DESIGN OF PARTNERSHIP-CENTRED INFORMATION REPOSITORY

BY

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material which has been accepted for the award of any other degree or diploma at any University or other institution of higher learning, except where due acknowledgement has been made in the text.

Student Name: J.A. 0kharedia

Signature: ----------

Date: ----------

DEDICATION

This work is dedicated to my wife, STELLA and to my children JOSEPH (Jnr.) and DAVID.

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ABSTRACT

Organizations require the development of Information Repository to improve their products and services. With the rising interest in the semantic web, research efforts have been geared towards the integration of distributed information sources into an interoperable knowledge-base environment. The objective of this research was to design an information repository to facilitate the integration of operational data from various sources into a single and consistent knowledge base that supports analysis and decision making within and across different organizations.

The research activities that resulted in the proposed information repository consisted of two major steps: (i) the design of an information repository aimed at promoting the usage of e-commerce through the Internet amongst the Small Medium Enterprises and the larger organizations and (ii) the implementation of repository architecture to facilitate knowledge sharing in response to queries on distributed metadata and easily interoperable sources merged into one semantic entity.

The SMEs and the larger organizations are focused as partners in the design of this information repository. The implication of focusing on the SMEs and the larger organizations is in line with the South African Government efforts to promote Black businesses, because the former is considered to be one of the most viable sectors with economic potential growth.

The functionality of the information repository is partitioned into a set of services which include: (i) registration of SMEs' profile, (ii) service advertisement and (iii) service delivery. These services provided the mechanism for storing, retrieving and updating of information. Richards Bay Minerals, an organization in the mining industry that has outsourced part of her core business to junior partner was used as a case study to illustrate the model.

XML, the Extensible Mark-up Language provided the descriptive language for the exchange of information between the different organizations via the web. The Java programming language was adopted for implementation.
A performance evaluation of the information repository based on a set of parameters like usability, scalability, functionality and collaboration was carried out, with the aim of determining areas where improvements could be made in providing solution to the design of information repository for the web environment.

KEYWORDS: Information Repository, knowledge sharing ontology, XML ontology, Java programming language and information representation on the web.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Overview

Information Repository is the logical place to uniformly retain and manage information knowledge within and across different organizations. It plays an important role in the business process of organizations and it is developed to improve the products and services of such organizations. The principal reason for developing an information repository is to integrate operational data from various sources into a single and consistent knowledge base that supports analysis and decision making within the enterprise. The design of such repository should conform to an information model that employs methodology for identification, classification and the assembly of data attributes.

The relationship between data forms of such a repository consists of the following components: data, information, knowledge and experience [Amodt, A and Nygard, M. 1995]. The relationship among these components is shown in figure 1.1.

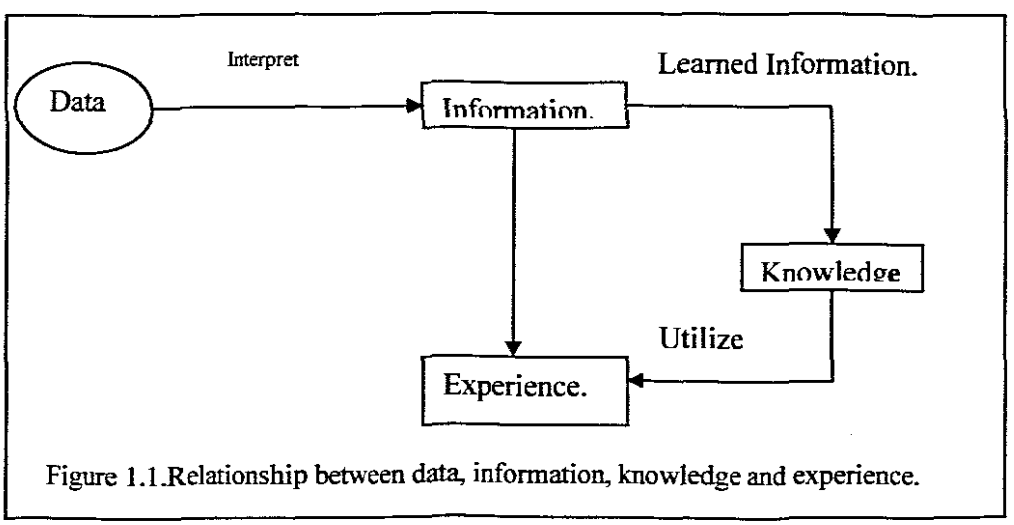

Figure 1.1.Relationship between data, information, knowledge and experience.

(i) Data: are patterns with no meaning; they are input to an interpretation process. All artifacts that occur during the development process of software can be denoted as data, regardless of their quality, quantity, or representation.
(ii) Information: is processed data with meaning that a human or an intelligent information system assigns to the data by means of conventions used in their representations.
(iii) Knowledge: is the range of learned information or understanding of a human or an intelligent information system.

(iv) Experience: this is gained by human through utilization of information and knowledge.

The partners in focus for this research are the Small Medium Enterprises and the Larger Organizations. The logical implications of designing information repository of SMEs and the larger organizations are (a) to promote the re-structuring and strengthening of SMEs to become emerging e-businesses that is ready for partnership with larger businesses and (b) to identify technological mechanism that could assist the Government to promote the Black Economic Empowerment programme. The success of Black owned companies is likely to inspire confidence and motivate the Black community to engage in productive socio- economic activities. This move by the Government through the Black economic empowerment (BEE) policy programme is seen in many quarters as a struggle to sharpen the present and future transformation of the South African state and society.

Unlike the larger organizations, SMEs have not been able to engage in E-Commerce because of the associated high cost of setting up an e-commerce web site [Australia Electronic Business Network, 1998].

1.2 Statement of the Problem

The BEE policy of government requires that large corporate organizations enter into partnerships with smaller enterprises in the same allied industry. The problems that need to be addressed for the implementation of the above policy are; (a) SMEs are not in a position to adopt e- commerce technology to

make them visible to those who need them for BEE purposes, due partly to lack of capacity on their part and (b) big corporates need to either collaborate or individually sponsor appropriate technological solutions, because they have the resources to pay for information system.

This research addresses the challenges outlined above via the provision of information repository from which organizations could collaborate with potential and candidate partnerships in the same industry. The assumption is that the challenges are achievable through the application of knowledge gained from existing technologies like (a) Knowledge Sharing Ontology and (b) knowledge modeling using the Extensible Markup Language (XML) and the Java programming tools.

1.3 Motivation for the Research

SMEs do not have the capacity to adopt e-commerce due to:

(i) Associated high cost of setting up an e-Commerce Web site;

(ii) Lack of awareness of the benefits and means of adopting online technologies and

(iii) Often having little time or no resources to address strategic issues or research alternatives to current practice [Australia Electronic Business Network, 1998].

However, the investigation that was conducted in this research enabled industry-specific information repository to be built. The success of this information repository technology depends on the emerging market place for information services. Such services include (a) advisory assistance and guide to junior BEE partners and (b) response to queries on metadata and easily interoperable sources merged into one semantic entity.

1.4 Research Goals and Objectives

The major aim of this research was to create an information repository from which different organizations can seek and discover viable and competent partnerships candidates. The specific objectives were to:

(i) Formulate an ontology based repository model that can be the basis of different organizations exchanging information via the Internet;
(ii) Develop a prototype system that allows the provisioning of services such as (a) storage of information (b) retrieval of information and (c) updating of information and

(iii) Test the prototype and analyze the performance of the prototype implementation.

1.5 Research Methodology

The research methods to achieve the above objectives included:

(i) Survey of modern and future information repository models through literature review exercise. The literature provided the sources needed for existing body of knowledge that could serve as guide for the formulation of research questions and hypothesis.

(ii) Conceptualization and modeling of Information Repository architecture from existing standards and best practices in knowledge sharing among the different organizations. This involved analysis and design that yielded the following artifacts: (a) the Information Repository Model; (b) the Information Repository Architecture and (c) the conceptual model.

(iii) Design, implementation and testing of the information repository system prototype. The research artifacts proved and validated by implementing, testing and evaluating the performance of a prototype.

The above methods involved the development of an enterprise-based Repository, created to define and organize relevant information about the activities and services of the different organizations. The process followed to implement the research methodology was as follows:

(i) The literature review was conducted to answer questions such as; "how useful is knowledge sharing ontology in the design of Information Repository"?

(ii) A set of textual data was collected during an interview with representatives from both partners.

(iii) Use cases based on Information Retrieval, Information Storage and Information Updating were constructed with evaluation of specific scenarios.

(iv) An XML Ontology tool was used for the semantic construction of the information repository.

(v) A set of parameters was defined to evaluate the performance of the Information Repository.

1.6 Organization of the Dissertation

The rest of this dissertation is organized as follows: Chapter two consists of the literature review. The chapter covers discussions on the architecture in the design of an information repository; the role of metadata and data management in a repository design; interoperable semantic system in information repository design and the research approach. Chapter Three describes the analysis and design phase with in-depth insight into the knowledge acquired from existing technologies to develop an extensible and interoperable service model. Chapter Four discusses the implementation and the performance analysis phase. The chapter describes a case study- based prototype referred to as Partnership-Centred Information Repository (PCIR), which, was implemented, using (XML) and validated via the Java programming tool. Chapter five concludes and describes further work envisaged for the future.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The design of information repository of SMEs needs to be preceded by the creation of an information architecture, which defines the structure that provides a map of the enterprise and a route planner for business and technology. The importance of architecture in the design of information repository cannot be over-emphasized. To this end, the Information Repository requires an architecture that can address effective and design of databases and applications.

2.2 Architecture in Information Repository design

Information architecture, at a higher level is described as the capability to integrate technical components to meet business needs. The concept of information architecture does not have a universally accepted definition in either the research or industry community. Some of the problems associated with poor or lack of architectural design are identified as follows:

(i) Inadequate application and database design could lead to complete collapse of the system;

(ii) Cost of design might increase due to slow methods of development;

(iii) Wasted effort and cost could result from the delivered system and database not meeting the specific needs of the owner or the end users and

(iv) The opportunity to reduce time and cost of application development might be missed unless information architecture is specified as integration standard components that can be built from pre-built program component, [Clive Finkelstein, 2001].

2.3 Foundation of Information Repository

Previous studies showed that information architecture includes a group of shared, tangible information technology resources that provide a foundation to enable present and future business application to define the structure that integrates technical components with business needs [McKay, Brockway, 1989], Duncan, 1995, Weil, and Broadbent, 1995].
In his contribution to architectural design of an information repository, [DeMarco, 1979], proposed the following approaches:

(i) A centralized metadata architecture; the strength of this approach is that it integrates all the metadata and stores them in one metadata schema that can be accessed easily;

(ii) A decentralized metadata architecture; this is best suited for large companies with disparate lines of business. It provides a means of centrally, managing and sharing common metadata across multiple local repositories, while allowing each business to have an autonomous repository for its own requirement and

(iii) A distributed metadata architecture; this adopts the best capabilities of both the centralized and the decentralized architectures.

2.3.1 Distributed Information Repository

For the purpose of this research, the distributed metadata architecture approach is considered because it adopts the capabilities of both the centralized and decentralized architecture. Information repository model for distributed databases is crucial to the operation of enterprises and is an interesting area for database systems research.

The main role of information model is to represent the different types of data objects and their relationships relevant to a distributed system. As distributed systems become larger and more complex, many things can go wrong, that can potentially interrupt and cripple critical operations.

Even though, not much work has been done on distributed information system, but the role of databases in network and system management has been studied. [Haritsa et.al., 1993], in their contribution to Managing Network using Database Technology (MANDATE), proposed Management Information Base (MIB) to support network management. The MIB is the focal point for integration of the management application. MANDATE also proposes an object oriented model to support management.

Finally, [Hills et.al., 1995] investigated the use of X.500 directory system as a repository for information system management. The X.500 system has the advantages that it is a distributed database and it is a widely available standard. However, X.500 has some reservations, because it is intended as a white pages system and not as a general DBMS.

The advantages and disadvantages of distributed database management in information repository are shown on Table 2.1 as follows:

Table 2.1 Distributed Data Management in Information Repository

Advantages	Disadvantages
(i) Location at demand site: data in a database system are dispersed to match enterprise requirements	(i) Security: security lapses increases when data are located at multiple sites.
(ii) Faster data access and process: data are accessed and processed faster at several sites, thereby spreading out the systems' workload.	(ii) Complexity of management and control: to keep the various components in a synchronized fashion is a complex task.
(iii) Growth facilitation: flexibility of adding new sites to the network without affecting the operation of other sites.	(iii) Increased storage: requirement: additional disc storage spaces are required to store multiple copies of data at different sites.
(iv) Processor independence: requests do not depend on a specific processor; any available processor can handle the user's request.	(iv) Lack of Standards: although TCP/IP is the de-facto standard at the Internet level, there are no standards at both the database and the application levels.
(v) User-friendly interface: PCs and workstations are equipped with an easy –to-use graphical use interface (GUI).	(v) Managing data Environment: disc access and storage in a widely dispersed environment are more complex than would be in a centralized database.

Table 2.1 Adopted from Database Systems (Design, implementation and Management 6th edition) by Peter Rob and Carlos Coronel [2004]

From the afore-mentioned points, distributed database can be used successfully, but issues like security, backups, query optimization, access path selection standard protocol governing transaction management need to be addressed, before they can yield the full flexibility of power of which they are theoretically capable.

However, there is a place and a need for each of the three architectures presented here. What is important is to be able to define the requirements and choose the architecture wisely that will support the repository requirements that would endure for many years.

2.3.2 Metadata in Information Repository Design

Metadata or data about data provide a description of the data in a database system. They are the crucial raw material from which information is derived. In the context of this research, metadata is understood as information needed to develop and maintain an information repository system [Vadura,a. 2001].

With the increasing importance of metadata in the last few years, many standardization efforts were made. Metadata standardization focused initially on defining a format for interchanging between systems and within components of the same system. Standards such as CDIF (Case Data Interchange Format) allowed interchange of some metadata models between CDIF complaint tools. This was the first standard to emphasize similarity and exchange at the metadata level.

With the advent of data warehousing, metadata gained its deserved importance and prestige. Standards such as OIM (Open Information Model) and CWM (Common Warehouse Model) were created specifically for warehousing design, development and maintenance [Verlerli, T. 2001]. The common point among these standards (OIM and CWM) is that all of them have a very precise target. Most standards however, are not extensible and they only cover a small subset of metadata. In order to fill this gap, general purpose metadata tools were developed, which were aimed at allowing representation of metadata in different abstraction levels.

It was at this stage that many software companies started to develop enterprise-wide metadata solutions. Only a very complex enterprise-wide information system could make use of these systems, because they were very expensive and more than that they could not solve the issue of information integration.

Today's information repository systems require a flexible, light weighted metadata solution that can easily be integrated in the system architecture. This is one of the reasons why in this research the design of an XML based metadata repository is presented. However, efforts are under way to standardize metadata [Meta 96].

2.3.3 Metadata Dictionary of Information System

Previous traditional data dictionary systems include the Information Resource Dictionary Systems (IRDS) of the American National Institute of Standards and Technology, formally NBS) [American National Standards Institute 1985], [NBSSIR, M.D.1988] and the repository developed by IBM. The former focuses only on data resources management, but the ones developed by IBM were designed for enterprise data integration. The IRDS effort was initiated [Konig, et. al 1985], to address the formulation of standards of data dictionary and the functionality required to qualify for use in a government information system. With the IRDS in place, it was easy to incorporate a major intersection of features in existing data dictionary system that gave rise to some benefits, as a result of the standardization.

