCP									
16.Messages	EO				1-5	L	1		4
17.Audit Trail	EI		[3],[8]		1-4	L	1		3

5 Value Adjustment Factor

This remained the same for both the analysis and implementation counts.

General System Characteristic	Rating
1.Data Communication	3
2.Distributed Processing	1
3.Performance	4
4.Heavily Used Configuration	2
5.Transaction Rates	1
6.On-line Data Entry	5
7.Design for Enduser Efficiency	1
8.On-line update	4
9.Complex Processing	2
10.Usable in other Applications	5
11.Installation Ease	2
12.Operational Ease	1
13.Multiple Sites	2
14.Facilitate Change	0
Total Degree of influence (TDI)	33

$$\text{Value Adjustment Factor} = (\text{TDI} * 0.01) + 0.65$$

$$= (33 * 0.01) + 0.65$$

$$= 0.33 + 0.65$$

$$= 0.98$$



MLA QMS

PEP Footprint For Project B

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iii
Configuration Control	iii
Document History	iii
Revision History	iii
Management Authorisation	iii
Change Forecast	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Definitions	1
1.5 Audience	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 PEP Footprint	3
3 Details	4

Change History

Configuration Control

Project:	MLA QMS
Title:	PEP Footprint for Project B
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA322.100
Created by:	Melanie Lang
Creation Date:	10 August 1998

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\05	Draft	Melanie Lang	MLA322.001
1.00	98\08\10	Approved	Melanie Lang	MLA322.100

Revision History

Version	Date	Changes
0.01	97\05\05	New document created from MLA002.102
0.02	97\09\24	Additions of PEP profiles
1.00	98\08\10	Document Checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	98\08\10	Approved	MLA 2031 section 2.10

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the PEP footprint received from Quantimetrix and CSC for project B.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

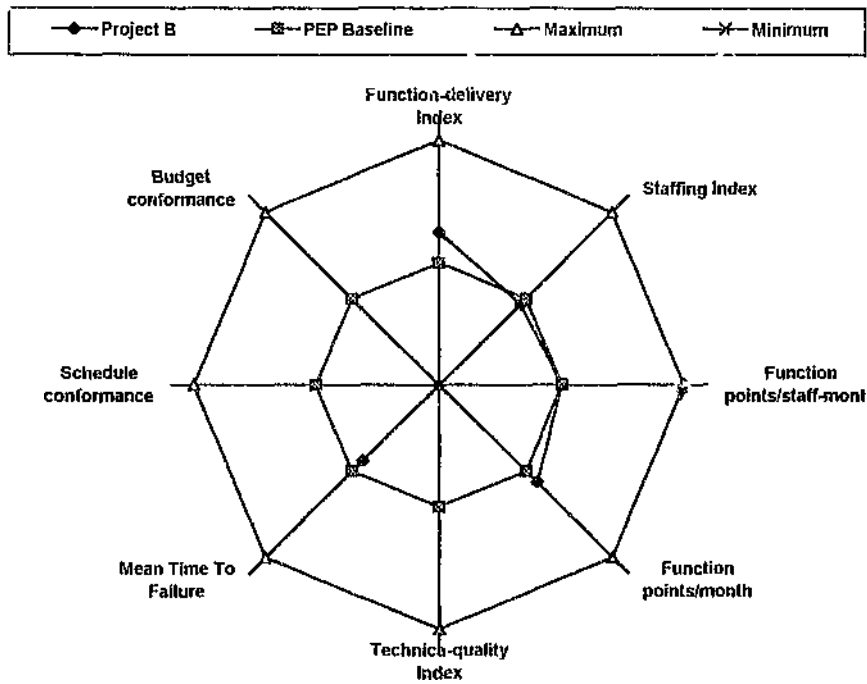
1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

2 PEP Footprint



3 Details

	Actual	Baseline	Difference / Multiple
Fdi (AB)	14.7	13.8	0.9
SI (AB)	8.3	7.2	1.1
fp/sm	18	19	1.0
fp/mo	50	38	1.3
Time Slippage %		25%	
Effort overrun %		20%	
Tqi		10.0	
MTTF	8.5	10.0	0.7

■



MLA QMS

Work Breakdown Structure For Project B

Management Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History.....	iii
Configuration Control.....	iii
Document History	iii
Revision History.....	iii
Management Authorisation.....	iii
Change Forecast... ..	iii
1 Scope	4
1.1 Introduction	4
1.2 Purpose.....	4
1.3 Applicability.....	4
1.4 Definitions	4
1.5 Audience	4
1.6 Applicable Documents	4
1.7 Assumptions	5
1.8 Requirements Traceability	5
2 Proposed Project approach	6
2.1 Key for table below:.....	6
2.2 Phase 1: Preparation and planning	1
2.3 Phase 2: Assessment and analysis.....	2
2.4 Phase 3: Reporting and close-out.....	3

Change History

Configuration Control

Project:	MLA QMS
Title:	Work Breakdown Structure for Project B
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA314.100
Created by:	Melanie Lang
Creation Date:	10 August 1993

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\05	Draft	Melanie Lang	MLA314.001
0.02	97\05\16	Draft	Melanie Lang	MLA314.002
1.00	98\08\10	Approved	Melanie Lang	MLA314.100

Revision History

Version	Date	Changes
0.01	97\05\05	New document created from MLA002.102
0.02	97\05\16	Additions of actual schedule.
0.02	97\06\28	Additions of actual schedule and outputs.
1.00	98\08\10	Document approved and checked.

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	98\08\10	Approved	MLA 2031 section 2.10

Change Forecast

1 Scope**1.1 Introduction**

This document goes into the detail in section 10 of MLA313.

1.2 Purpose

To manage the subproject of a SPICE assessment on a process instance which has been part of the previous PEP project cycle.

1.3 Applicability**1.4 Definitions****1.5 Audience**

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents**1.6.1 Specifications****1.6.2 Standards**

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 **Assumptions**
- 1.8 **Requirements Traceability**

2 Proposed Project approach

The high level proposed project approach from the feasibility study document has been expanded below:

2.1 Key for table below:

Under the actual person-hours column, numbers which appear in brackets indicate tasks which have already been integrated with another, indicated firstly by the heading number, and then the number of the row in square brackets.

All dates are for 1997, unless otherwise recorded.

Where estimates are different from actuals, the actuals are recorded in [] after the estimate.

2.2 Phase 1: Preparation and planning

TASK		OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
1.	Assessment Initiation	ML	Complete		08/05 [15/05]	08/05 [15/05]	
1.1.	Initiate assessment - secure project and agreement or contract	ML	Complete				
1.2.	Establish processes and area to be assessed, as well as work products	ML	Complete				
2.	Define and document process	ML	Complete		05/05	28/05	
2.1.	Preparing the Assessment Input	ML	Complete	MLA 313			
2.2.	Develop Feasibility Study	ML	Complete	MLA 313			
2.3.	Develop Work Breakdown	ML	Complete	MLA 314			
2.4.	Develop Quality Plan	ML	Complete	MLA 315			
3.	Conduct training	ML	Complete				
3.1.	Assessor training in use of SPICE, instrument and tool	ML	Complete		07/02/1996	08/02	
3.2.	Prepare training material	ML	None	-	-	-	
3.3.	Briefing the sponsor and/or OU staff about the methodology to be used	ML	Complete		08/05	08/05	(2.2[1])
4.	Preparation	ML	Complete				
4.1.	Schedule assessment interviews	ML	Complete		09/05 [15/05]	16/05	
4.2.	Review input with assessment sponsor, obtain approval and validate assessor qualifications.	ML	Complete		08/05 [12/05]	08/05 [12/05]	

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
4.3. Informal site visits to get the 'feel' for the processes and products - this was part of the function point count.	ML	Complete		1996	1996	?
4.4. Select compatible model, method and instrument	ML	Complete		05/05	05/05	(2.2[1])

2.3 Phase 2: Assessment and analysis

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
1. Conduct assessment	ML	Complete	Sealoq.db	12/05	16/05 [24/06]	
1.1. Record a rating for each process attribute for each process instance	ML	Complete				
1.2. Collect objective evidence to substantiate the ratings, based on indicators, including:	ML	Complete				
1.2.1. practices examined	ML	Complete				
1.2.2. work products examined	ML	Complete				
1.2.3. people interviewed	ML	Complete				
1.2.4. rating justification	ML	Complete				
2. Analyse Findings	ML	Complete	MLA 316	12/05	27/05	
2.1. Verify and validate the ratings and evidence and correct assessment accordingly	ML	Complete	MLA 316	12/05	16/05	
2.2. Manage risks and quality of ratings and evidence and correct plan accordingly	ML	Complete	MLA 316	12/05	16/05	
2.3. Record set of process attribute ratings as a process	ML	Complete	MLA 316	12/05	16/05	

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
profile						
2.4. Record evidence to verify compliance with the requirements from:	ML	Complete	MLA 313	05/05	28/05	(2.2[2.1])
2.4.1. reference model part 2 and exemplar model part 5	ML	Complete				
2.4.2. conducting an assessment part 3, including defined indicators	ML	Complete				
2.4.3. documented process	ML	Complete				
2.4.4. assessor guidance and competence part 6	ML	Complete				
2.4.5. choice of assessment instrument part 4.	ML	Complete				
2.5. Negotiate modifications to the assessment input with the sponsor	ML	Complete	MLA 316	08/05	28/05	
2.6. Review the assessment results with independent internal and correct assessment accordingly	ML	Complete		19/05	19/05	