Though comprehensive in its design for a standardized data dictionary system, IRDS was not poised to handle aspects that were considered important to the enterprise information integration, such as knowledge model. In particular, a metadata model should contain at least three (3) classes of knowledge; (i) operating knowledge (business rules), (ii) control knowledge for sequential system interaction and (iii) decision knowledge for parallel system interactions.

At a later stage, the Global Information Resource Dictionary (GIRD), an extension of IRDS, was developed for the metadatabase approach. This model was developed using the Two Stage Entity Relationship (TSER) model [Hsu, 1985]. The TSER approach to information modelling was designed to represent complex and multiple systems [Skevington, C. 1987]. This approach provided a representation method and a modelling methodology that included both the contextual knowledge of an organizational information system and its data objects.

When compared to the previous efforts, the GIRD models feature: (i) the inclusion of contextual knowledge: (ii) a hierarchy of (modelling) constructs and (iii) self-descriptiveness.

2.3.3.1 Comparing GIRD with IRDS Standard

The GIRD and IRDS models differ at a fundamental level; i.e., in terms of the scope and use of metadata. Table 2.2 presents how the GIRD framework extended the IRDS in metadata modeling. The results presented in the same Table show that the GIRD approach contributed major extensions to the traditional IRDS approach. Specifically GIRD was developed using the TSER construct to represent heterogeneous and the distributed information systems. The model is generic and it can be implemented in contemporary environments, such as the relational system with little development effort.

Table 2.2. A presentation of how GIRD extends IRDS.

Comparison based on	Global Information Resource Dictionary (GIRD)	Information Resource Dictionary Systems (IRDS)
Fundamental in terms of scope and use of meta data.	1. Facilitates information integration for functional synergy. 2. Accommodates heterogeneous systems 3. Includes knowledge.	1. Lacks the ability to represent hierarchical structures of application, such as object-oriented models. 2. Cannot represent relationship of degree greater than binary. 3. Cannot represent metadata in terms of complex structures, definitional knowledge and process models.
Event relationship approach.	It extends the concept of metadata to include events and the rules that trigger such events in both the enterprise and the meta database itself.	It represents a static view of the enterprise through the Entity-Relationship model; i.e. its constructs do not capture the dynamic interrelationships between systems in the enterprise.
Benefits	Meta database is modelled and the model is stored within itself. As a result, the self-description permits comprehensive control.	The layer structures anchor less in their underlying model, which do not allow for stable and generic self- description.

The development of IRDS and the repository systems attests to the fact that metadata management is becoming very important as enterprises are striving to achieve functional synergies through information integration. The extension work necessitated a method that encompassed both databases and knowledge-

based systems and models in an interactive manner. However, issues concerning semantic interoperability were not addressed because of the limitations in the GIRD modeling to address such important issues in the design of information repository

2.3.3.2 Database Management System

DBMS is a collection of programs that manages the database structure and controls access to the data stored in a database. It helps to create an environment in which end users have better access to data. In general data management includes the managing of databases, interoperability, migration, warehousing and mining.

The advent of the Internet has given rise to the demand for effectively managing data, information and knowledge. So much data are now available on the Web that managing the information with conventional tools could be very difficult. This, therefore calls for new tools and techniques that can handle these data in an easily interoperable system environment, whereby response to sources can be merged into one semantic entity

Efforts made by CORBA (Common Object Request Broker Architecture) [Ram, Park and Lee, 1999C], RMI (Remote Method Invocation) and DCOM (Distributed Component Object Model) to adopt message-oriented middleware to support reliable data and events [March, Hevner, and Ram, 2000] could not produce fully–interoperable environment because (i) the approaches were difficult and expensive to implement in a widely heterogeneous environment, using the public Internet for transport and (ii) no solution was provided for the formatting of large blocks of structured data contained in the body of the message.

Since the above efforts could not provide the technology to resolve semantic interoperability, standardizations such as SOAP (Simple Object Access Protocol), WSDL (Web Service Description Language) and UDDI (Universal, Description, Discovery Integration), emerged to address the problem with respect to the web [Goh, et.al.1994].

2.4 Distributed Database

In a distributed database environment, logical and related data are stored and processed over interconnected computer system in which both data and the processing functions are distributed among several organizations.

Before the advent of the distributed database management, the centralized database was adopted to meet the structured information needs of many organizations. In a centralized database environment, organizations are required to store their data in a single central site, usually a mainframe computer; thus data access was provided through dumb terminals. However, the centralized database performed well to fill the needs of structured information, but it fell short when quickly moving events required faster response time and equally quick access to information. The slow progression of information request to end users did not serve decision makers in a dynamic environment. What was needed then was quick, unstructured access to generate on the spot information.

The birth of a series of critical social and technological changes in the 80s created a dynamic business environment in which organizations had to respond quickly to competitive and technological pressures. These changes were as well influenced by the growing acceptance of the Internet and particularly the World Wide Web (WWW) in the 90s, as the platform for data access and distribution. The WWW is in effect, the repository for distributed data.

Even though, the long-term impact of the WWW on distributed database design and management is not very clear at the moment, but the success of WWW could foster the adoption of distributed database in the development of information system. In any case, distributed database exist today, and many distributed databases operating concepts and components are likely to find a place in future database development in information repository.

2.5 Modern and Future Repository Model

A modern approach to metadata management for Internet database requires techniques that can manage the metadata. These include storing, querying and updating the metadata. Because the Internet environment is very dynamic, there is therefore the need for the metadata to be updated continually as the users browse through the Internet. Furthermore, as new data sources get added, the changes have to be reflected in the metadata.

Each of the approaches outlined in section 2.3, has its own limitations, and no single approach was good enough to address the problem of knowledge sharing amongst different organizations. Therefore a gap exists for a flexible mechanism that is capable of presenting a generic approach to knowledge sharing. This is achievable by exploring the advantages of different methods of approach and overcoming their limitations via the application of the mechanisms discussed in the remaining part of this section.

2.5.1 Knowledge Sharing Ontology

Ontology in philosophy refers to a conception of what can exist or 'be' in the world [Bunge, Reidel, 1977]. The artificial intelligence community appropriated the term to mean the construction of knowledge model [Nowell, 1982 and Gruber, 1993], which specifies concepts or objects, their attributes and inter-relationships. In the context of this project it is defined as the specification of concepts used in expressing the reusable part of a knowledge model. [Motta, Buckingham and Domingue, 1999].

Ontology is an important aspect of metadata and it specifies the semantics of various applications. It is particularly important for knowledge management as well as for different database systems to interoperate with each other. This approach has the advantage of using ontology to capture the tacit knowledge within a certain domain in order to provide a rich conceptualization of data objects and their relationships. The success of ontology as a facilitating tool in knowledge sharing includes the fact that:

(i) It is embraced by end-users because it emphasizes content rather than program formalism [Chandrasekaran et.al. 1999];

(ii) It is able to synthesize legitimate perspectives of desired knowledge and to suppress irrelevant information and

(iii) It is free of technical requirements and is able to address domain conceptualization.
Another related, but distinct mechanism, the Extensible Markup Language is discussed next.

2.5.2 Extensible Markup- Language (XML)

With the advent of XML, major standards committees started defining their own interchange standards using XML [W3CXML 2003]. It has a great potential for defining metadata information, since it is meta-markup language. With XML schema [W3C XML Schema 2000], it is possible to define a structure and Data Types for any XML document and with XSL [W3C XSL 1999]; it allows transforming the data present in an XML to any other format XML, HTML etc.

XML was developed by the World Wide Web Consortium (W3C) to overcome some of the limitations of the Hypertext Markup Language [3]. HTML was created in 1990 as a very simple technique for storing and linking documents that are easily exchanged in a global information network [Berners-Lee, 1997]. But as the HTML evolved and matured in its design, much of this initial simplicity was lost and its capability of presenting richer information on the Internet was limited. This short fall in the capability of the HTML gave rise to the development of XML to provide a better means to manage information that the growth of the Internet now demands.
The two main applications of XML are the publication of web pages and the exchange of information. It is widely used for a variety of reasons and these include:
(i) Extensibility: - XML provides the ability to add data and extend a language with custom markup tags;

(ii) Data and Information Exchange: - XML provides a common language for the exchange of data; independent of programming language and computer platform;

(iii) Data description; - XML can describe data with markup, making it easier to access and process and

(iv) Content separation: - with its extension capabilities, XML can be used not only as interchange format, but as a format for storing and managing metadata.

An issue that needs clarification is the difference between ontology and XML. Whereas XML specifies the structure of a document, ontology specifies the semantics of various applications. The challenge is to integrate the structure with the semantics to provide a complete set of interoperable mechanism.

2.6 Research Approach

The focus of the research was to evolve a repository architecture that would bridge the existing gap in knowledge sharing. The architecture was intended to facilitate the management of and access to information through knowledge sharing ontology in a web-based environment. Knowledge Sharing Ontology technology was adopted in the development and implementation of the repository to specify the semantic of the various application.

Figure 2.1 shows a high-level view of the repository. This repository contains library and catalog data, which are represented in XML. The use of XML was to facilitate knowledge modeling and exchange in a more flexible manner. The library data was used to produce the actual information stored and the catalog data is associated with the classification properties to facilitate searches. The repository data was elaborated enough to accommodate the generation of both information stored in the traditional sense (page- oriented output) and of interactive, dynamic hypertext taking advantage of the full capabilities of HTTP and the Java programming language.

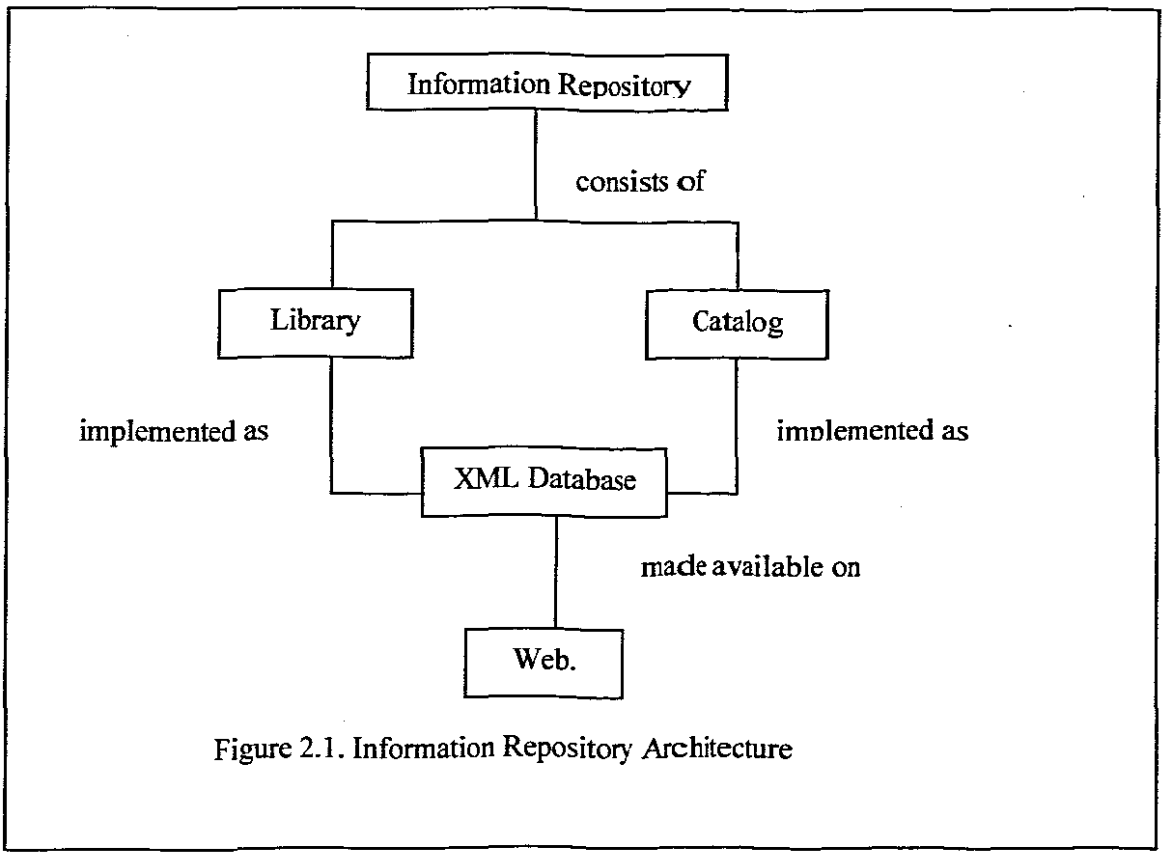

Figure 2.1. Information Repository Architecture

The overall functionality of the information repository is partitioned into a set of services with well-defined interfaces. The services provided the mechanism for depositing and storing of information; thus enabling user interface services that provide a human gateway into other services.

2.6.1 Normalization of Information Repository

Normalization is crucial to the design of and development of information repository, because discussion of relational database is not complete without a section on normalization. Normalization is a process in which an initial database model is transformed or decomposed into a different, but equivalent model in the sense that no information is lost when going from one to the other. Normalization works through a series of stages called Normal Forms.

Normalization is a design technique that is widely used as guide in the design of relational databases. It is essentially a two step process that organizes data

in a tabular form by removing repeated groups of data from the relational tables. In his paper on relational model [Codd, E.F. 1970; Codd, E.F.1972], observed that relation schema in which certain patterns of functional dependencies occur exhibit undesirable behaviour. The normal forms he said are where the undesirable behaviour does not occur.

The normal form (NF) of relational database theory provides certain criteria for determining a table's degree of vulnerability to logical inconsistencies and anomalies. The normal forms are applicable to individual table; to say that an entire database is in normal form means that all the tables are in normal forms. These criteria are discussed as follows:

(i) First Normal Form (1NF) – A table is in the first normal form if it faithfully represents a relation. In this normal form, each attribute or column occurs only once for each instance of the primary key. This is in short, a table with a unique key, which by definition prevents the duplication of rows or columns.

(ii) Second Normal Form (2NF) – The second normal form starts from the first normal form model. All partial dependencies are removed so that all the non-key attributes are fully dependent on the composite primary key. By definition, a model is already in the second normal form if it only has a single attribute primary key.

(iii) Third Normal Form (3NF) – This normal form starts with the second normal form model, and then modifies it so that no attributes depend on any other non-key attributes. By definition all attributes are dependent on the primary key and only the primary key.

From a structural point of view, 2NF is better than the 1NF and 3NF is better than 2NF. For enterprise database design purposes, 3NF is high enough for a good normalization process; hence the database design for this research, normalization process was carried out to the third normal form (3NF).

2.6.2 Denormalization of Information Repository

Once a model has reached the third form, any variation from that form is called denormalization. Queries against an Entity Relation (ER) model typically require the joining of two or more tables together. The more joins required for a query, the slower the database system responds to end-user demands. The success of a database design depends largely on meeting the demands of the end-user for fast performance. The need therefore, to occasionally denormalize some portions of database design for better performance requirements becomes a necessity. Through denormalization a higher normal form is converted to a lower form (i.e. from 3NF to 2NF); thus the price paid for increased performance through denormalization is a large amount of data redundancy and anomaly.

2.6.3 Repository Evaluation Matrix

The term metrics is defined as measurement method, whereby numerical values are assigned from the measured scale to the measured attributes [ISO/IEC FDIS 9216-1 1999].