2.4 Phase 3: Reporting and close-out

TASK	OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
1. Prepare assessment results	ML	Complete	MLA 318	20/05	21/05 [20/06/1998]	
1.1. Document general findings, conclusion and recommendations	ML	Complete				
1.2. Generate report	ML	Complete				

TASK		OWNER-SHIP	STATUS	REFERENCE	START DATE	END DATE	ACTUAL PERSON-HOURS
2.	Prepare assessment presentation	ML	Complete		22/05	26/05	
2.1.	Prepare presentation, including venue, attendees and barco	ML	Complete	MLA 319	06/05	13/05 [28/06/1998]	
2.2.	Present results to assessment participants	ML	Complete				
2.3.	Distribute assessment output for review	ML	Complete				
3.	Prepare assessment presentation to assessment owner and immediate stakeholders	ML	Complete		27/05	27/05	
3.1.	Prepare presentation, including venue, attendees and barco	ML	Complete	MLA 349	06/05	13/05 [28/06/1998]	18
3.2.	Present results to stakeholders	ML	Complete				
3.3.	Distribute assessment output to stakeholders	ML	Complete				
4.	Close out project	ML	Complete		28/05	28/05	
4.1.	Complete trials questionnaires with interviewees	ML	No longer required				
4.2.	Complete trials questionnaires with sponsor	ML	No longer required				
4.3.	Assessor to complete trials questionnaires	ML	No longer required				
4.4.	Prepare lessons learned and presentation comments document	ML	Complete	MLA 309	06/05	13/05 [28/06/1998]	18



MLA QMS

SPICE Profile For Project B

Technica' Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iii
Configuration Control	iii
Document History	iii
Revision History	iii
Management Authorisation	iii
Change Forecast	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Definitions	1
1.5 Audience	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 SPICE Profile	3

Change History

Configuration Control

Project:	MLA QMS
Title:	SPICE Profile for Project B
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA321.103
Created by:	Melanie Lang
Creation Date:	2 November 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	97\10\08	Draft	Melanie Lang	MLA321.001
1.00	97\11\02	Approved	Melanie Lang	MLA321.100

Revision History

Version	Date	Changes
0.01	97\10\08	New document created from MLA002.102
1.00	97\11\02	Document Approved
1.00	98\08\10	Document Checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	97\11\02	Approved	2.5

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from SPICE profile for project B.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

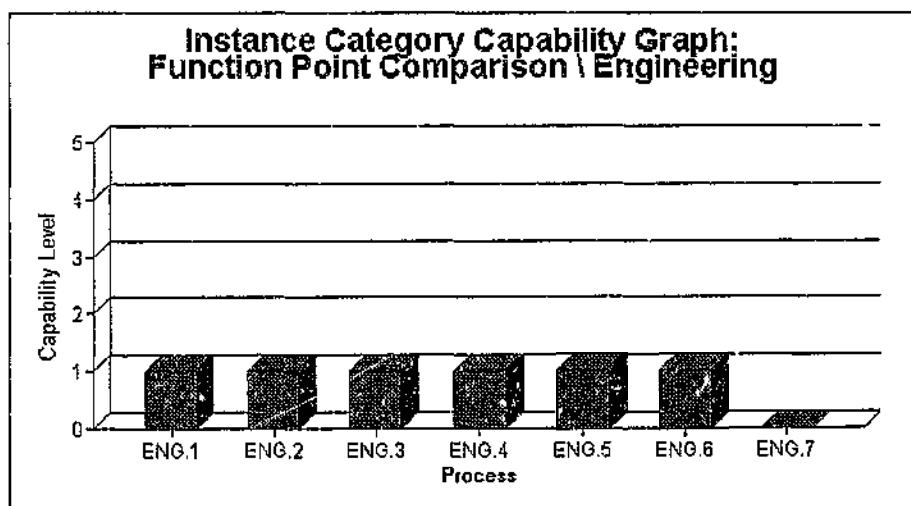
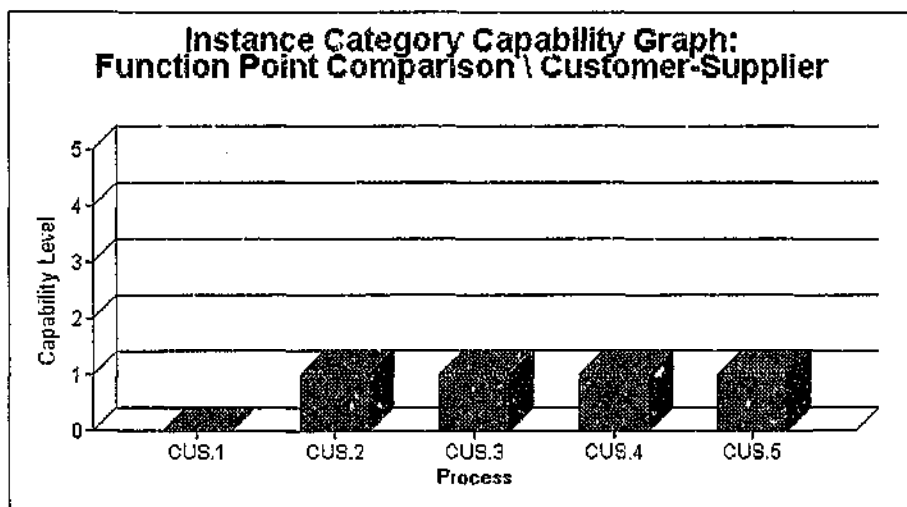
1.6.1 Specifications

1.6.2 Standards

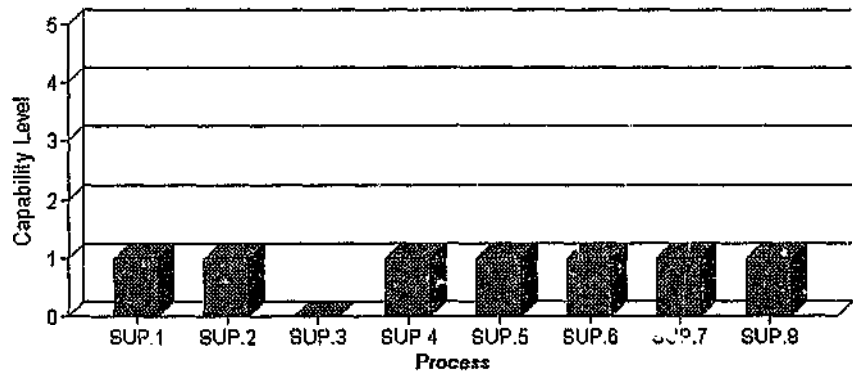
- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures.
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

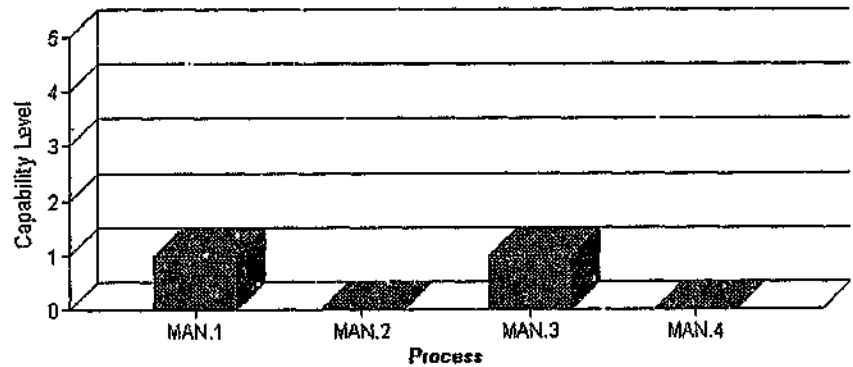
2 SPICE Profile



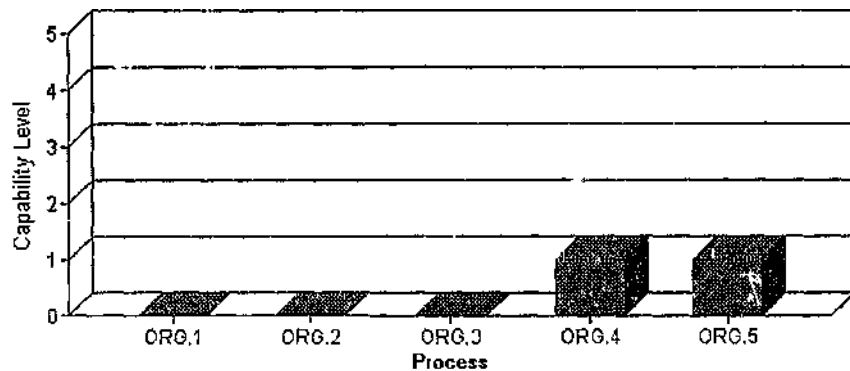
**Instance Category Capability Graph:
Function Point Comparison \ Support**



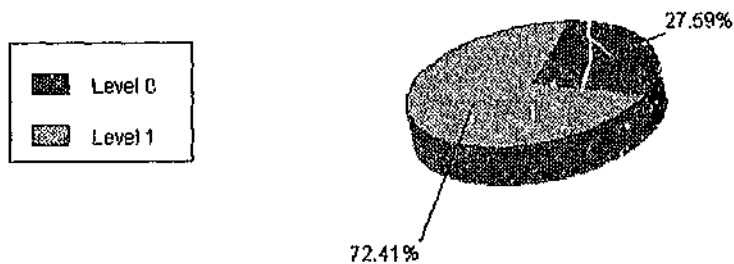
**Instance Category Capability Graph:
Function Point Comparison \ Management**



**Instance Category Capability Graph:
Function Point Comparison \ Organization**



**Instance Capability Level Distribution Summary Report:
Function Point Comparison**



SPICE Assessment Feedback for Project B

MT Lang

Eskom IT Application Systems Quality Team

ESKOM, P O Box 1091, Johannesburg, 2001, South Africa.