The overall objective for the evaluation of information repository is to design a good quality repository that can meet the expectation of end users. The evaluation processes involved in the design are as follows:

(i) Quality requirement: The main issue of every evaluation is to have clear definition of its purpose. Without a clear purpose or goal, it is impossible to expect the evaluation to succeed. In the evaluation process of a quality model, the relevant and measurable components are included while those that have no meaning or relevance are excluded.

(ii) Defining the metrics: In order to evaluate the quality of the repository, the model was adjusted to suit the intricacies of enterprise domain. Metrics for Scalability, Utility, Functionality and Collaboration were considered for quality evaluation. These have been found to be part of accessibility

guidelines and standards [Neielson, J. 2005] [Lynch, P.J. et.al. 2006] and [World wide consortium 2006].

(a) Scalability; this is the incremental and expandable development that can integrate gradually over time without operational continuity and structural integrity

(b) Utility; this covers the extent to which the information repository meets the needs of the end- users.

(c) Functionality; this refers to the ability of an editor to facilitate repository development in a professional manner and

(d) Collaboration; this provides support for the exchange and sharing of information amongst business partners.

(iii) Evaluation Planning: Evaluation planning is based on data gathering. The relevance of data collected via personal interaction with representatives of the SMEs and the larger organizations was to assist in the determination of what is to be measured and how and to devise the measurement and evaluation accordingly.

(iv) Evaluation execution: This involves where each metrics defines the data collection method, the attributes to be measured and the criteria to be used in assessing the degree in which the measured value satisfies the stated or the implied requirements. At the end of the measuring process, the final ratings of each parameter and the overall repository quality were determined, based on their mutual relationships, using appropriate scoring techniques.

The realization of these criteria is viewed against the background of a repository system that is reliable to enable the SMEs and the larger organization to embrace e-commerce through the Internet for the exchange of information. Realization is regarded as a process underlying changes that is controlled by quality management [Perrow, G. et.al.1995].The quality management component defines all processes and their interdependencies that enable the repository to respond to substantial changes.

2.7 Summary

As a way of summarizing this chapter, the following inferences could be made from the literature reviewed:
(i) The need to have good information architecture in the design of an information repository is very important, because it helps to address the issues of better planning and the design of databases and their applications;

(ii) The distributed metadata architecture approach is considered better than either the centralized or the decentralized architecture because it adopts the capabilities of both and is able to integrate disjointed and autonomous repository with its own metadata to facilitate information integration;

(iii) The success of data management in heterogeneous environment requires a service that can easily respond to interoperable data sources merged into one entity and

(iv) The adoption of XML and Knowledge Sharing Ontology technology in the development and implementation of information repository is based on the fact that XML specifies the structure of a document, whereas knowledge sharing ontology specifies the semantic of various applications.

(v) Normalization of database design is crucial because it provides the means of transforming or decomposing the original database into a normal form where undesirable information or behaviour does not occur.

(vi) Evaluating the quality of the repository is important in the sense that it provides the means of assisting the end-users to take a positive decision on having and sharing a common repository through the Internet.

CHAPTER THREE

3.0 MODEL ANALYSIS AND DESIGN

3.1 Introduction.

This project deals with the development of an Information Repository for the purpose of disseminating information to promote e-commerce amongst the junior and senior partners. The success of such a repository depends largely on the technology capable of providing services that can respond to an easy interoperable data sources merged into one semantic entity.

The proposed approach to the design of this information repository was an abstraction to formulate an ontology based repository model that could be the basis of different organizations exchanging information through the Internet. An ontology repository strategy, which consisted of (i) repository analysis yielding repository model, (ii) repository design giving rise to repository architecture and (iii) repository implementation which produces repository components as deliverable was discussed with the view to use the model as a resource to construct a repository for the junior and the senior partners. In order to visualize the relevance of the strategy, the research attempted to describe the importance of knowledge sharing ontology in the development of an information repository for the web.

3.2 Proposed Information Repository Model

The proposed model for this repository addressed two challenges, namely, (i) to formulate ontology based repository model that forms the basis of exchanging information amongst the different organizations and (ii) to create repository from which different organizations can seek and discover viable and competent partnerships candidates

Ontology repository model is an abstraction of how different organizations share information. It emanates from the point of view of ontological commitment. [Gruber, and Olsen, 1994], ontological commitment is an agreement to use shared information in a coherent and consistent manner.

The repository is represented in a functional hierarchy to serve as an information broker [Weiderhold, 1992]; among various components of the architecture that provides a flexible tool for abstracting and modifying methods of operation. Figure 3.1 represents the information repository model, designed to demonstrate partnership service of the junior and senior partners from different organizations.

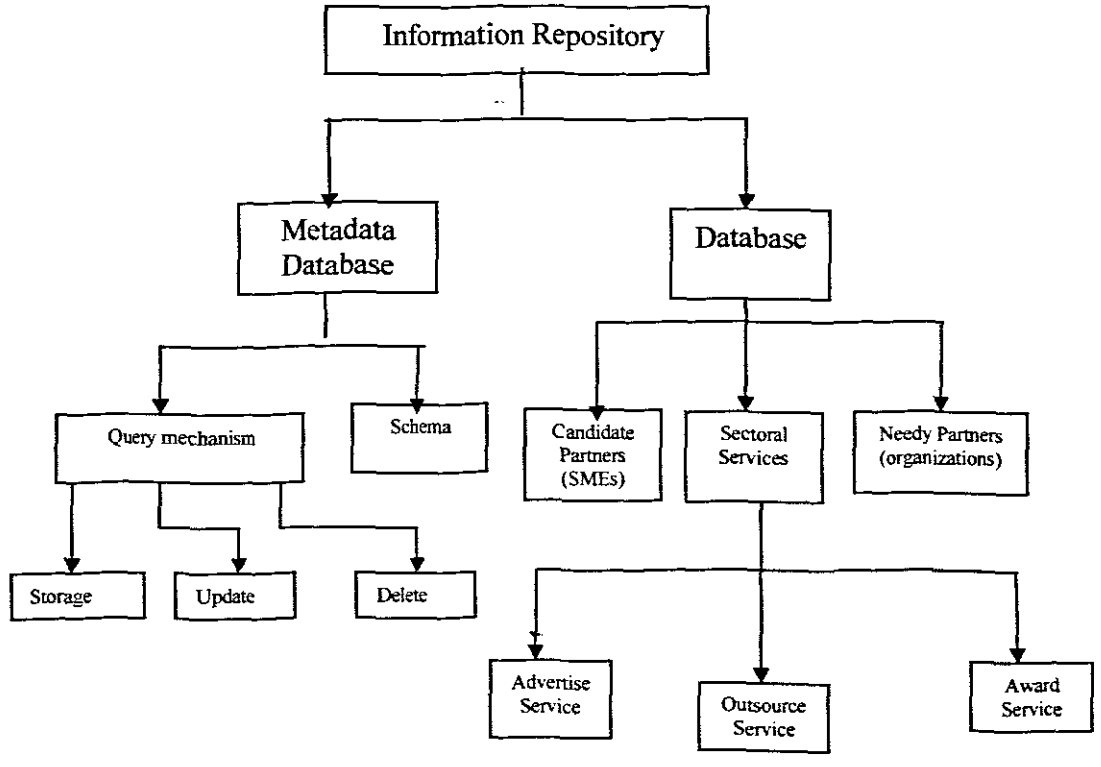

Figure 3.1 Information Repository Model

The model is based on a collaborative mechanism [Motta, E. 1997], which generates a domain model on conceptual modeling techniques. Domain ontology [Mizoguchi et al., 1995 and Van Heijst et al., 1997] is the reusable vocabulary of the concept within a domain and their relationships and the activities taking place in that domain; thus resulting in a conceptual schema. In this model, the main concepts include services and relationships between the senior and junior partners.

The knowledge source comes from interactions among partners. These interactions lead to the creation of (a) the profile of the partners and (b) the sectoral services, giving rise to service advertisement, outsource of services and execution of service.

Next is the metadata which is a term that describes the data in the databases [Data 90]. Closely associated with the metadata abstraction is the repository. A repository is a database that stores the metadata; the mapping between various data sources in the integration of heterogeneous data sources. This provides support to the end users by enabling them to query and to update the database. However, a technology is needed to store, update and to retrieve the data. To achieve this, the Extensible Markup Language (XML) was used for the formatting of response from the database so that the end users can understand the results.

3.3 Information Repository Architecture

Information Repository is the part of the architectural environment where the different organization can exchange information.
Figure 3.2 shows a high-level schematic diagram of the repository architecture, which contains a library and catalog data, both represented in XML. The library data is used to produce the actual documentation of service while the Catalog data associates classification properties with services to facilitate searches.

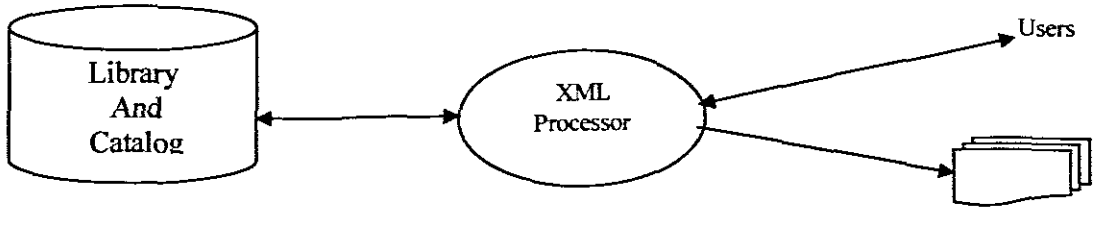

Figure 3.2 High-level Information Repository Architecture

A layered representation of the architecture is depicted in Figure 3.3. This architecture provides a generalization framework of the metadata that describes the data in the databases [Data 90]. Closely associated with the metadata notion is that of the repository, which stores the metadata and the mapping between the various data sources during the integration of heterogeneous data sources.

A four- layer architecture labeled from 1 to 4 provides the environment to manage the conceptual schema. Schemas describe what is in the database and state whether it is relational, object-oriented, centralized or distributed. With the use of schemas it is easier to expand the database to include ontology and knowledge representation. The description of the architecture is presented as follows:

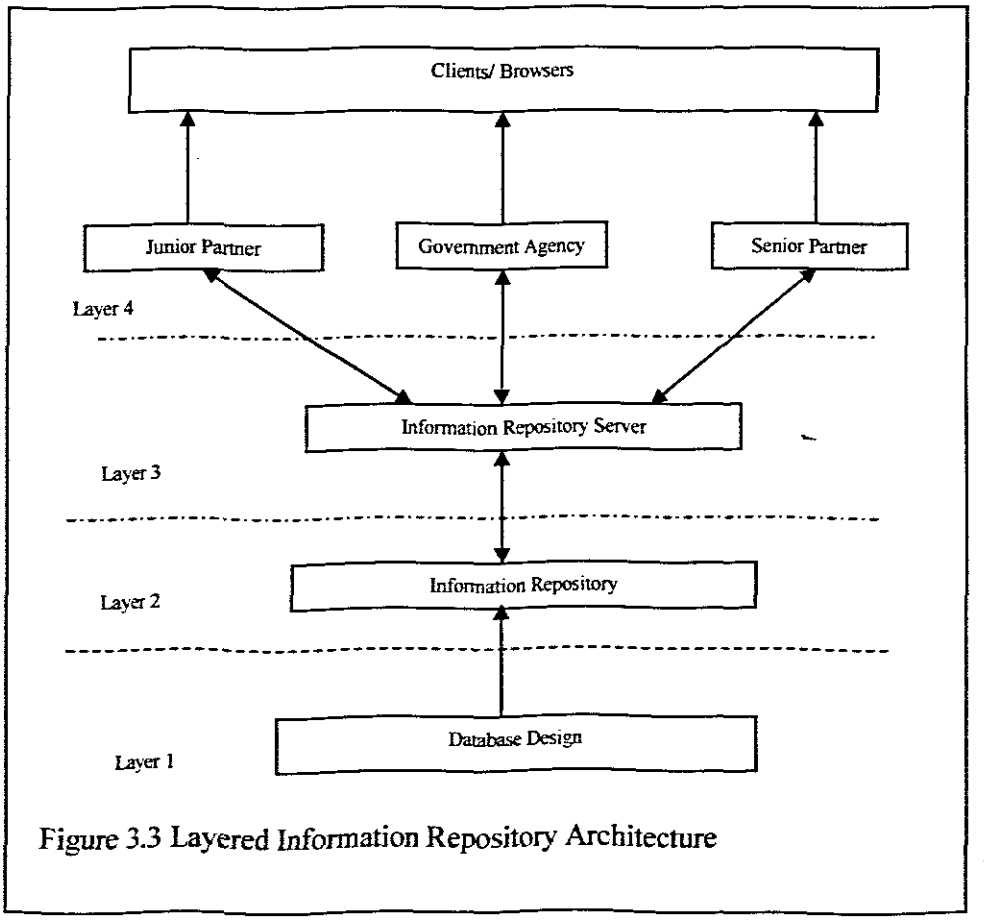

Figure 3.3 Layered Information Repository Architecture

(i) Database Design: The steps involved in the design of the repository include: (a) the capturing of the entities of the application and the relationships between the entities, using the Entity Relation (ER) model, (b) the generation of the relations from the representation of the ER diagram and (c) the normalization

process; this involves the elimination of redundant data that could cause potential anomalies.

(ii) Information Repository layer: This layer provides the storage for the database and is where the various schemas and mappings are defined. Other functions of the repository include the provisioning of support to users by enabling them to query, store, delete and update the database.

(iii) Information Repository Server: This layer is responsible for managing the enterprise objects needed to implement the function of the repository in an e-commerce environment.
As a result of the dynamic nature of the Internet, appropriate techniques are needed to manage the repository. Such techniques like Ontology and the XML were used in the implementation of the repository. [Fikes 96] defined ontology to be the specification of concepts used for expressing knowledge, while XML specifies the format for the representation of documents that can be understood universally. With XML, both the clients and the Server can specify documents with common notations and domain-type definitions.

(iv) Client / Browser: This is the layer where e-commerce is conducted in a client-server environment. The browsers are used to access the commerce sites and to specify the needed item.

3.3.1 Functional Repository Architecture

The repository architecture is designed to satisfy both the functional and non functional requirements of an information system. Implementation of this architecture focuses more on the functional requirements in the form of use cases, while the non-functional requirements like usability, reliability, functionality, and scalability were used to evaluate the performance of the information repository. Figure 3.4 is a representation of the hierarchical architecture of the functional repository.