Melanie.Lang@eskom.co.za.

1 Introduction

The project assessed in this instance is known as the CRP Process B5.2 (Collect and Bank Money) Payments Receipting System. The project was a new 6-month development project used to develop a system in support of Distribution's business processes by the in-house IT department consisting of a project team of. The system was developed as an independent system, using predominantly fourth generation languages which could later be integrated into the larger Customer Relationship Process programme to record information at a till point for Payments of Electricity in a database. Rapid Application Development methodology was used.

The SPICE assessment was performed as this project met the requirements for the assessor's MLA Masters research project i.e. it was assessed in the CSC PEP Programme Cycle 2, and therefore had both function point counts and a PEP footprint available, as well as being used by a core Eskom business function and had no major problems regarding resource availability for interviews.

In function point and lines of code(LOC) terms it was a medium project.

The technical environment was PC/Workstation and the target use of the product was as an information system. A moderate level of code reuse was achieved, but mainly as a result of the programmer's own personal software process, rather than out of any significant organizational unit(OU) processes.

This document provides a summary of SPICE, the assessment methodology, the actual assessment, results obtained from the assessment and proposed enhancements to the existing processes.

2 Abbreviations

The following abbreviations are used throughout this document:

ATACC:	Advanced Test and Change Control
CASE:	Computer Aided Software

Engineering

EDM:	Eskom Development Methodology
ITD:	Information Technology Department
MPO:	Macro Project Office
OU:	Organizational Unit
PEP:	CSC Performance Enhancement Programme
SPICE:	Software Process Improvement and Capability Evaluation

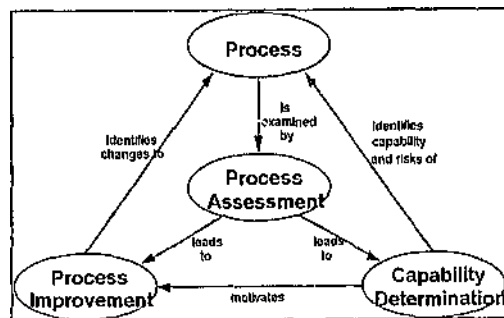
3 Software Process Improvement and Capability Determination

ISO/IEC 15504, also known as Software Process Improvement and Capability Determination or by the acronym SPICE is an international standard developed by ISO/IEC JTC1/SC7 WG10 to provide a structured approach for the assessment of software processes.

3.1 The SPICE Model

The model adopted by ISO/IEC 15504 is shown in Figure 1. Fundamental to the model is the concept of a process, which is described as *a set of interrelated activities, which transform inputs into outputs*.

Figure 1: The Assessment Process

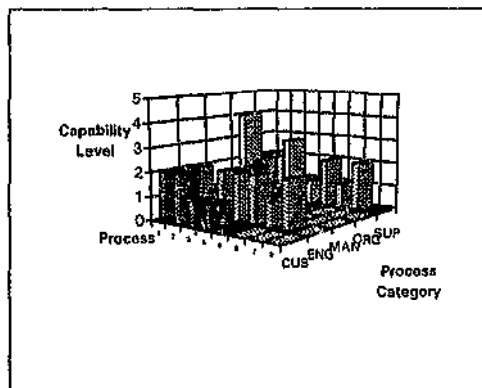


Processes are examined using the mechanism of process assessment, defined as a disciplined evaluation of an organisation's software processes. The output of the assessment exercise is a profile, which can be used variously for process improvement (Action taken to change an organisation's processes so that they meet the organisation's business needs and achieve its business goals more effectively) and/or for determination of process capability - a systematic assessment and analysis of selected software processes within an organisation against a target capability, carried out with the aim of identifying the strengths, weaknesses and risks associated with deploying the processes to meet a particular specified requirement.

The two key components of the standard are a process model and guidance on conducting assessments.

The process model is made up of a framework of attributes in two dimensions: The Process dimension contains process categories, processes and base practices, and the Capability dimension contains capability levels, process attributes and management practices. Input and output work products are used as indicators of level of achievement of base and management practice.

Figure 2: The Dimensions of the SPICE Model



3.2 The SPICE Process Categories

Processes are grouped into general areas of activity called process categories:

1. Customer-Supplier (CUS)
2. Engineering (ENG)
3. Support (SUP)
4. Management (MAN)
5. Organization (ORG)

The processes in Figure 2 are enumerated for illustrative purposes, but they are not the same across all the process categories.

3.3 The SPICE Capability Levels

A capability level is a set of process and management attribute(s) that work together to provide a major enhancement in the capability of a Supplier to perform a process.

Each level provides a major enhancement of capability in the performance of a process. The levels constitute a rational way of progressing through improvement of the capability of any process.

There are six capability levels in the reference model.

As you progress up the capability maturity scale, you transform from not performing the process (level 0) to solely performing the process (level 1) to managing it at a team-based level (level 2) to using a defined organisation-wide process (level 3) to measuring it, and using it for effective prediction and process control (level 4) and then finally to optimising it (level 5).

The capability level of each process is independently assessed, by an assessor making a judgement supported by documented objective evidence. This may be based on practice attributes (by interviewing process practitioners and managers) or work product characteristics (by examining documents, plans etc.) provided by the SPICE embedded model. This leads to a collection of profiles which represent the assessment output, as seen in Figure 2.

A first assessment can form part of a baseline and then using the Guidelines for Process Improvement, improvements can be prioritised and implemented in accordance with organisational goals.

SPICE is a relatively new standard and is still undergoing development and phase 2 trials.

4 SPICE Assessment Methodology

This section details information additional to the standard SPICE Methodology as represented by the SEAL Of Quality v0.82 tool. Both the instrument and the methodology are SPICE compatible.

4.1 Assessment Input

The following people were involved in the assessment:

1. Erich Roberts was the sponsor and owner. A sponsor internal to the OU.
2. Melanie Lang was the qualified assessor responsible for the assessment.

SPICE Assessment Feedback for Project B

3. Available process and project resources were the interviewees.
4. Christine Griesel was the internal auditor.
5. Prof. Walker was the external auditor

Refer to the Assessment Quality Plan (MLA315) for further detail on their responsibilities.

The purpose of the assessment was to provide a profile for comparison against the function point count and PEP footprint, providing additional insight into processes in other words a process assessment rather than for capability determination.

The assessment approach was self (performed by a member of the organisational unit), discrete (a 'snapshot at a point in time) and team-based (no automated tool was used, but a group was involved).

The assessment type was full (covering all processes), basic (without adding additional processes to the SPICE set) and initial (no previous assessment had taken place).

The scope of the assessment was all the processes, excluding Acquire Software, Maintain Software and Manage Subcontractors, up to capability level 3 (Established Process) where applicable within Eskom IT Application Systems (about 200 people). Reasons for limiting this scope is that as a result of this being an assessment with an internal sponsor, the sponsor would only have control of those areas he managed and very few processes were expected to be at level 2 and even less at level 3.

Main constraints included:

- the availability of key resource and maximum amount of time to be used for the assessment. This was restricted to +/- 1 hour for 6 days for the main interviewee;
- confidentiality agreements protected the identity of an interviewee outside the SPICE Assessment Team.

4.2 Assessment Approach

The assessment schedule involved Preparation and planning (of the assessment input and project and quality plans); Assessment and Analysis (with the identified resources and auditing with identified experts); and Close-Out and Reporting (Presentation to all involved).

4.3 Assessment Assumptions

The following assumptions were made during the assessment:

1. The assessment was conducted as far as possible with the project leader, and the assessment ratings were validated by reviewing the available documentation and cross-checking certain practices with other resources.
2. Most of the Organisation process category focussed on a much higher level, and was covered by the upper managerial roles, rather than the junior ones.
3. The main focus of the assessment was the Engineering and Customer-Supplier categories, but with the additional time, it was decided to complete the entire profile.
4. As this was a discrete assessment, it was essentially a snapshot of the processes at a point in time after the function point count had been done, and which was covered by the information in the PEP data capture forms. This meant that processes which may have been used later on in the year, were not assessed.
5. Due to the informal nature of the project, base practices were examined mainly on the basis of trust, rather than expected documented evidence, however, where documents were available, they were informally examined, although not rated, and listed in the Assessment Working Document (MLA316).
6. Main project members were available for interviews, but rather than them being 100% available for a week, the assessor had to be available to accommodate them. As a result of the time and this resource constraint, only the CCP process leader, customer, CCP quality manager, CCP issues manager, CCP data model team leader, development team leader, developer, project manager, MPO project leader, IT training manager, Distribution systems application manager and applications manager were interviewed, and problems arose where areas were covered strictly by other project roles, although the CCP process leader's view was taken as objectively as possible. It was thus assumed that the CCP process leader was aware of most of the procedures followed, and problems encountered during the project, and could provide the most accurate view of the processes.

SPICE Assessment Feedback for Project B

4.4 Assessment Risks

The following risks were considered throughout the assessment:

Table 1: Assessment risks and planned approaches

Risk	Management
The assessment may cross boundaries into areas which are not covered by the scope i.e. IT Application Systems.	Where possible, these processes were omitted from the assessment, as they were processes which were not under the control of the sponsor, and no changes to them could have been made. This meant that the next level of the assessment e.g. for the base practices, the process ratings would be adjusted to exclude that practice aggregation.
The size of the group of project resources, who each work on several areas, may cause problems in terms of coverage of the processes and capability levels.	The major source of information for doing the assessment was the CCP process leader, supported by the documents in the project folders.
The assessment team made use of the existing documentation that has been created to confirm the assessment rating. There was insufficient time to review every document that has been created.	A combination of interviews and investigation of the documents were used to do the assessment. It will be taken on trust that what has been stated and submitted by the assessment participants is true and correct.

5 SPICE Assessment Findings and Analysis

This section presents the profiles of each process category and summarises findings. For detailed evidence and ratings, consult the Assessment Working Document (MLA316).

This section is in the following format:

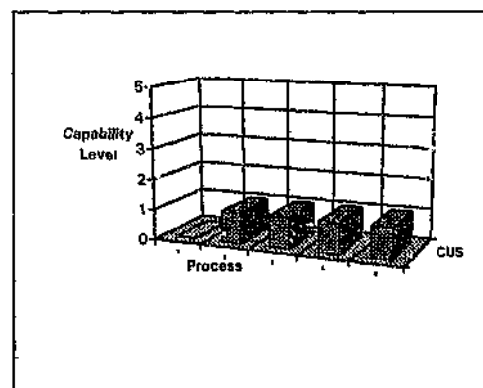
- For each process category,

- Description
- Graph of process category
- Summary of supporting evidence and findings
- Summary of findings
 - Summary graph
 - Summary of assessment findings

5.1 Customer-Supplier Process Category

These are processes that directly impact the customer, support development and transition of the product to the customer, and provide for its correct operation and use. They include: (1) Acquire software, (2) Manage customer needs, (3) Supply software, (4) Operate software and (5) Provide customer service.

Figure 3: Customer-Supplier Process Category



- Acquire Software was excluded from the assessment, as it was assumed that the customer had defined the need, business case and then approached IT with high level requirements, as one of the possible suppliers to produce a suitable contract.
- Based on the fact that source code was no longer available from the original system and it was decided to improve the skills of the end users of the system, the old system was used as the requirements specification. Requirements were obtained through workshops, pilot/prototyping and open days, but not all end customers were as committed as other end customers. A functionality matrix was used as the baseline and change requests were managed. Project team and application build owner communicated fairly often.

This was still too informal to make the Manage Customer Needs process of a higher capability level.

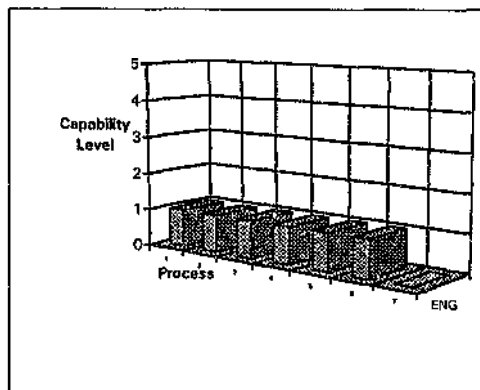
3. At the CRP level, the Module D document formed the high level contract, but this system was supplied independently before CRP deployment due to its urgency. Prototyping and testing reviews were used to review development. Costs were not communicated at this level. Risks and progress were communicated to the application build owner. Delivery requirements were not formalised and an installation procedure was defined.
4. Workshop and system design was used to mitigate risks. Test days for operational testing took place, but additional test data would have been useful. Operating standards were defined, but not always followed. Software operation problems were not always reported through the correct channels, but correct user requests were recorded as KP29's. System capacity and service monitoring was not in place.
5. Training was provided at corporate and pilot sites, support was managed when the correct channels were used, monitoring performance was performed where possible and benchmarking were not really formally done. Customer satisfaction was done at a high level.

Generally, there was a fairly good relationship between customer and team facilitating this process, but a different team and/or customer may not have resulted in the same assessment. Most base practices are performed. The weaknesses of this process category is that minimal configuration management would make it difficult to repeat.

5.2 Engineering Process Category

These are processes that directly specify, implement, or maintain a system and product and its user documentation. They include: (1) Develop system requirements and design; (2) Develop software requirements; (3) Develop software design; (4) Implement software design; (5) Integrate and test software; (6) Integrate and test system; and (7) Maintain system and software.

Figure 4: Engineering Process Category



1. Process models and a prototype based on the functionality matrix formed the system requirements. High level requirements for system architecture were identified, and no requirements needed to be prioritised, as they were all necessary. Certain users contributed a great deal less than others, and their request for changes close to the release date impacted the project.
2. Development team wrote a technical specification, but no detail requirements specification. System was felt to be self documenting. A simple release strategy was defined, but since there were only minor changes from one release to the next, documents were not updated. Communication was aided by the prototyping approach.
3. CRP's existing architecture was used and interfaces to CRP were designed. Detail design was self-documented in Access. Complete traceability between requirements and design could not be established.
4. Code units with comments were implemented. Procedures and plans were set up for unit testing and during unit testing, regression test strategy was to re-test everything. Users provided real data sets for testing.
5. During software testing, development continued until a point in time when it was decided to re-test thoroughly. There was no rigorous testing with defined test data, expected results and test plan and although users supplied a list of tests, 'live data' was not supplied. Software test records were kept, but have since been erased.
6. Component testing consisted of the cross product of the modes and security access. Integrity and user testing was performed. User test input and results

were not recorded, although problems were reported. Hard copies of some test results are available. Informal test planning was done, but results were not always fully documented.

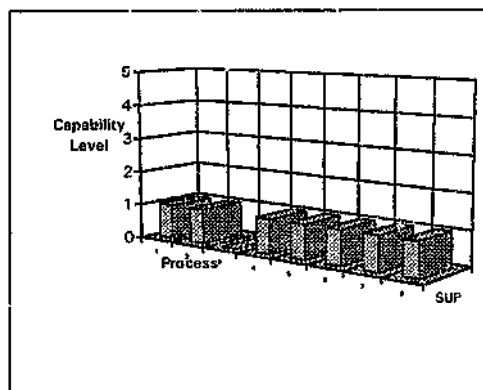
- The system had not needed maintenance during the scope of this assessment, and the Maintain System and Software process could therefore not be assessed.

The Engineering process category is performed, placing all of the assessed processes on level one. Processes were dependent on the team. Standard process consisted of tailored EDM. The strengths of this process are the general usage of SE principles. The weaknesses of this process are the lack of configuration management, although a standard process is used and some quality management is in place, they are not rigorous enough to constitute a higher maturity level. The weaknesses arise mostly from the lack of work product management practices as described by the Capability level 2 of the SPICE model.

5.3 Support Process Category

These are processes that may be employed by any of the other processes (including other supporting processes) at various points in the product development life cycle. They include: (1) Develop documentation; (2) Perform configuration management; (3) Perform quality assurance; (4) Perform work product verification; (5) Perform work product validation; (6) Perform joint reviews; (7) Perform audits; and (8) Perform problem resolution.

Figure 5: Support Process Category



- Documentation requirements were informally defined for user documents, entity-relationship diagrams (ERD's), function hierarchy diagrams (FHD's) and online help. The only implementation document requirement was usage of Access which was self-documenting. Reviews of ERD's, FHD's

and developer's documents took place. Documents were informally distributed to the application build owner and Oracle models were accessible to those who required them. Developer documentation was accessible to those who had Access installed. Some documents were maintained.