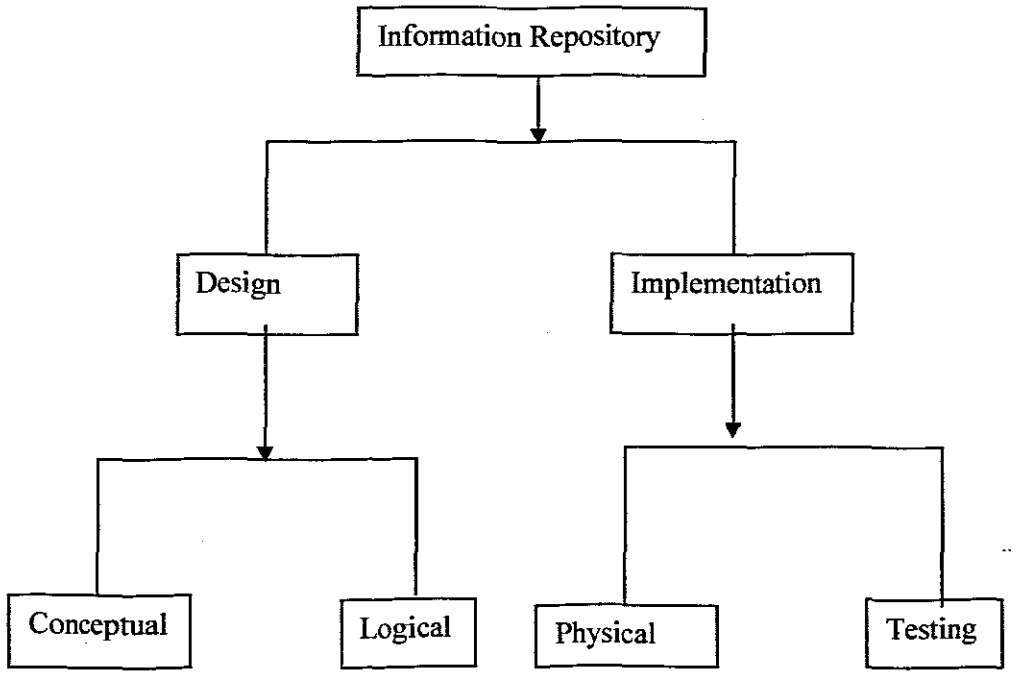

Figure 3.4 Functional Repository Architecture

3.3.2 The Framework and Associated Enterprise Architecture

The framework of the repository architecture is based on E-Commerce or enterprise model, of which the Business-to-Business (B2B) model is assumed for the Information Repository System. The implication of the above assumption is that the repository should be able to describe how the different organizations are able to share knowledge from the same repository across the web. In order to demonstrate this, the framework is designed to show the characteristic of the taxonomical view of the repository. Figure 3.5 depicts the domain characteristics feature of the repository. It should be noted that the figure is restricted to the mining domain for the purpose of this research. Therefore the focus is on services which are partnership specific to the mining industry. Among these services, only Registration and Advertisement were highlighted for the study, apart from services that are earmarked for outsourcing. These are Exploration, Drilling and Dune Rehabilitation; therefore only mining SMEs with

modern equipment can be considered for junior partnership. These components are described as follows:

(i) Registration of members of SMEs: - This is important for the formation of the SME community; a body established to oversee the legal activity of the SMEs as well as a liaising organ between the SMEs, the larger organizations and the Government Agency;
(ii) Advertisement and Networking: - Services are advertised through the Network by the junior partners; thus creating avenues for the senior partners to network with the potential SME partners with the aim to outsource services to them after the necessary contract negotiation and

(iii) Outsourcing of Services: -Core services are outsourced by the larger organizations based on whether the SMEs have the necessary facilities in terms of the availability of modern equipment and qualified expertise to execute the service.

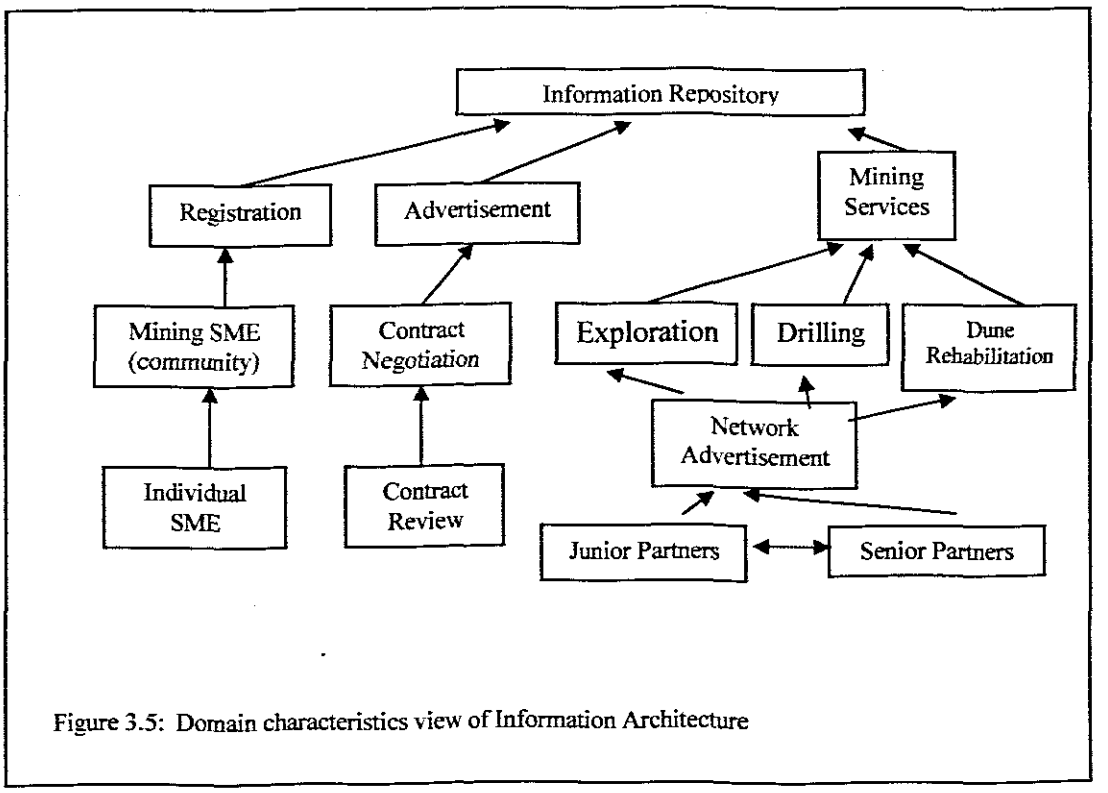

Figure 3.5: Domain characteristics view of Information Architecture

3.4 Conceptual Model of the Information Repository

The conceptual model of the repository shown in figure 3.6 defines the key concepts that are important for modeling the information repository. As an enterprise-based repository, it is created to define and organize relevant information about the activities and processes of products and services of different organizations [Uschold, et al 1999].
This repository contains concepts and instances relevant to the business partnership between the junior and the senior partners. Top of the hierarchy is the concept of organization, which is a super-class of the larger organization and the SMEs. It has the basic attributes for both business partners.

Basically, there are five classes created for this repository. Three of them, (the project, the core services and SMEs classes), which are further sub-divided into one, two and three sub-classes, respectively. A brief description of the interaction between the various classes is given below:-

(i) The SMEs` Class advertises for services through the Internet. It has two sub-classes (Human Resource Expertise and Equipment). Attributes of these classes form part of the requirements that the larger organizations need to look out for before services are outsourced to the SMEs.

(ii) The larger organizations have the responsibilities of outsourcing the core services. These services are sub-divided into three sub-classes of exploration, drilling and Dune Rehabilitation. They also have the responsibility to call for Tenders and to award contract.

(iii) Government Grant as assumed in this project is awarded or granted to the SMEs that may have the initial financial problem of meeting the requirements to execute the outsource services. This kind of gesture from the government is both to motivate the SMEs as well as to promote the implementation of the BEE programme.

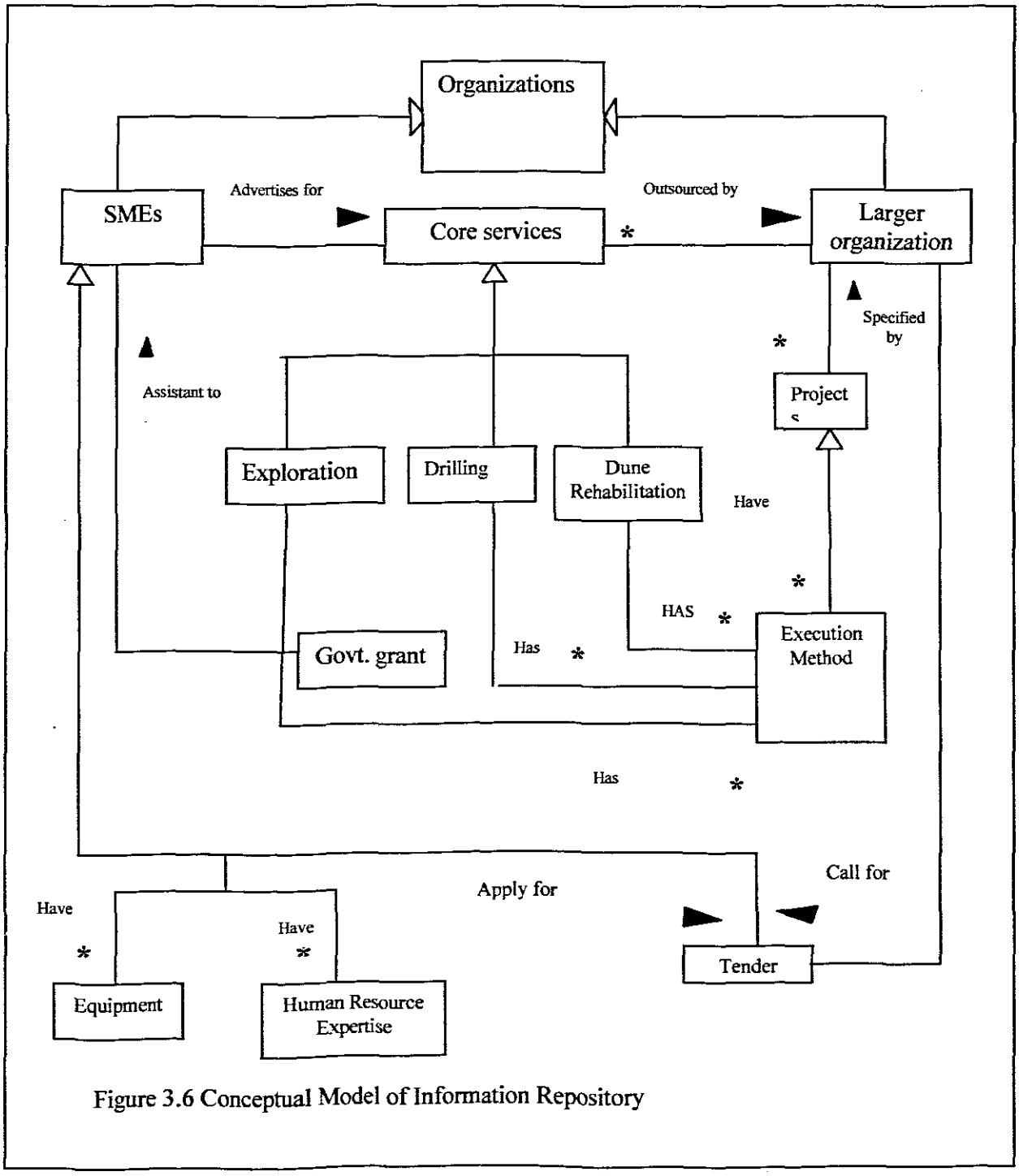

Figure 3.6 Conceptual Model of Information Repository

3.5 Richards Bay Minerals- Case Study

The feasibility of the Repository framework is demonstrated in the implementation of a case study prototype that can document:

(i) Requirements for the analysis and modeling of a database structure of the different organizations;

(ii) The use of XML and its associated schema language to enhance sharing of information amongst the business partners and

(iii) Using the Java programming language to provide a direct manipulation interface through collaborative browsing, creation and editing of information.

This is illustrated here by the specific example of a hypothetical case study of SMEs in the mining industry. The mining organization in this case study is Richards Bay Minerals. RBM, an example of an organization, is a leading mining company involved in the production of Titanium slag, high purity pig Iron, Rutile and Zircon. It is situated in Richards Bay on the Indian Ocean Coastline in Northern Kwazulu- Natal province of South Africa.

The Government policy on BEE requires that big corporate organizations enter into partnerships with smaller enterprises in the same allied industry. In order to fulfill this obligation, RBM has currently outsourced some of her core business activities in the area of Exploration, Drilling and Dune Rehabilitation to SMEs that could be classified as BEE companies. The stakeholders in the mining industry have established mentorship to monitor the operational activities of the SMEs for a period of about five (5) years. The aim of mentorship is to provide the necessary technical skill for effective performance to achieve empowerment, ownership and equity objectives. The principal success factor in implementing the empowerment policy is any technology that facilitates knowledge sharing among partnering SMEs and the larger organizations operating in a distributed interoperable system environment.

To achieve this objective the design requires the development of information repository of the SMEs and the larger organizations. This chapter discusses the model of the proposed repository, which has been partitioned into the following sections: (a) the general over view of Partnership Centred Information Repository (PCIR); (b) Use Case diagram of PCIR; (c) Prototype Development of PCIR and (d) Software Implementation Architecture of PCIR

3.6 Overview of PCIR Prototype

Figure 3.7 is a general over-view of PCIR. This diagram is designed as an umbrella that can accommodate the various services and stakeholders involved in the implementation of the BEE programme. For the purpose of a case study for this project, the design of the information repository is narrowed down to the industrial sector of the economy; the focus of which is the mining service

3.6.1 PCIR Research Agenda

The following interrelated tasks were identified for the repository design and implementation:

(i) Assessment of the design in terms of meeting the set goals and objectives.

(ii) Interaction with the representatives of both partners to assess the level of involvement of each partner; thus able to identify problems likely to hinder the collaborative partnership.

(iii) Collection of data from the representatives to develop a database for the repository using Microsoft access to design the database table.

(iv) Developing a prototype system of service for storage, retrieval and updating of information and

(v) Test the prototype, analyze and evaluate the quality of the repository in terms of Functionality, Scalability, Utility and Collaboration.

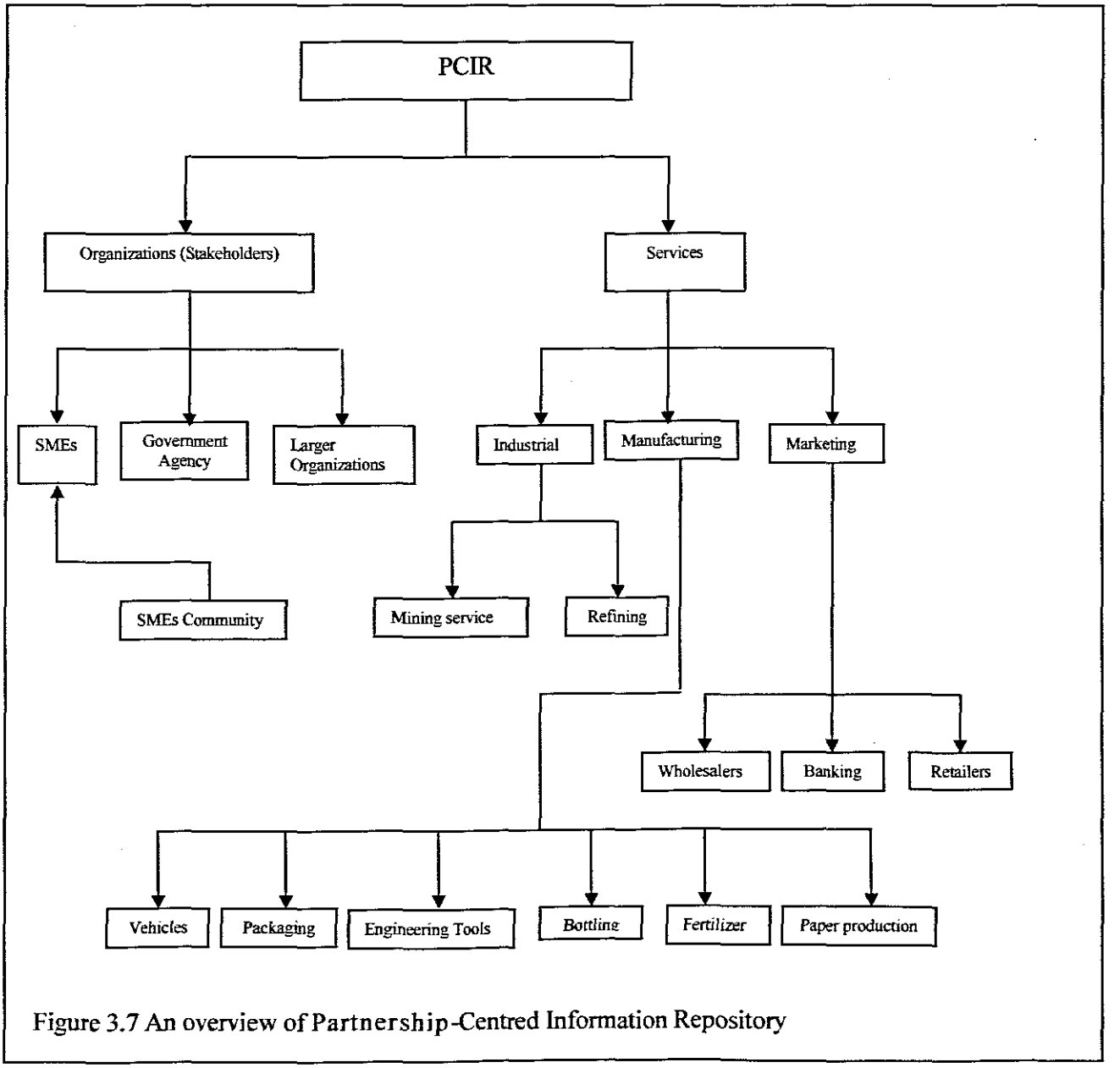

Figure 3.7 An overview of Partnership-Centred Information Repository

The afore-mentioned tasks are important because they are able to provide useful information to the development and the implementation of the information repository. The next task is the description of the conceptual framework and this is discussed as follows:

3.6.2 Dependent Variables

The dependent variable as referred to in this research is the outcome of interest accountable for the level of quality of information repository design. Quality is

defined as the totality of characteristics of the entity that bear on its ability to satisfy stated and implied needs [ISO/IEC 9126 1999].

The measurement of this variable is discussed in detail in section 4.10.3. Figure 3.8 represents the Conceptual Framework of analysis of the information repository. The dependable variable is shown as the central oval in figure 3.8. One important attribute of this variable is that it describes the methodology that enables quantitative measurement of the information repository, that will assist the stakeholders to take a decision on their expectation of a good quality repository.

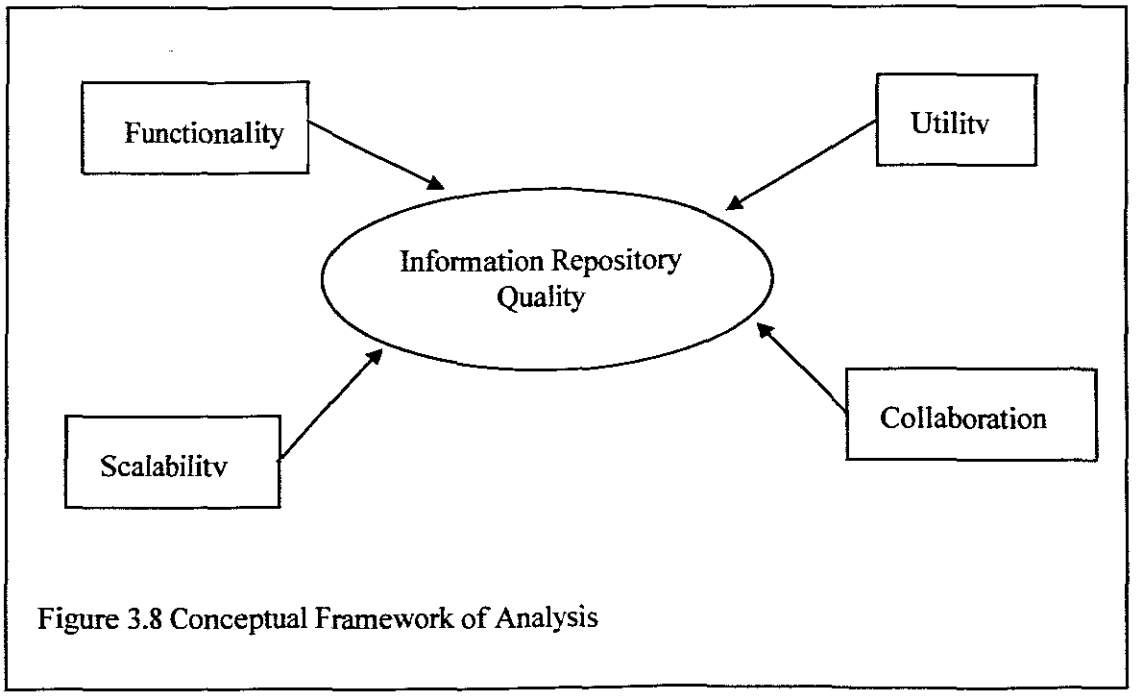

Figure 3.8 Conceptual Framework of Analysis

3.6.3 Independent Variables

These are the variables that influence the dependent variables. According to [McCall, J.A et.al. 1977] and [Boehm, B.W.et.al. 1978], the Independent variables are the elements that define quality of software products. In order to evaluate whether information repository satisfy a certain quality requirement, the quality model defined by McCall and Boehm was adopted. The identified variables / requirements are Functionality, Scalability, Utility and Collaboration.

These are indicated by rectangular boxes surrounding the dependent variable in figure 3.5. These variables are important contributors to the quality of the information repository because through a quantitative analysis it was possible to conclude if the repository design was successful and could be reliable

3.6.4 Case Study Approach

Richards Bay minerals, a mining organization was chosen as an example of a larger organization because of its involvement in the implementation of the BEE programme. The involvement is such that RBM has outsourced some of the core services to some SMEs. Again, the organization is located in the same environ where the research was carried out. The unit of measurement surrounds the encouragement of business partners to embrace e-commerce to exchange information through the Internet. This is one of the reason of using RBM and the SMEs as partners in the design of the information repository.

3.6.5 Data Sources and Collection

The idea of data collection for this research was based on Information System development rather than scientific piece of work. The selected SMEs and details of records on them were collected during an interview with their representatives. Details of collected data are shown in section 4.4.

3.6.6 Analysis Plan

Both the qualitative and quantitative approaches were applied in measuring the success of the repository. The qualitative data (largely from the independent variables) were used to quantify the quantitative measure for the repository. A mathematical model based on random sampling using the Ranking formula was used to measure the level of success of the repository

3.7 Use Case Diagram of PCIR

Use cases were used to demonstrate the functionality of the components from the stakeholders' point of view. Figure 3.9 is the use case diagram of PCIR,

using the Unified Modeling language [Eriksson,et.al. 2000]. The decomposition of the functional requirements led to the following set of use cases.

(i) Register SMEs
(ii) Advertise service
(iii) Request grants / assistance
(iv) Identify Service/Project
(v) Approval grants / assistance
(vi) Call for Tender
(vii) Award Service and
(viii) Outsource Service.

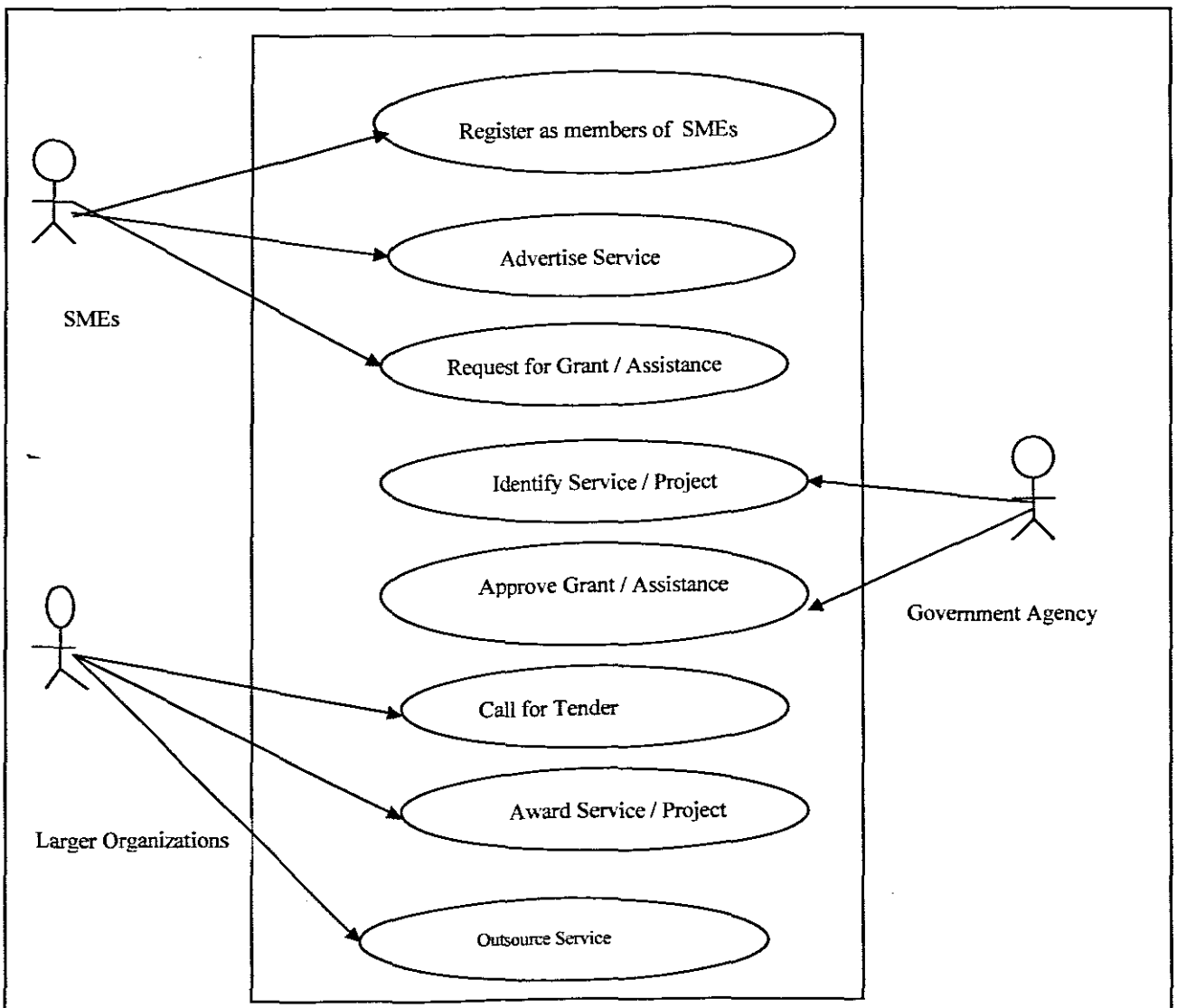

Figure 3.9 Use Case Diagram of PCIR

The definitions of these use cases are partnership driven and they offer common, reusable functionality. A succinct description of each use case is as follows:

(i) Register SMEs – The purpose of registration is to establish an SME community; a body to oversee the legal activity of the SMEs, as well as a liaising organ between the stakeholders;

(ii) Advertise Service – SMEs advertise their services through the Internet to create avenues for the larger organization to know them and be able to do business with them;

(iii) Request grant / assistance – It is assumed in this project that there could be some SMEs who may not be financially viable or may not have the collateral to secure loan to execute a service. In a situation like this, assistance from the government becomes important if the BEE programme is to be implemented;

(iv) Identify Service – This process is important to enable the government to ascertain if assistance is required or not before conveying any approval for grant.

(v) Grant approval – The Government Agency can approve a grant only after all the necessary investigations have been carried out and are satisfied with the report on the SMEs.

(vi) Call for Tender – The call for tender is carried out by the large organizations. This call for tender offers opportunity for SMEs to apply for contract. An interface form is designed by the larger organizations for completion by the SMEs. Details on the forms are scrutinized, and the SMEs that meet the entire requirement as spelt out on the form are awarded the contract.

(vii) Award Services – Services are awarded by the larger organizations, after going through the profile of the registered SMEs. Selection of SMEs is based on certain criteria such as: (a) the type of equipment /

machinery owned by the SMEs and (b) the category and the number of qualified expertise to execute the service;

(viii) Outsource Service – The outsourcing of core services is carried out by the larger organizations in compliance with Government requirements for the implementation of the BEE policy. In this scenario, services like exploration, drilling and dune rehabilitation are outsourced to the SMEs;

The above use cases form the bases upon which the database was designed for the information repository.

3.8 Development of the PCIR Prototype

To realize the development of the Prototype, sequence diagrams were used to describe the ways in which objects interact with other. They depict the sequence of messages between a set of organizational units, such as the stakeholders, the processes and the information system. *Figure 3.10 represents the sequence* diagram of the stakeholders logging into the system for authentication.

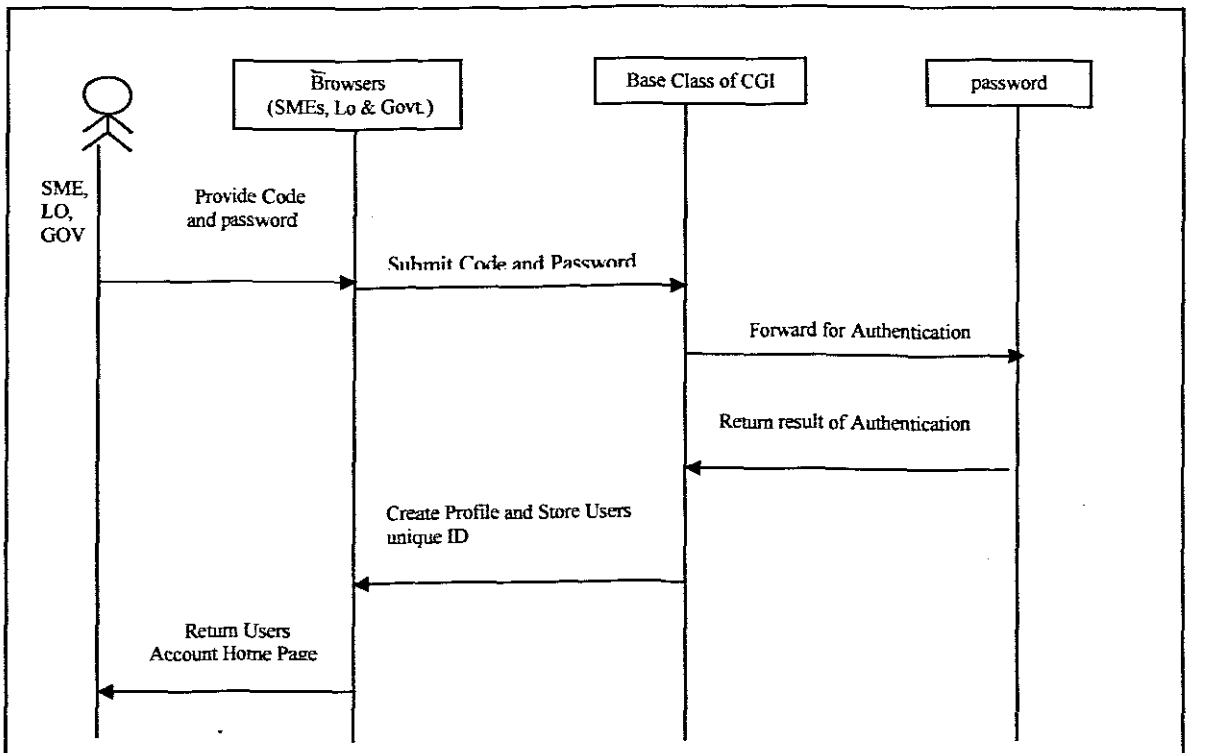

Figure 3.10 Sequence diagram of stakeholders Use Case.