- An informal configuration management library existed on the network server and CASE database. Strict control was not exercised, as some work products were kept on local PC hard drives. Change control of most items were informal or unnecessary, except on the CASE diagrams which was more controlled. KP29's were used to record code changes. Product releases were usually built with the correct versions. Configuration item history was kept where it was automatic and only status was draft and other.
- Quality assurance against the Eskom Development Methodology. Some peer reviews, reviews and audits were performed and reported to the required levels of management and deviations were fully handled. External auditors were independent audit resources.
- ERD's, FHD's and the prototype underwent work product verification. Mechanisms were functionality checks and cross checks with the outputs of the original system. Action items were only documented and communicated when performed externally and no formal tracking was performed.
- Workshop requirements, prototype and pilot site software underwent work product validation. The only mechanism used was functionality checks. Criteria, test cases and specifications were not formally defined, but testers knew the focus areas. Anomalies were documented as informal notes and tracked.
- Reviews took place in the workshop prototyping sessions and testing. Management and technical reviews were informal and software process assessments were not done.
- One audit was identified, prepared for, conducted and corrective actions taken, although the auditors (outside the scope of this assessment) did not cover the requested scope.
- Problem resolution was also fairly mature and problem details, prioritisation, resolution and tracking was done informally or through KP29's (Change request as defined in Eskom's change process). Defect correction and distribution was

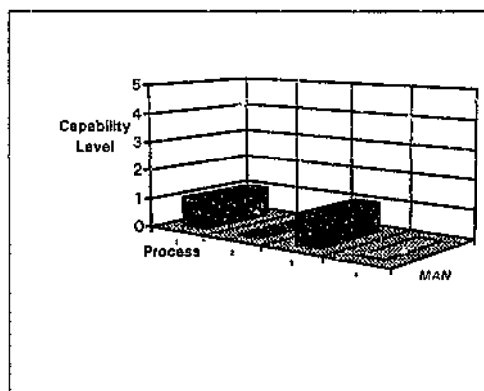
performed, however defect analysis was performed when problem was severe.

The strengths of this area consist mostly of the fact that some quality is in place for the processes, particularly testing, joint reviews and problem resolution. The major weaknesses are that the processes are not formal enough.

5.4 Management Process Category

These are processes that contain practices of a generic nature which may be used by anyone who manages any sort of project. They include: (1) Manage the project; (2) Manage quality; (3) Manage risks; and (4) Manage subcontractors.

Figure 6: Management Process Category



1. Scope of work, project estimates, work breakdown structure, project schedule, infrastructure requirements and allocation of responsibilities were performed, using multiple MS Project project plans at various levels, however tracking and evaluating the project performance was only informally performed. A prototyping development approach was used. Consolidation and central storage of project plans was not done.
2. At the project level, quality and risk management were partially performed on the identified goals. At the CRP level, standards and risks were identified, but since only part-time resources were allocated to manage these, they could not be properly planned and tracked. Risks were more regularly managed and communicated to stakeholders as a formal scope, matrix and strategy was in place.
3. No subcontractors were managed.

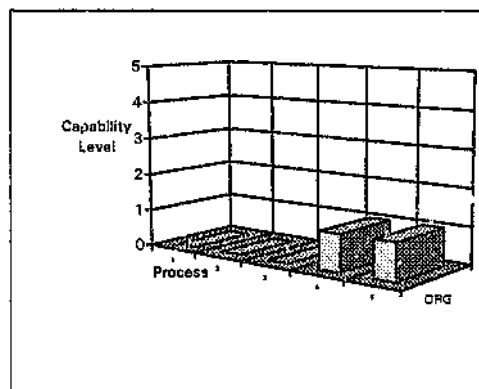
Difficulties arose as a result of the fact that there were many layers of management, and there were no central

consolidated management plans with responsibilities allocated at the various levels.

5.5 Organization Process Category

These are processes that establish the business goals of the organisation and develop process, product, and resource assets which, when used by the projects in the organisation, will help the organisation achieve its business goals. They include: (1) Engineer the business; (2) Define the process; (3) Improve the process; (4) Provide skilled human resources; and (5) Provide software engineering infrastructure.

Figure 7: Organization Process Category



1. A strategic vision was established for the organisational unit, but not many people seemed to be aware of it, indicating a problem with deployment. The appointment of a quality advisor, CRP quality resource and subscription to an international benchmarking programme was considered to be the starting point of establishing a quality culture. CRP was an integrated team, but seemed to subcontract part of the development to another OU team. Formal incentives for the project were not provided, other than the existing ones. Recognition / rewards are based on end product rather than process outputs (End product is usually considered to be a working system - process outputs are intermediate deliverables, which would indicate a well-documented system which is easily maintainable and possibly contributes to future projects). For those who chose to participate, there was a Personal Development Plan (PDP) for career development.
2. This project was not used specifically to either define or improve existing OU or team processes, although it (among others) could have been one of the contributing factors to future process definition. Processes which were being defined at this time was Advanced Test and Change Control (ATACC)

SPICE Assessment Feedback for Project B

for Eskom's standard test and change control process and Macro Project Office (MPO) for Eskom's standard project management process. The base practices were mostly partially to largely performed with no policy for it's use and no performance expectations. Process measures took the form of PEP Baselineing and function point counting. Human resources for supporting process definition were informally defined and provided through the MPO resources and the Quality Advisors.

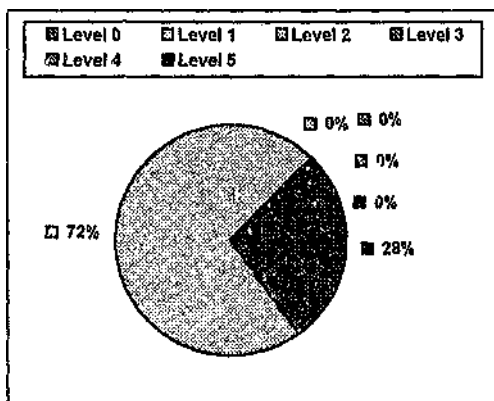
- As the processes for MPO and ATACC were currently undergoing definition in the timeframe assessed, these processes would improve the current practices. However, for the Eskom Development Methodology (EDM) which had been defined prior to this timeframe, improving the process would mean improving the EDM itself. CRP performed a process assessment on EDM, but this was not widely communicated. There were no formal plans, resourcing, standards or process infrastructure for future process improvements i.e. it appears to be ad hoc, and not a direct result of organisational goals.
- PDP's and business plans were used to identify human resource needs. These were used by the training department to acquire training courses. Project teams are defined and available resources with the necessary skills are selected, otherwise the recruitment process is started. The Personal Performance Contract, Job Output Models and Performance Appraisals are used to evaluate staff performance and feedback then given. Good personnel records are kept, no formal training records are kept and skills information was previously kept in the EDCO system but is now outdated. Empowerment and team interactions are not formally defined, except within CRP.
- Software engineering infrastructure are limited to technology specific issues and physical infrastructure, as well as several team standards. A reuse strategy in the form of the use of EOS and Natural Construct is partially in place, however not organization wide or as a formal part of the life cycle.

This process category was sometimes difficult to assess on a project level, and was taken on a much broader view. For the Provide Skilled Human Resources process, SPICE suggests that training and skilling is the responsibility of managers, however the OU took a human-centred approach, where each individual is responsible for him/herself and empowered to make their own decisions. This may also be the reason that it performed better than the others. This may be the

reason for unsuccessful deployment of other processes. The fact that people are empowered, means they manage and control their own decisions and their subordinates, so instead of having to obtain commitment from 1 manager, the process deployment teams have to obtain commitment from 200 'managers'. Although processes are defined, there is no arrangements for future improvements. Infrastructure by means of organisation-wide standards and resource libraries (of all configuration items) did not exist, but was provided for the physical and language software engineering environments.

5.6 Summary

Figure 8: Derived SPICE Profile



- Capability:** This project is mainly at capability level 1, performing a large number of the base practices and many of the activities managed by the various levels of leadership. As a result of processes not existing, or the one's being used on the project not being documented, the project would not be repeatable if resources within the same teams are used. Most of the teams making use of the processes will never achieve higher than level 2. The crux of level 1 are that processes are not dependent on individuals, i.e. if someone else in the team had to be given the same project, they would be able to achieve the same level, apart from several individualistic areas where they may be stronger or weaker. Level 3 is dependent on the fact that anyone in the department would be able to take on the project and not specifically the team involved. This of course would take into consideration management practice 2.1 that an individual with the required skills was chosen. However, the fact that the Engineering processes had the most highly skilled resources may indicate that individuals have to acquire skills in another SE processes (eg. manage quality, develop documentation). This would also mean that it

would not make a difference if anyone else in the OU had been managing eg. quality instead, since they would have had as much skill as the other person.

2. **Experienced Resources:** The projects assessed definitely had highly proficient and skilled resources who did not necessarily need processes to ensure best practices, but the lack of correct documentation would make it difficult in future for maintenance. The nature and experience of the team made them inadvertently follow basic software engineering practices, but nothing formalised, or documented, which would lead to a repeatable process. These software engineering practices were also more easily planned, tracked and managed than the support and management category practices.
3. **Service Provision:** Eskom projects appear to be highly pressurised, where customer requests are often satisfied without regard for what may be 'healthy' for the OU. OU members seem to be condemned to a service provider role (except in one-off projects). This situation is a hindrance to proper planning, tracking and management since unplanned for emergencies interfere with work which cannot be rescheduled. This forces project resources to work long hours, often with no additional reward. This could have an effect on employee (dis)satisfaction.
4. **Size Counts:** The fact that the systems are rather small has a positive impact, since they appear to be easier to plan and manage, although constraints remain severe.
5. **Process Owner:** A major problem is that there is no clear definition of who owns / is responsible for which part of most processes.
6. **Existing Procedures and Libraries:** The fact that there are a number of procedures and even resource libraries that have been defined was a pleasant surprise. Unfortunately, they are not widely enough available or in some cases, are rejected by process users as being too broad to be applicable. Standalone projects are usually thought to be fairly simple and not requiring processes, however existence of standard departmental processes, architecture and various libraries of resources would not only speed up development, but also assist in maintenance. Engineering process category standards are centralised in the 'Blue Book' (Phoenix programme's database standards).
7. **Feedback Loop:** For the existing standard processes, there is currently no mechanism in place

for those who use it (and possibly tailor it) to provide feedback to the owners, so that they can be modified, or the tailoring can be noted as a possibility. Although the processes state that they should be re-looked at every half-year, this does not happen, as there is no responsibility assigned for this.