The stakeholders (SMEs, Larger Organizations and the Government Agency), individually need to go into the system. To do this, they are expected to register their business code and have a password for authentication.

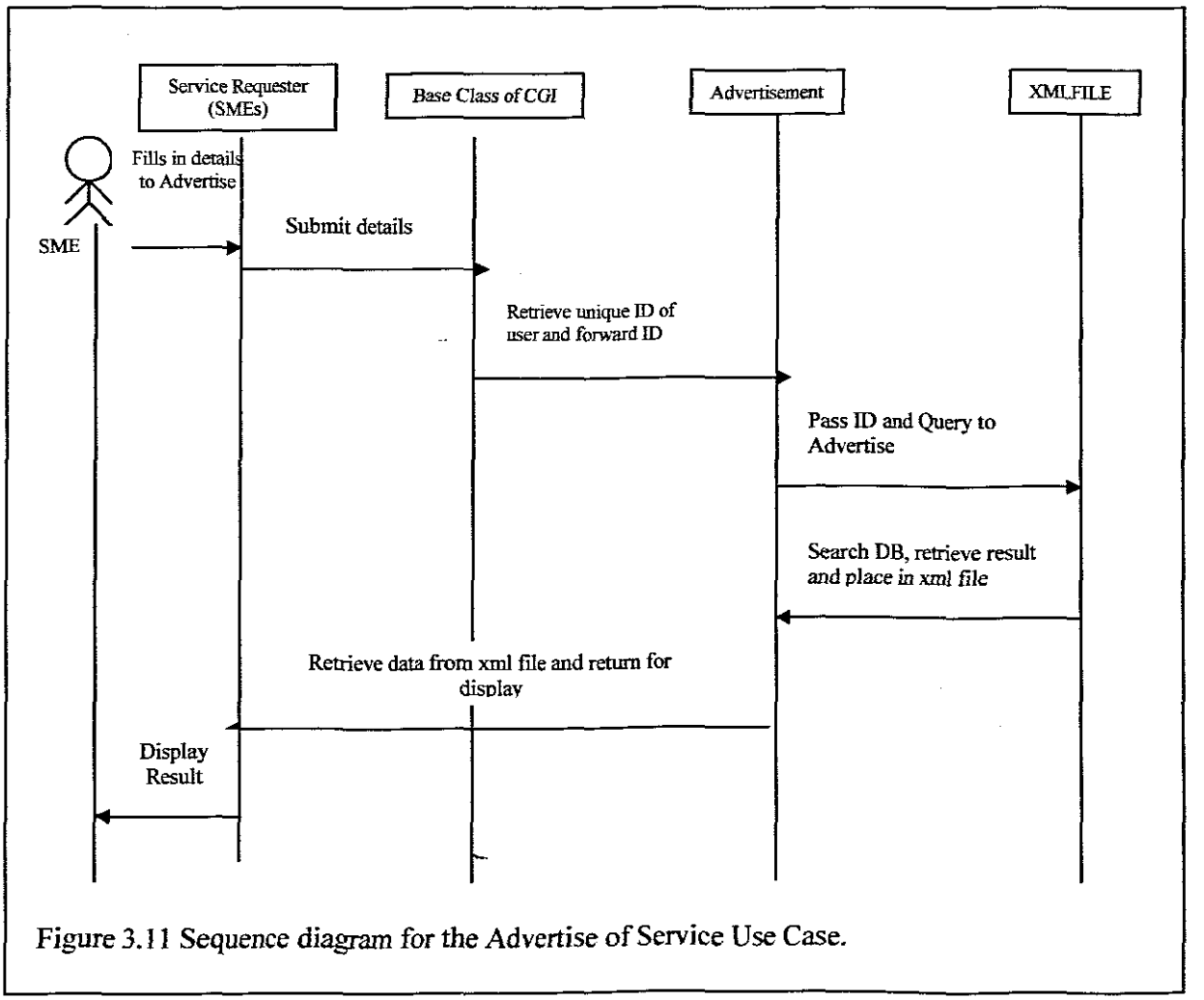

Figure 3.11 Sequence diagram for the Advertise of Service Use Case.

The above figure represents the Sequence diagram where the SMEs advertise their services by providing the details of their profile in the advertisement form interface. These details are forwarded to the Base Class and on identifying the Login details of the SMEs, forward same to the Advertisement Class. The Advertisement Class creates a new object of the XML Class to Update the SMEs details in the database. A select query gathers all the changes that were updated and stores the new information in an XML file. The Advertisement Class now returns it to the Service Requester for displacement.

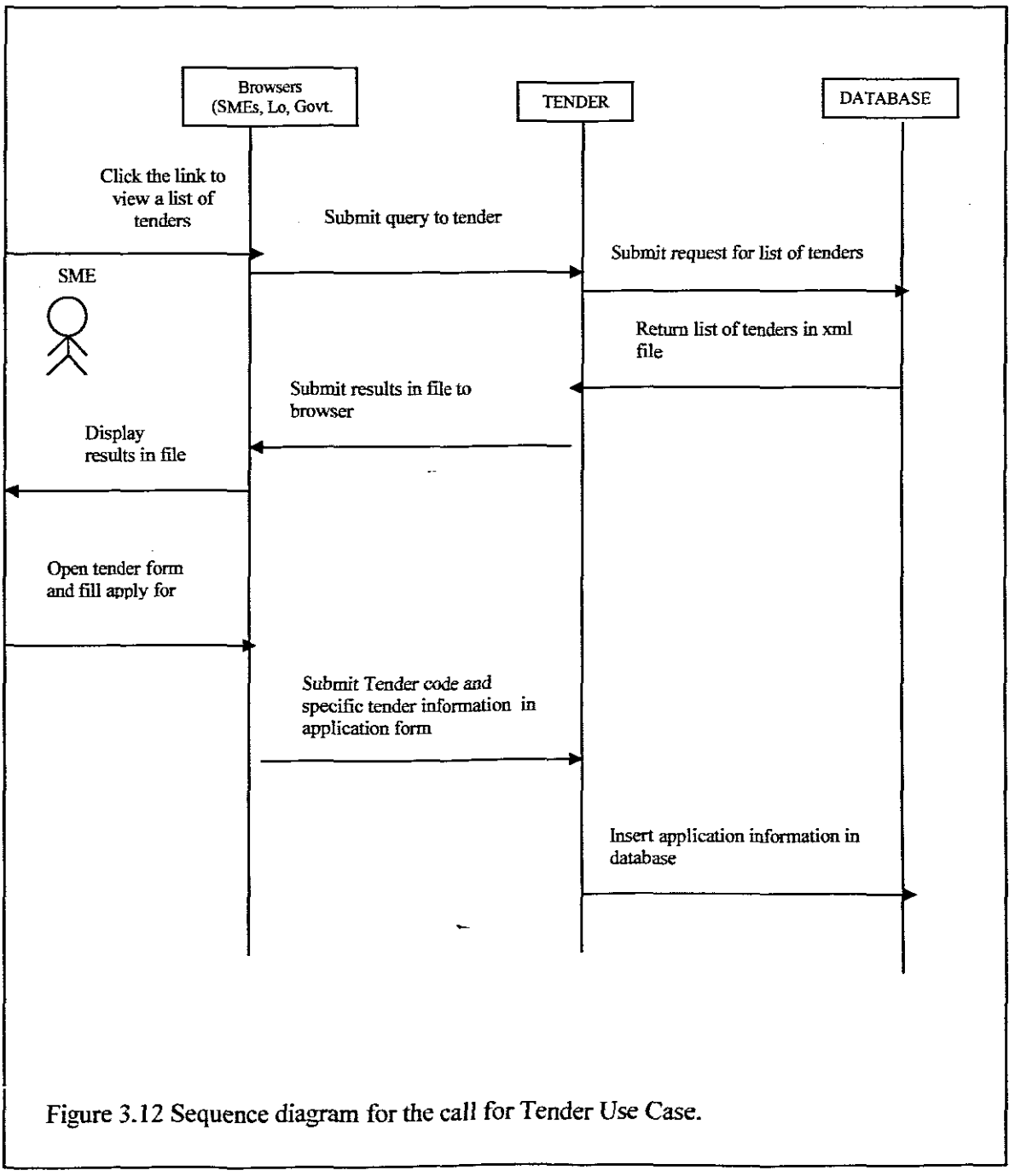

Figure 3.12 Sequence diagram for the call for Tender Use Case.

The above sequence diagram represents where the larger organizations call for Tender from the SMEs in respect of services to be outsourced. An interface form is designed for completion by the SMEs. Details on the form include the profile of the SMEs as well as the nature of the contract (see figure 4.8 for the form).

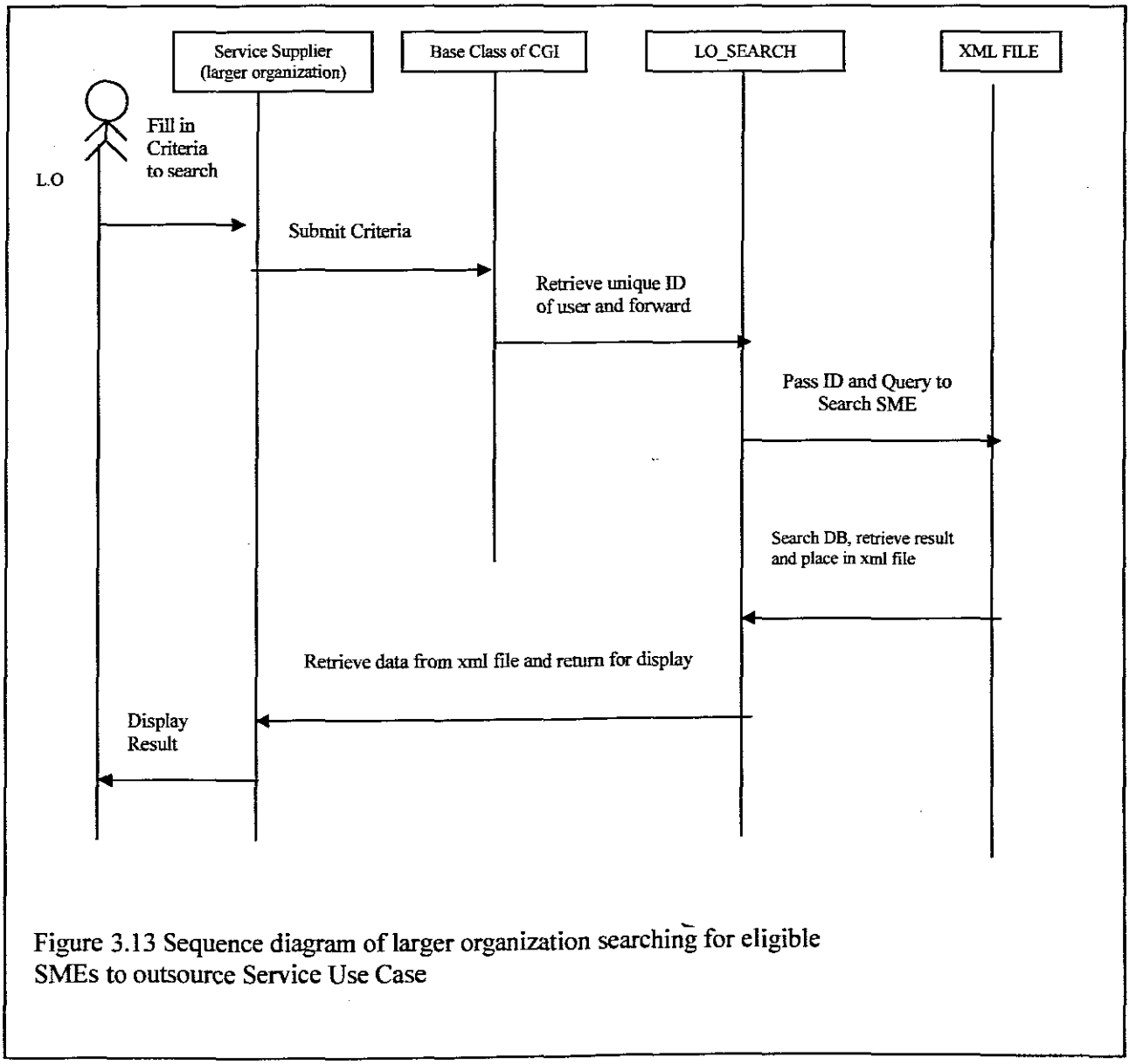

Figure 3.13 Sequence diagram of larger organization searching for eligible SMEs to outsource Service Use Case

Figure 3.13 represents the Sequence diagram of Larger Organizations in search of SMEs to outsource service. The larger organizations complete a form where the requirements for the outsource of different services are indicated. Next click on the submit button to connect to the Base Class, whose responsibility is to identify the Login details and forward same to the search Class. The search Class creates a new instance of the XML Class to search the database according to the requirements of the larger organizations. The search Class retrieves data from the XML file and sends the results to the Service Supplier for displacement.

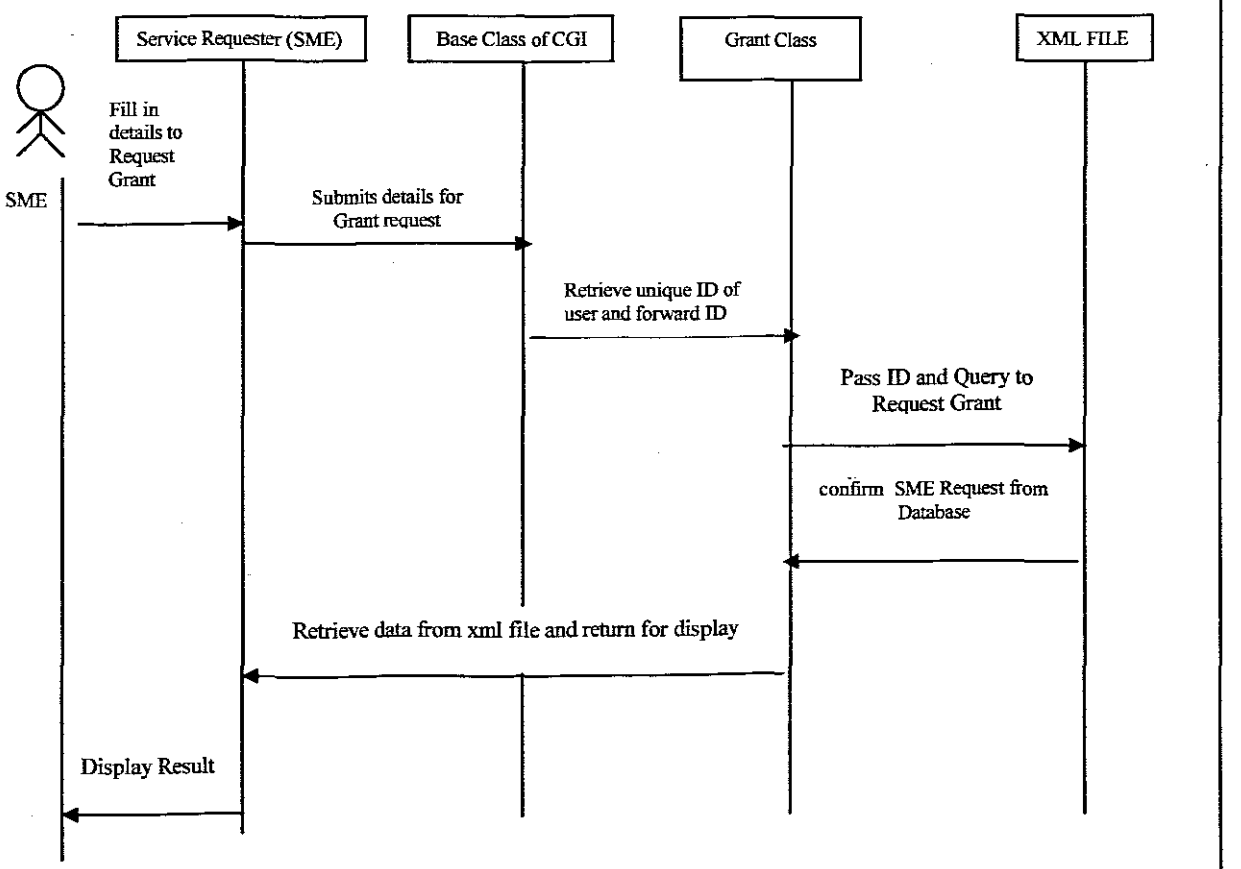

Figure 3.14 Sequence diagram of SME requesting for Grant Use Case

Figure 3.14 represents the Sequence diagram where the SMEs make request for grant. The SMEs requesting for Grants Pass their information to the Base Class, whose responsibility is to identify the Login details of the SMEs, and forward same to the Grant Class. Here the grant Class creates a new object of the XML file Class and makes use of the Methods by inserting the request of the SMEs into the database.

A Select Query retrieves all the data on SMEs' request for grant and sends the results to the XML file Class. And finally, the grant Class retrieves the data from the XML file and sends it to the Grant Request for displacement.

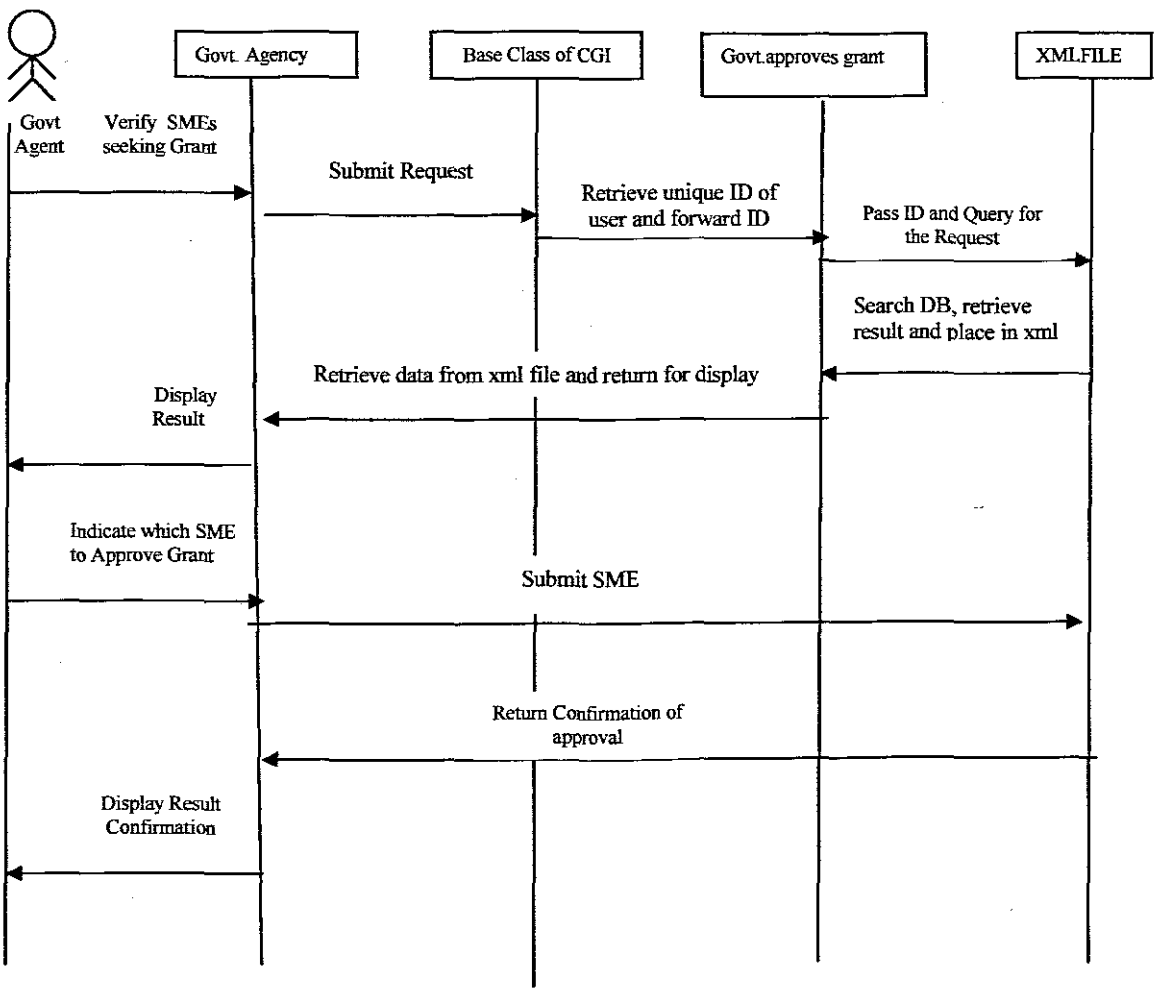

Figure 3.15 Sequence diagram of Government Agency approving Grant to needy SMEs

Figure 3.15 represents the Sequence diagram of Government Agency approving Grant to the needy SMEs.

Click on the SMEs grant link; a webpage with a list of SMEs requesting for grant is returned. From here, the government can select the SMEs to receive grant based on certain conditions, as set out by the government. The codes of the selected SMEs are then sent to the grant Class. Next the grant Class creates a new instance of the XML file Class, and makes use of its Methods to indicate the particular SMEs that have been accepted for grant award. The result is then sent to the XML file Class, and then retrieved by the government grant Class.

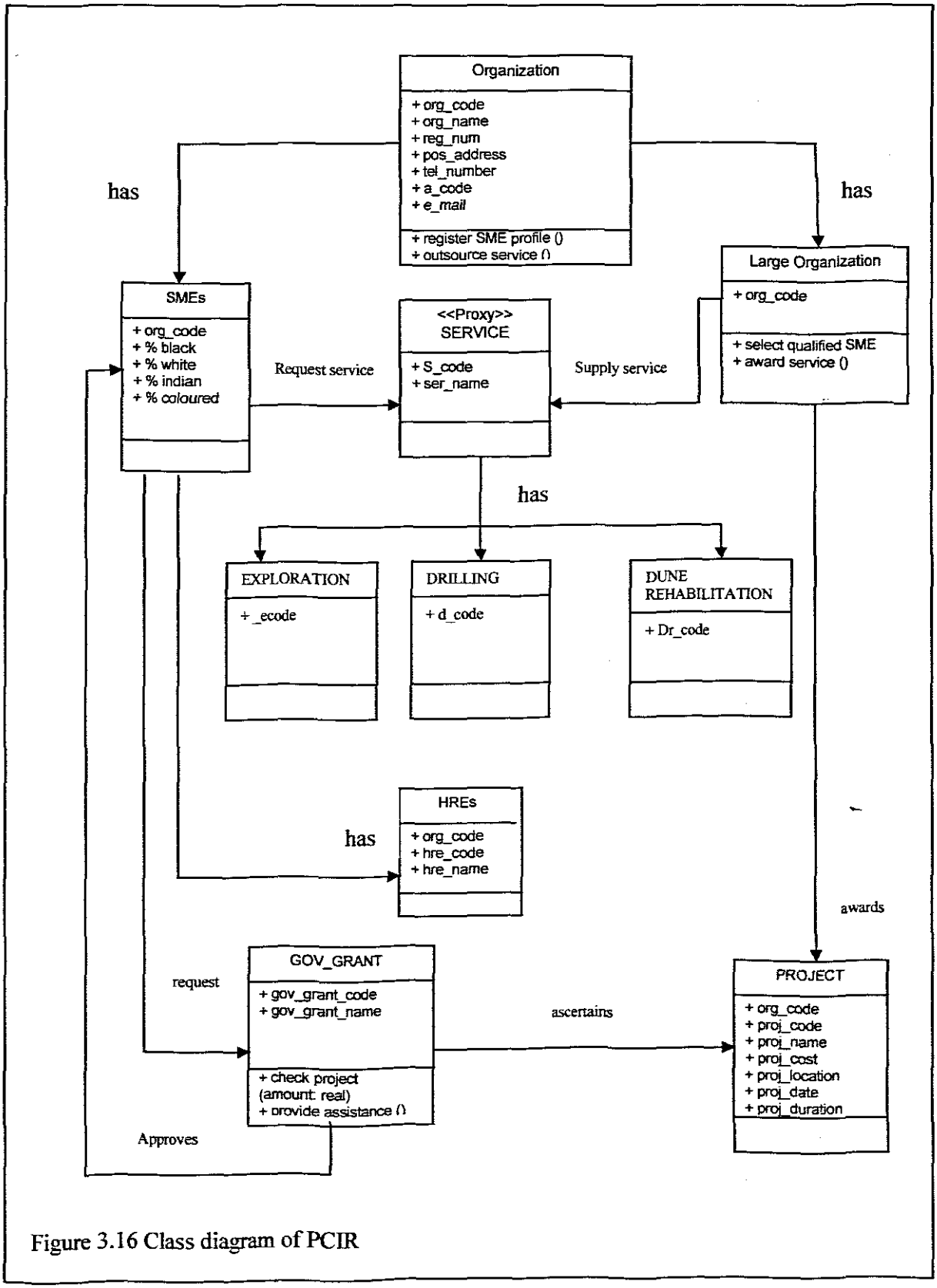

Figure 3.16 Class diagram of PCIR

3.9 Class diagram of PCIR

The Class diagram of Figure 3.16 illustrates the relationships between the various classes, their attributes and operations. It captures and describes information within the organizations.

A proxy pattern was used to structure the PCIR component. [Gamma, et al, 1994], defines a proxy as a surrogate or a placeholder for another object to control access to it. One reason for controlling access to another object is to defer the full cost of its creation and initialization. The service application is a proxy, which acts as directory to the interacting activities of the service requester and the service supplier. This proxy maintains a reference that allows the business partners to interact and it is responsible for the overall development of the information repository system.

3.10 Software Implementation Architecture of PCIR

Figure 3.17 illustrates the implementation architecture of the PCIR prototype. The information repository is implemented using a web-based server that has been integrated with the Internet to support broader access by the stakeholders (SMEs, larger organizations and the Government agency (BEE)).

The repository is accessed through Java-enabled web browsers. From repository point of view, it represents how information is structured, designed and accessed. A common database repository is developed to serve as a reservoir of information for both partners. The repository provides interfaces and operations for storing, retrieving and updating of information; this is represented in a manner to enable interactive, dynamic hypertext, taking advantage of the full capabilities of the XHTML and the servlet.

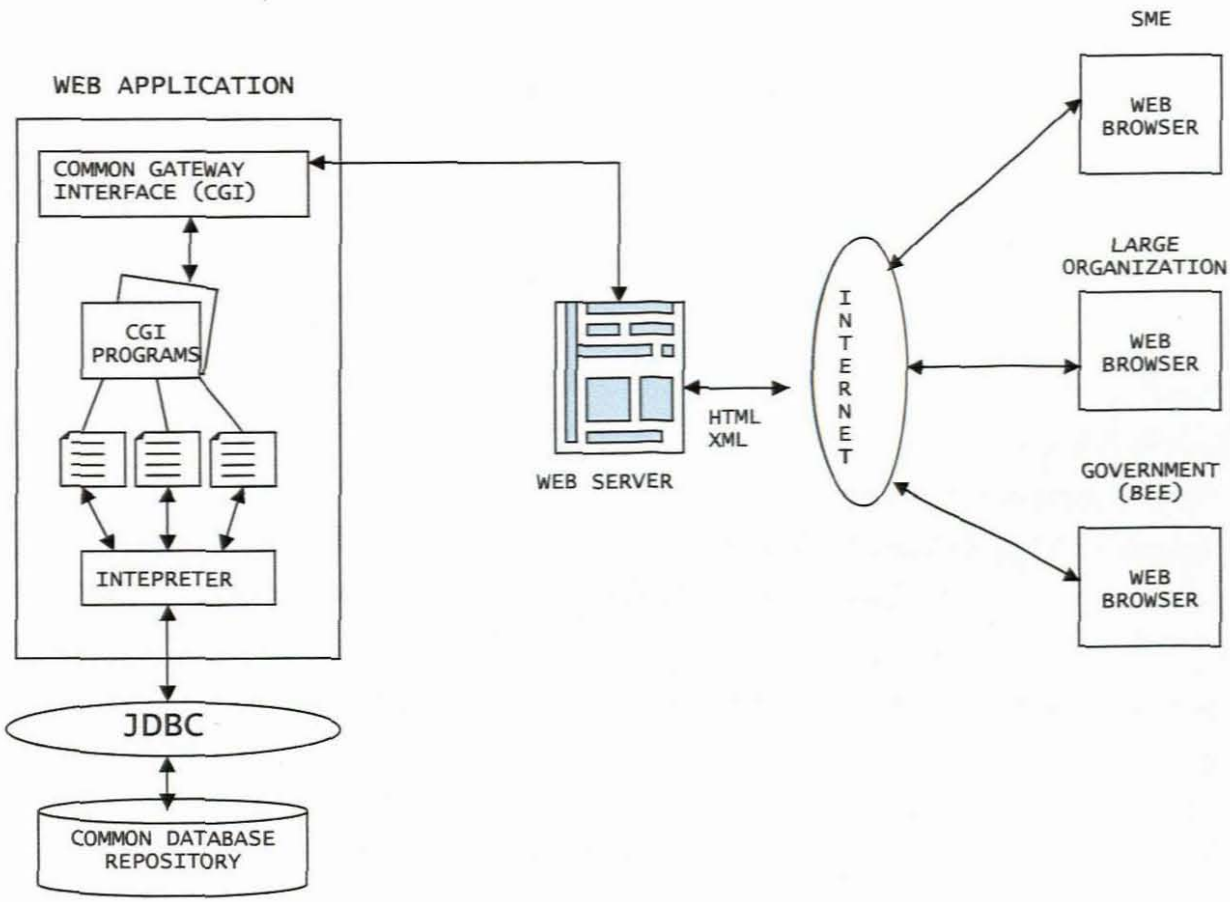

Fig 3.17 Software Implementation Architecture of PCIR

The Common Gateway Interface (CGI) which is integrated into the web server software represents the interface to implement the web application. It consists of base classes that process requests from the web browser. The processing of request involves accessing the common database repository of both partners through a language specific interpreter and driver. On returning results to the CGI, a web document is developed and sent to the associated web browser.