8. **Pilot Process Projects:** Different requirements of each site makes using a pilot project to test a process difficult. It is important to take the pilot site's problems into account in context with the influence and requirements of the rest of the OU. Processes could be beta tested where responsible parties within all (development and maintenance) teams gather observations from within their programmes or their functional areas and communicate these to the process definition and improvement change control administrator. This would then be incorporated into each project's plan.
9. **Intangible System:** Prototyping is used as the excuse when requirements cannot be gathered for a system, but if a system is supposed to fulfil a business function regardless of the technology or the interface, this should be able to be gathered during analysis and design and during detail design, interface and other issues may be considered. This is a problem with both user and development teams, since the user is usually unable to visualise and developers are unable to explain a virtual system. It is important that "visionary" users and business analysts be involved at the requirements level and that "visionary" users, business and system analysts be involved at the detail design level. This will mean that a project can move through a waterfall model and not require as much rework as continual re-development will require.
10. **Maintenance of Work Products:** In general, projects are fairly well done and documented as far as allowed i.e. if a customer demands a delivery date, the resources do as much as possible by that date, but documentation is often not considered to be of as high a priority, particularly when a project is timeboxed. There is a tendency after moving to the next phase to ignore maintenance of output work products or deliverables from previous phases (e.g. changes noted in minutes, must be recorded as change requests, and updated in code, test data, design, analysis and specifications). This leads to re-analysis and re-design if (the inevitable) additional maintenance or enhancements are required, and even if the original resources are involved, they will not remember the workarounds and changes from the old system. Even worse, if

there is re-development or conversion of a system, then the analysis and design has to be re-worked, instead of just new requirements added on.

11. **OU Scope:** As a result of the fact that our projects are not really standalone projects, but are part of a larger programme, this means that the assessment extends further into group information management, where IT's customer is actually a part of the development team, and the business managers, as well as the programme managers manage customer needs. The difficulty with this is that there needs to be complete communication between all parties involved. Often responsibilities and roles are not clarified and process execution is duplicated or not performed at all.

Although assessments were performed on specific process instances, they seem to be typical of the entire OU. So, the individuals which are part of the projects are not to blame (except if personal professionalism was an issue), but rather the system of which they are a part - there is no means of seeing the whole picture. You need to define EVERYTHING as a part of a system and process in order to do that.

6 Significance

This section discusses lessons learned and suggestions for improvement from all the assessments performed as part of the study.

6.1 Lessons Learned

Questions and problems were directed to the local trials co-ordinator and discussed at some of the meetings of WG10. The following were experiences from the SPICE assessment:

1. **Assessment Management:** Like any project, an assessment should be carefully planned, resourced, managed and tracked. Although most of this assessment was performed last year, the fact that all documentation had been kept up to date, meant that it was fairly easy to continue from where one had left off.
2. **Accuracy vs. Time:** In the ideal world you would want to interview every practice/process "user" and review every work product, but taking the Pareto Principle (to only perform 80% of the work, since the additional 20% will require as much effort, with little benefit) into account, you should be able to get a fairly accurate view from a good sample of people and work products. Further time reduction can take place if interviews are audio- or video taped and the assessor consolidates and reviews together with work products simultaneously later.

Reviews are very tiring and should not exceed 3 hours a day. Timeboxing may be a good technique.

3. **Habits:** Interestingly, although projects vary, processes are like habits and most people remember how they performed a specific process.
4. **Honesty:** Interviewees appeared to be fairly honest (although some discrepancies were found, as a result of misunderstanding and/or miscommunication, rather than intentional misleading). It is expected that for an internal assessment, interviewees would continue to be honest as long as the results were not to be used for personal measure. Generating accurate documented evidence (unless an ISO certificate depends on it) would be counterproductive, but for any assessment / test there is likely to be a way of cheating if interviewees are trained to answer in a specific way, but like all tests, the best way to pass is the honest and legal way.
5. **Capability Level Assessment:** At the higher levels, the assessment becomes more difficult, since evidence of management practice performance must be found. There were not assessed in detail, since it was limited to (usually) an outdated project plan, which had some activities on it, and then the main interviewee was usually able to say which were and were not implemented.
6. **Record Availability:** Difficult to perform post assessment if records from that point in time are unavailable e.g. correct version of Blue Book, rather than current version.
7. **SPICE Assessor Skills:** Recommended that a SPICE assessor have basic system knowledge i.e. analysis, design and construction, so that they are able to recognise dishonesty from an interviewee based on documented evidence. Also, auditing and software engineering skills are an advantage. A recommended skill set as you assess each process attribute level for capability levels is project management, quality and configuration management, standards (both international and OU) and resource and infrastructure management.
8. **SPICE Assessment Difficulties:** were experienced when assessing related or dependent practices. The large amount of time is spent on validation. Also, resource availability influences scheduling, and even advance planning does not ensure that interviewees or auditors will be available when required. A useful tool would be cross-check matrix between some of the practices and capability levels, although if you do the assessment

SPICE Assessment Feedback for Project B

within a short time frame, it should not be very hard to establish.

9. **SPICE Assessment Process:** Recommended to perform in the following order: For all interviewees: (1) Conduct interview and collect ALL work products, (2) Review interview and work products and assign ratings, (3) Confirm with interviewee, (4) Audit and confirm with external auditor.

6.2 Recommendations

The following general approaches can be taken:

1. **Action Plan with Approval:** The next process improvement step should be taken, but not in terms of this individual project, but rather as a larger initiative across the department. Management should approve the areas for improvement, goals and targets and thereby actively commit the OU to the process improvement. An action plan should be put together describing the set and priority of actions to improve software processes.
2. **Root Cause Analysis:** A complete impact analysis could be done to determine the main root causes of the problems. They not only have a negative effect on the process, but also on the people and technology too. Elimination of these should become a priority and would derive the greatest benefit.
3. **By Osmosis:** Use some of the lessons learned and techniques within the Phoenix Architecture team to introduce changes to the entire OU.
4. **Increased Capability Levels:** In order to achieve level 2 and higher, base practices must be documented in a common process framework, with individual and team tailoring also being noted in a commonly identified document. Also, all work products must be under configuration management. We then run into the difficulty that you will no longer be able to maintain the speed of delivery, since you have additional work products to be delivered to your OU and not to your customer. However, eventually these work products should have standard templates and should influence later work which would require less planning and more implementation time, as the standard plan templates should exist and just require minor tailoring. Also, resources will have the required process experience to understand what needs to be done when, and will almost execute out of habit, without requiring a defined plan (although the project manager must still track this). If a workshop is supposed to cover managing

customer needs, QA, verification and developing system requirements, then there should be a standard checklist, so that it will meet all those requirements. Such a project requires at least a 2-year commitment.

As a start, one or more of the following actions could be taken, taking the OU's business goals and objectives into consideration:

1. **Process Roles:** Define process owners and process stakeholders.
2. **Process Deployment:** Identifying an integrated, standard set of processes, which are available in a standard format in a standard area. Existing processes should be deployed and training or standards on related tools (e.g. timesheets) should be given to all process users. SPICE could be used as the common framework. These should then be monitored, controlled, audited and continually improved.
3. **Process Change Management:** Define change management process and roles and responsibilities for standard processes i.e. ATACC, EDM, MPO.
4. **Process Tracking:** Accurate record keeping from timesheets would assist in future planning and estimation efforts and impact analysis.
5. **Maintenance Process:** Alternately, change focus, use Phoenix as basis, and then re-define process for 'small developments' or maintenance (similar to micro function points) i.e. investigate and establish a common process framework.
6. **A Work Product Archive:** should be defined and created, where deliverables of each software development phase of a project including source code, project history and categorised lessons learned are stored for future reference. Project plans should also be submitted and consolidated across the OU, giving a good resource usage and availability tracking mechanism. These must be all under strict configuration management including auditing.
7. **Requirements Specification:** Using EDM with the requirements specification document template for capturing functional and non-functional specs (under review for inclusion in MPO), all requirements can be captured and used for auditing purposes. This will allow project managers to focus only on contractual obligations and enforce better requirements definition and change control, not only in terms of functionality, but 'quality' too.

8. **Change Control:** Although the template mentioned in the previous point would try to assist by listing all possible considerations, requirements will always change as a result of some omissions or ignorance. These changes will always need to be controlled i.e. a good change control methodology must be in place. This would assist with contract re-negotiation.
9. **Eskom Supplier Standards:** would greatly improve development and testing, as it is clearly impossible to test for endless possibilities and limiting hardware/software to some preferred suppliers would allow one to set up a test lab in which all performance testing could be properly run.
10. **Intermediate Deliverables:** Process outputs should be additional product outputs i.e. define that we require actuals to be recorded correctly for future planning, require lessons learned to be documented for input into other projects, require contributions to reuse libraries etc.
11. **Professionalism:** People should be professional enough to recognise the impact of their actions on the rest of the system. System being supervisor, team members (any number of teams - programmes, technical, customer etc.), customer, subordinates. This is a personal responsibility and is not a skill which can be taught.
12. **Communication Procedures:** The large number of roles and parties involved in processes are not distinctly modelled in SPICE, but creates a considerable communication overhead. There may be a need to set up proper communication procedures within and external to the department, so that a single consistent message (under configuration management) is always sent out.
13. **Training:** Due to the nature of the skilling process, is important that all OU members use a mechanism such as the PDP to ensure that they continually renew their skills and are assigned to new projects to gain experience. There should be a minimum standard of education for each process role (e.g. systems analyst). Education will either be formal instructor-led, vendor-provided training or CBT training from IT Training. Self-study is not bad, but there is no way of seeing at what standard the knowledge is.
14. **Knowledge Sharing:** There must be a realisation that one is not being employed because of personal project knowledge, but rather the personal knowledge they can contribute to their peers, the department, their customers and Eskom. Continual

re-work is the result of being unable to or refusing to share information. This has to be a conscious effort from management, team leaders and team members, but should probably start where it is most visible. Knowledge sharing groups should be set up, and each person should be expected (as a personal KPI) to contribute. Registers (e.g. contact persons for function point measurement) and procedures (eg. how to setup Windows 95 on a notebook) could be documented.

15. **SPICE Assessment Embedded Model:** Recommended to re-define or add to base practices, work products, resource and infrastructure to use Eskom terminology and/or create common process framework using SPICE model (or ISO 12207).

7 Conclusion

On a final note, suggestions have been made and it is up to the process owners and assessment sponsor to decide on the actions to be taken. Individuals may also choose to improve their personal software process. This is a medium term initial commitment with long term benefits. Individuals may also choose to improve their personal software process.

As this is part of a larger study, the next step for the study is to establish, in conjunction with the other SPICE assessments:

1. insight provided by the footprint performance indicators into the capability level of an OU.
2. insight provided by the footprint performance indicators into the capability level of a process.
3. insight provided by the footprint performance indicators into the capability level of a process category.
4. insight provided by the capability level of an OU into the footprint performance indicators.
5. insight provided by the capability level of a process into the footprint performance indicators.
6. insight provided by the capability level of a process category into the footprint performance indicators.
7. limitations of SPICE covered by PEP.
8. limitations of PEP covered by SPICE.
9. limitations of both PEP and SPICE.

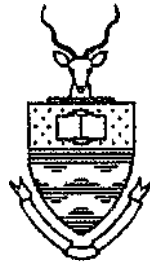
8 Acknowledgements

Thanks to all the people who participated and contributed to the assessment.

9 References

1. ISO/IEC 15504 Parts 1-9 v2.00
2. MLA316 SPICE Assessment Working Document for Project B
3. MLA315 SPICE Assessment Quality Plan for Project B

■



MLA QMS

FPA Count For Project C

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History.....	iii
Configuration Control.....	iii
Document History	iii
Revision History.....	iii
Management Authorisation.....	iii
Change Forecast.....	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose.....	1
1.3 Applicability.....	1
1.4 Definitions	1
1.5 Audience.....	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 Summary.....	3
3 Data Function Types	4
4 Transactional Function Types	5
5 Value Adjustment Factor.....	6

Change History

Configuration Control

Project:	MLA QMS
Title:	FPA Count for Project C
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA330.100
Created by:	Melanie Lang
Creation Date:	23 September 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\05	Draft	Melanie Lang	MLA330.001
1.00	97\09\23	Approved	Melanie Lang	MLA330.100

Revision History

Version	Date	Changes
0.01	97\05\05	New document created from MLA002.102
0.01	97\09\15	Information added to all sections
1.00	97\09\23	Document approved
1.00	98\08\10	Document checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	97\09\23	Approved	MLA 2023 section 2.10.1

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the analysis and implementation function point counts done on project C on 9 May 1996. An analysis count was not done, as metrics were collected after project completion.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

2 Summary

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Function Type	Complexity Rating	Number of Functions	Function Points Awarded	Total Function Points
EXTERNAL INPUTS	Low	1	3	3
	Average	0	4	0
	High	4	6	24
EXTERNAL OUTPUTS	Low	4	4	16
	Average	1	5	5
	High	0	7	0
EXTERNAL INQUIRIES	Low	1	3	3
	Average	0	4	0
	High	0	6	0
INTERNAL LOGICAL FILES	Low	5	7	35
	Average	0	10	0
	High	0	15	0
EXTERNAL INTERFACE FILES	Low	1	5	5
	Average	0	7	0
	High	1	10	10
TOTAL Number of UN-ADJUSTED Function Points				101
VALUE ADJUSTMENT FACTOR				0.88
TOTAL Number of ADJUSTED Function Points				89
Development Work Product				89

3 Data Function Types

Internal Logical Files = ILF

External Interface File = EIF

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Data	Type	Record Element Types	Data Element Types	Complexity	Multiplier	Function Points
1. Bid Price Data	ILF					
	ILF			Low	1	7
2. Composition per view	EIF					
	EIF			Low	1	5
3. Energy Bid	ILF					
	ILF			Low	1	7
4. Energy Curve	ILF					
	ILF			Low	1	7
5. Ad hoc energy parameters	ILF					
	ILF			Low	1	7
6. Ad hoc parameters	ILF					
	ILF			Low	1	7
7. Plant Data	EIF					
	EIF			High	1	10
8. System Trading Parameters	ILF					
	ILF			Low	1	7

4 Transactional Function Types

External Input = EI

External Output = EO

External Inquiry = EQ

Complexity = Com

Low = L

Average = A

High = H

Multiplier = Mult.

Function Points = FPs

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Transaction	Type	File Types Referenced	Data Element Types	Com	Mult	FPs
1. Supply dates	EI	0-1	1-4	L	1	3
2. General Prices						
2.1. Calculation	EI	>=3	>=16	H	1	6
2.2. Output	EO	2-3	6-19	A	1	5
3. Scaling						
3.1. Calculation	EI	>=3	>=16	H	1	6
3.2. Output	EO	0-1	1-5	L	1	4
4. Setup networks & tx loss factors						
4.1. Calculation	EI	>=3	>=16	H	1	6
4.2. Output	EO	0-1	1-5	L	1	4
5. Calculation of spot prices						
5.1. Calculation	EI	>=3	5-16	H	1	6
5.2. Output	EO	0-1	1-5	L	1	4
6. View spot prices						
6.1. Startup Inquiry	EQ	0-1, 0-1	1-4, 1-5	L	1	3
6.2. Print report	EO	0-1	1-5	L	1	4

5 Value Adjustment Factor

This remained the same for both the analysis and implementation counts.

General System Characteristic	Rating
1.Data Communication	3
2.Distributed Processing	3
3.Performance	4
4.Heavily Used Configuration	1
5.Transaction Rates	0
6.On-line Data Entry	4
7.Design for Enduser Efficiency	1
8.On-line update	3
9.Complex Processing	1
10.Usable in other Applications	0
11.Installation Ease	1
12.Operational Ease	0
13.Multiple Sites	2
14.Facilitate Change	0
Total Degree of Influence (TDI)	23

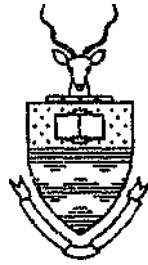
$$\text{Value Adjustment Factor} = (\text{TDI} * 0.01) + 0.65$$

$$= (23 * 0.01) + 0.65$$

$$= 0.23 + 0.65$$

$$= 0.88$$

■



MLA QMS

PEP Footprint For Project C

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iii
Configuration Control	iii
Document History	iii
Revision History	iii
Management Authorisation	iii
Change Forecast	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Definitions	1
1.5 Audience	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 PEP Footprint	3
3 Details	4

Change History

Configuration Control

Project:	MLA QMS
Title:	PEP Footprint for Project C
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA332.100
Created by:	Melanie Lang
Creation Date:	10 August 1998

Document History

Version	Date	Status	Who	Saved as:
0.01	97\05\05	Draft	Melanie Lang	MLA332.001
0.01	97\09\24	Draft	Melanie Lang	MLA332.001
1.00	98\08\10	Approved	Melanie Lang	MLA332.100

Revision History

Version	Date	Changes
0.01	97\05\05	New document created from MLA002.102
0.01	97\09\24	Addition of PEP profile
1.00	98\08\10	Document approved and checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	98\08\10	Approved	MLA 3031 section 2.9

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the PEP footprint received from Quantimetrix and CSC for project C.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

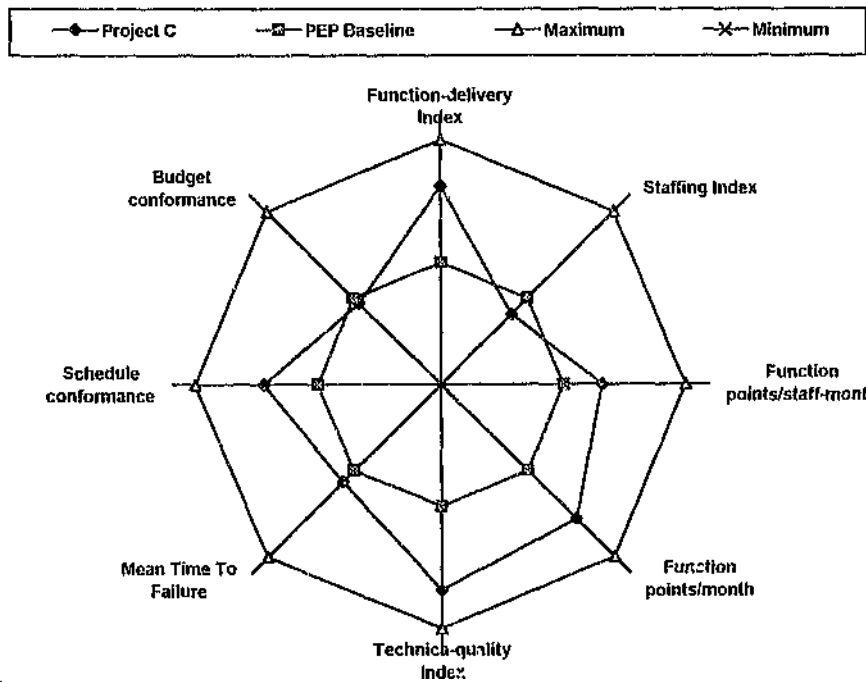
1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

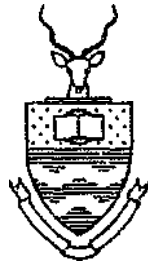
- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

2 PEP Footprint



3 Details

	Actual	Baseline	Difference / Multiple
Fdi (AB)	20.6	14	6.6
SI (AB)	10.1	7.2	2.9
fp/sm	25	11	2.3
fp/mo	62	15	4.0
Time Slippage %	0%	25%	0.0
Effort overrun %	25%	20%	1.3
Tql	14.7	10.0	4.7
MTTF	22.0	15.0	1.5



MLA QMS

FPA Count For Project D

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History.....	iii
Configuration Control.....	iii
Document History	iii
Revision History.....	iii
Management Authorisation.....	iii
Change Forecast.....	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose.....	1
1.3 Applicability.....	1
1.4 Definitions	1
1.5 Audience.....	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 Summary.....	3
3 Data Function Types	4
4 Transactional Function Types	5
5 Value Adjustment Factor.....	7

Change History

Configuration Control

Project:	MLA QMS
Title:	FPA Count for Project D
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA340.100
Created by:	Melanie Lang
Creation Date:	23 September 1997

Document History

Version	Date	Status	Who	Saved as:
0.01	97\09\15	Draft	Melanie Lang	MLA340.001
1.00	97\09\23	Approved	Melanie Lang	MLA340.100

Revision History

Version	Date	Changes
0.01	97\09\15	New document created from MLA002.102
1.00	97\09\23	Document Approved
1.00	98\08\10	Document Checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	97\09\23	Approved	MLA 2023 section 2.10.1

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the analysis and implementation function point counts done on project D on 9 May 1996. An analysis count was not done, as metrics were collected after project completion.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994

- 1.6.3 Procedures
- 1.6.4 Guidelines
- 1.6.5 Other Documents
 - a. FPA Documents
 - b. SPICE Documents
- 1.7 Assumptions
- 1.8 Requirements Traceability

2 Summary

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Function Type	Complexity Rating	Number of Functions		Function Points Awarded	Total Function Points
EXTERNAL INPUTS	Low		2	3	6
	Average		0	4	0
	High		2	6	12
EXTERNAL OUTPUTS	Low		4	4	16
	Average		0	5	0
	High		3	7	21
EXTERNAL INQUIRIES	Low		0	3	0
	Average		4	4	16
	High		6	6	36
INTERNAL LOGICAL FILES	Low		5	7	35
	Average		0	10	0
	High		0	15	0
EXTERNAL INTERFACE FILES	Low		1	5	5
	Average		0	7	0
	High		0	10	0
TOTAL Number of UN-ADJUSTED Function Points					147
VALUE ADJUSTMENT FACTOR					0.87
TOTAL Number of ADJUSTED Function Points					128
Development Work Product					128

3 Data Function Types

Internal Logical Files = ILF

External Interface File = EIF

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Data	Type	Record Element Types	Data Element Types	Complexity	Multiplier	Function Points
1. Ad Hoc Energy Schedule	EIF					
	EIF			Average	1	7
2. Bid Availability	ILF					
	ILF			Low	1	7
3. Composition per view	EIF					
	EIF			Low	1	5
4. Energy Bid	ILF					
	ILF			Low	1	7
5. Energy Curve	ILF					
	ILF			Low	1	7
6. Ad hoc energy parameters	ILF					
	ILF			Low	1	7
7. Ad hoc parameters	ILF					
	ILF			Low	1	7

4 Transactional Function Types

External Input = EI

External Output = EO

External Inquiry = EQ

Complexity = Com

Low = L

Average = A

High = H

Multiplier = Mult.

Function Points = FPs

The light grey section represents the results of the analysis count, and the dark grey section represents the results of the implementation count.

Transaction	Type	File Types Referenced	Data Element Types	Com	Mult	FPs
1.Input for query	EI	0-1	1-4	L	1	3
2.Total sys avail inquiry	EQ	0-1, >=4	1-4, 6-19	H	1	6
3.Details for hour inquiries	EQ	0-1, 2-3	1-4, 6-19	A	1	4
4.Details for station						
4.1.Validation on station etc.	EI	0-1	1-4	L	1	3
4.2.Station data inquiry	EQ	0-1, 2-3	1-4, 6-19	A	1	4
4.3.View reserve	EQ	0-1, 2-3	1-4, 6-19	A	1	4
4.4.Total server per station	EO	0-1	1-5	L	1	4
4.5.Modify station data	EI	>=3	5-15	H	1	6
4.6.Station unit inquiry	EQ	0-1, 2-3	1-4, 6-19	A	1	4
4.7.Modify station unit data	EI	>=3	5-15	H	1	6
5.Available station mw calc	EO	0-1	1-5	L	1	4
6.Available system	EO	0-1	1-5	L	1	4

[illegible]

5 Value Adjustment Factor

This remained the same for both the analysis and implementation counts.

General System Characteristic	Rating
1.Data Communication	3
2.Distributed Processing	4
3.Performance	1
4.Heavily Used Configuration	1
5.Transaction Rates	2
6.On-line Data Entry	5
7.Design for Enduser Efficiency	1
8.On-line update	3
9.Complex Processing	0
10.Usable in other Applications	2
11.Installation Ease	0
12.Operational Ease	0
13.Multiple Sites	0
14.Facilitate Change	0
Total Degree of Influence (TDI)	22

$$\text{Value Adjustment Factor} = (\text{TDI} * 0.01) + 0.65$$

$$= (22 * 0.01) + 0.65$$

$$= 0.22 + 0.65$$

$$= 0.87$$



MLA QMS

PEP Footprint For Project D

Technical Product

Version 1.00

Document Status: Approved

Table of Contents

Table of Contents	ii
Change History	iii
Configuration Control	iii
Document History	iii
Revision History	iii
Management Authorisation	iii
Change Forecast	iii
1 Scope	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Applicability	1
1.4 Definitions	1
1.5 Audience	1
1.6 Applicable Documents	1
1.7 Assumptions	2
1.8 Requirements Traceability	2
2 PEP Footprint	3
3 Details	4

Change History

Configuration Control

Project:	MLA QMS
Title:	PEP Footprint for Project D
Doc. Reference:	C:\MY DOCUMENTS\1996_24\TP\MLA342.100
Created by:	Melanie Lang
Creation Date:	10 August 1998

Document History

Version	Date	Status	Who	Saved as:
0.01	97\09\24	Draft	Melanie Lang	MLA342.001
1.00	98\08\10	Approved	Melanie Lang	MLA342.100

Revision History

Version	Date	Changes
0.01	97\09\24	New document created from MLA002.102
1.00	98\08\10	Document approved and checked

Management Authorisation

Version	Date	Status	Management Board Minute Reference
1.00	98\08\10	Approved	MLA 2031 section 2.9

Change Forecast

1 Scope

1.1 Introduction

This document lists the details from the PEP footprint received from Quantimetries and CSC for project D.

1.2 Purpose

1.3 Applicability

1.4 Definitions

1.5 Audience

The audience for this document comprise the various stakeholders of the SEAL, including:

- The student undertaking this M.Sc. project.
- Interested members of Eskom IT, including my team leader, the IT Application Systems Quality Team and the IT Application Systems Manager.
- The supervisor of this M.Sc. project.
- Members of the SEAL Management Board.
- Head of Department of Electrical Engineering.
- Individuals who perform internal and external audits on projects undertaken within the SEAL Quality Management System.
- All involved in the assessed project.

1.6 Applicable Documents

1.6.1 Specifications

1.6.2 Standards

- a. SEAL QMS Document Creation Template, QS 002, Revision 0.02, 3 October 1994
- b. SEAL QMS Document Layout, Presentation and Typesetting Guide, QS 003, Revision 1.00, 3 October 1994