The next chapter discusses the implementation of the use case prototype.

CHAPTER FOUR

4.0 IMPLEMENTATION OF PCIR

4.1 Introduction

Implementation is the transformation of design into a working program. This chapter describes the implementation of a prototype of the mining industry as a case study. The case study demonstrates the design and the implementation of PCIR from which the research artifacts will be proved and validated by testing and evaluating the performance of the prototype repository.

An ontology-driven approach was used to capture the semantic objects in a top-down fashion [Gruber, 1993] to populate the PCIR. Ontology in the context of this research is the reusable part of an information repository model; it defines the concepts, instances, relations and axioms that are used to develop classes of model by reuse. This is expressed in a logic-based language, based on the XML technology.

4.2 Database and Information Repository

Organizations require information that can serve as the foundation of their primary business applications. Inaccurate or inconsistent can hinder an organization's ability to understand its current and future business problem.

To create an organized and a comprehensive information repository, for organizations, an understanding of the role of the data structure is required. Through database schema, data structures provide broader capabilities by containing both details and summarized data, while providing extensive reporting and analysis possibilities. Through the application of entity-relationship and database design, data are better organized by reducing data redundancy in a manner called normalization. A fully normalized design can be regarded as a good representation of the real world; one that is intuitively easy to understand and is a good base for future growth.

Because redundancy is eliminated, multiple entities accessed to obtain the desired information. As the number of relationships increases, so does the complexity of relationships, which also impacts performance. Functionality issues also occur because data needed for reporting and analysis are often stored in disparate databases, thereby causing organizations to access multiple databases to obtain the data they need. These issues spawned the movement towards the creation of data structure and information repository.

4.3 Implementing XML database-based document for PCIR

The significance of XML database document is informed by the collaborative application of XML in e-commerce, data management and information management. As different partners (SMEs and the larger organizations) conduct transactions, numerous documents have to be exchanged. These documents are represented in XML format, which provides the facility to represent the data in a way that both partners can interpret.

4.4 Data collection

In his contribution to data collection, [Babbie, and Mouton, 1998], identified two possible types of data in business related research, namely:
(i) Primary data – the researcher personally collects primary data and the
(ii) Secondary data- data collected by someone other than the researcher.

The various categories of data sources identified by [Mouton, 2001], include:

(i) Observation: Laboratory experiment carried out under a systematic and a controlled environment;
(ii) Self-reporting: Personal and group face to face interviewing, e-mails, telephone discussion and
(iii) Archival/documentary sources: Historical documents, business plans, medical records, etc.

Using Mouton's definition of self-reporting, a set of textual data was personally collected via a face to face interview with representatives from both the SME and the larger organization.

4.5 Data representation in XML document

Tables 4.1- 4.9, present data collected from the representatives of both partners, after interviewing them. These data were put in a tabular form using the Microsoft Access database system, (See Appendix A-1). The data were retrieved from the database using the Java programming language, which were thereafter transformed into an XML document, (See Appendices A-2 andA-3). The idea of having the data represented as XML document is that XML is a metalanguage for describing a document, which can be exchanged on the web without any ambiguity. It is also useful for the integration of heterogonous databases, information sources on the web, and the promotion of interoperability.

Table 4.1 SMEs Data Table

SMEs_Code	SMEs_Name	Reg_Num	Pos_add	Post_Code	Tel_Num	E-mail_Add
Scode-101	J.K Drilling LTD.	PM_41101	Private Bag X4572 R/B	3990	(035) 7865212	Jkd@yahoo.com
Scode-214	Dube &Sons PLC.	PM_52214	P.O.Box 7896 Empangeni	3887	(032) 7458562	Dusp@gmail.ac.za
Scode-306	Mthembu Mining Co.	PM_41306	P.O.Box 6587 Esikhawini	3886	(035) 7854216	mm@absa.ac.za
Scode_128	KZN Multi Services	PM_35128	Private Bag X6479 R/B	3991	(031) 9874512	Kms@yahoo.com
Scode_421	Rehabilitation Service Co.	PM_41421	Private Bag X5249 DN	4021	(035) 9025624	Rss@gmail.com
Scode_282	Umfolozi Exploration Co., LTD	PM_45282	P.O.Box 74582 Mtinzini	5210	(035) 9044524	Umfe@absa.ac.za
Scode_524	Mother CAT LTD., Co.	PM_26524	Private Bag X1197 DN	4021	(033) 7564956	Mcat@yahoo.com

The above table is the profile of some SMEs who are registered members of the SME community as well as with the larger organization.

Table 4.2 Larger Organizations Data Table

Org_Code	Org_Name	Reg_Num	Pos_add	Post_Code	Tel_Num	E-mail_Ad
RBcode_4639	Richards Bay Mineral	GM_ 87120	Private Bag X04265 Mzingazi	3991	(035) 9027856	rbmineral @gmai .ac.zal
EEMcode_5400	North East coast Mining company	GM_41258	Private Bag 075692 New CASTLE	4005	(034) 7842125	eem@gmail .ac.za

Table 4.2 represents the profile of the larger organizations that are registered with the Government and whose obligation is to implement government policy on the BEE programme.

Table 4.3 Call for Tender Data Table

Org_code	T_Code	Nature of Tender	Description	Working block	Date of tender release	Last date to submit Tender
RBCode-4639	T_103	Exploration	Explore for Iron ore	4Km^2	02/02/07	05/03/07
	T_104	Drilling	Drilling (wet method)	2.5km^2	03/04/07	24/05/07
	T_105	Dume Rehabilitation	Rehabilitate area for agriculture	3.5km	05/05/07	27/05/07
	T_102	Processing heavy mineral	Recover pure iron	----------	24/05/07	15/06/07
	T_107	Mining for heavy mineral	Surface mining (dry method)	8.7km^2	20/06/07	10/07/07
EEMCode- 5409	T_203	Dume Rehabilitation	Rehabilitate land for recreation	10.2km^2	22/06/07	24/07/07

The above table depicts a call for Tender from the larger organizations. The SMEs are expected to apply for these contracts if they are qualified to do so. A form is designed for this purpose for the SMEs to complete within specified period.

Table 4.4 Outsource Service Data Table

Outsource_ code	Service Description	Cost	Location	Duration
Oss_10206	Recovering of Titanium from the ore	R1.6 Million	# N.E Mbilo	5 Months
Oss_10306	Rehabilitation for Agriculture	R2.5 Million	# S.W Empang.	8 Months
Oss_10406	Exploring for Iron ore	R3.2 Million	# N.N.E Umbo	10 Months
Oss_10506	Dry drilling for heavy mineral	R5.4Million	# S. E.Mzingazi	12 MONTHS
Oss_10606	Rehabilitation for recreation	R2.7 Million	#N.W Umtata	9 Months

Table 4.4 is the description of contract for award by the larger organizations. It covers details like the cost, location and the duration of the contracts to be executed.

Table 4.5 Service Data Table

Service_ Code	Service _ Name
EScode-001	Exploration
DScode-012	Drilling
DRScode_023	Dune Rehabilitation

Above table represents the core services of the larger organizations.

Table 4.6 Human Resource Expertise Database Table

SMEs_Code	Mining Engineers	Drilling Engineers	Exploration Engineers	Landscape Engineers	Number of expertise	Type of mining equipment	Number of mining equipment
Scode-101	2	3	-	-	5	-	-
Scode-214	1	2	-	-	3	-	-
Scode-306	2	2		1	5	-	-
Scode_128	-	-	-	-	-	-	-
Scode_421	-	-	-	2	2	-	-
Scode_282	1	-	2	1	4	-	-
Scode_524	1	2	2	1	6	-	-

Table 4.6 depicts the category and the number of Human Resource Expertise of the SMEs. These details are required because they form part of the requirements needed by the larger organizations to consider the SMEs for the award of contract.

Table 4.7 Project Database Table

Org_code	P.code	SMEs code	SMEs Name	Description	P.Cost	P.Loc	Award date
RBcode_4639	EP_201	Scode-306	Mthembu Mining Co.	Exploring for Iron ore	R3.2 Million	# N.N.E Umbo	12/06/06
RBcode_463	RP_012	Scode_421	Rehabilitation Service Co.	Rehabilitation for Agriculture	R2.5 Million	# S.W Empang.	15/08/06
EEMcode_540	DP_027	Scode_524	Mother CAT LTD., Co.	Dry drilling for heavy mineral	R5.4 Million	# S. E.Mzingazi	12/11/06

Table 4.7 represents details of the contract that have been awarded, including the amount and date of award.

Table 4.8 Government Grant Database Table

Govt _Code	Govt Agency	SMEs.Code	P.Code	Amount	Date
		Scode-306	EP_201	R3.2 Million	15/09/06

Above table represents the details of the SME that has received grant from the government. The purpose of the giving of grant by the government is to motivate and to help SMEs that don't have the collateral security to secure loan from the banks.

Table 4.9 Percentage (%) of Registered SMEs Data Table

SMEs.Code	% Black	% White	% Coloured	% Indians	% Others
Scode-101	30%	40%	10%	20%	-
Scode-214	35%	45%	8%	20%	-
Scode-306	40%	35%	10%	15%	-
Scode_128	50%	10%	15%	20%	5%
Scode_421	45%	35%	5%	15%	-
Scode_282	55%	25%	10%	10%	-
Scode_524	45%	35%	7%	10%	3%

4.6 Entity Relationship diagram of PCIR

The process of database design is an iterative, which involves the repetition of processes and procedures. The process involved in the development of the entity relation (ER), started with a general narrative of the raw data in Table 4.1 to 4.9, based on operations and procedures. The ER went through several review processes, during which uncovered objects, attributes and relationships were added and modified to incorporate new discovered components. The process was repeated up to the third normal form (3NF), until it got to a state where the ER

diagram was fair enough to represent the activities and functions of the repository.

In a relational database model, connectivity and cardinality are governed by business rules. Accurate representation of ER notation is very important, because if the descriptions of an organization's data environment, transaction and information requirement are not accurate, the business rules that are derived from such descriptions will yield inadequate or inaccurate data model.

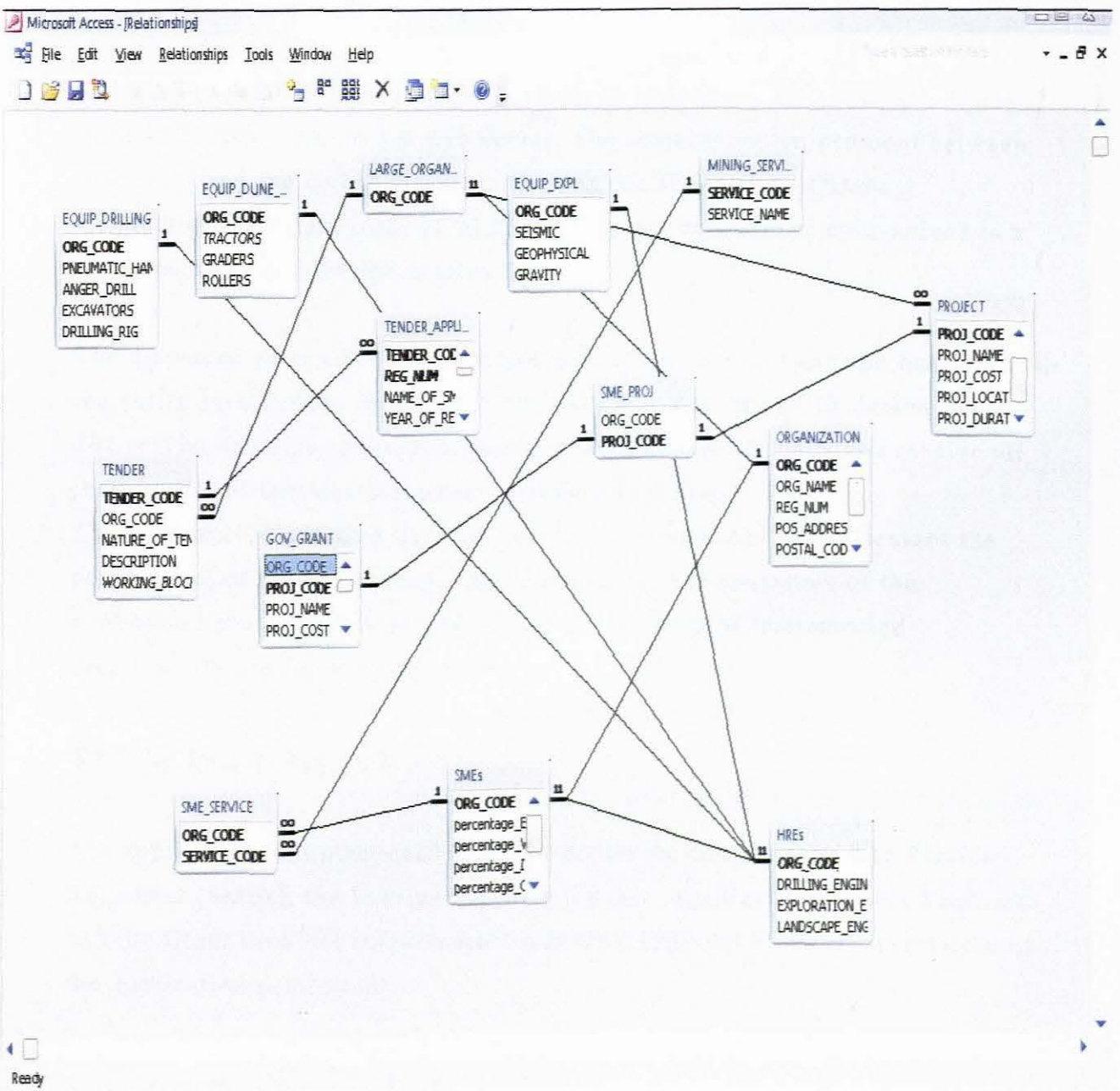

Figure 4.1 Entity Relationship Model of PCIR

Figure 4.1 represents the ER model. This model uses the ER diagrams to represent the conceptual database as viewed by the end user. The components of the ER model are entities, relationships and their attributes. The ER diagram also includes connectivity and cardinality notations. Connectivity describes the relationship classification (1:1, 1: M, M: N). Cardinality expresses the specific number of entity occurrences associated with an occurrence of related entity.

4.7 Implementation of PCIR

The Java programming language was used to implement the prototype. It has a built-in Tomcat version 6.0 web server. The communication protocol between the server and the database was done using the JDBC (Java Database Connectivity) [Moertiyoso, et. al.2002].This protocol allows connections to a database, runs queries and creates SQL.

The displaced screenshots were prototyped using Java servlet; that has access to the entire Java family, including JDBC API to access the PCIR databases.
The servlet can also access the library of HTTP- specific calls and receive all the benefits of the Java language; including usability.
The next session gives an overview of the prototype, and then discusses the partitioning of the application into components. The snapshots of the application prototype are presented and the snippets of implemented functionality are found in Appendix C.

4.8 The PCIR Application

The application was composed from the following components: The Service Requester (SMEs), the Service Supplier (Larger organization), Grant Requester and the Grant Provider (Government Agency). Figure 4.2 is a representation of the application component.

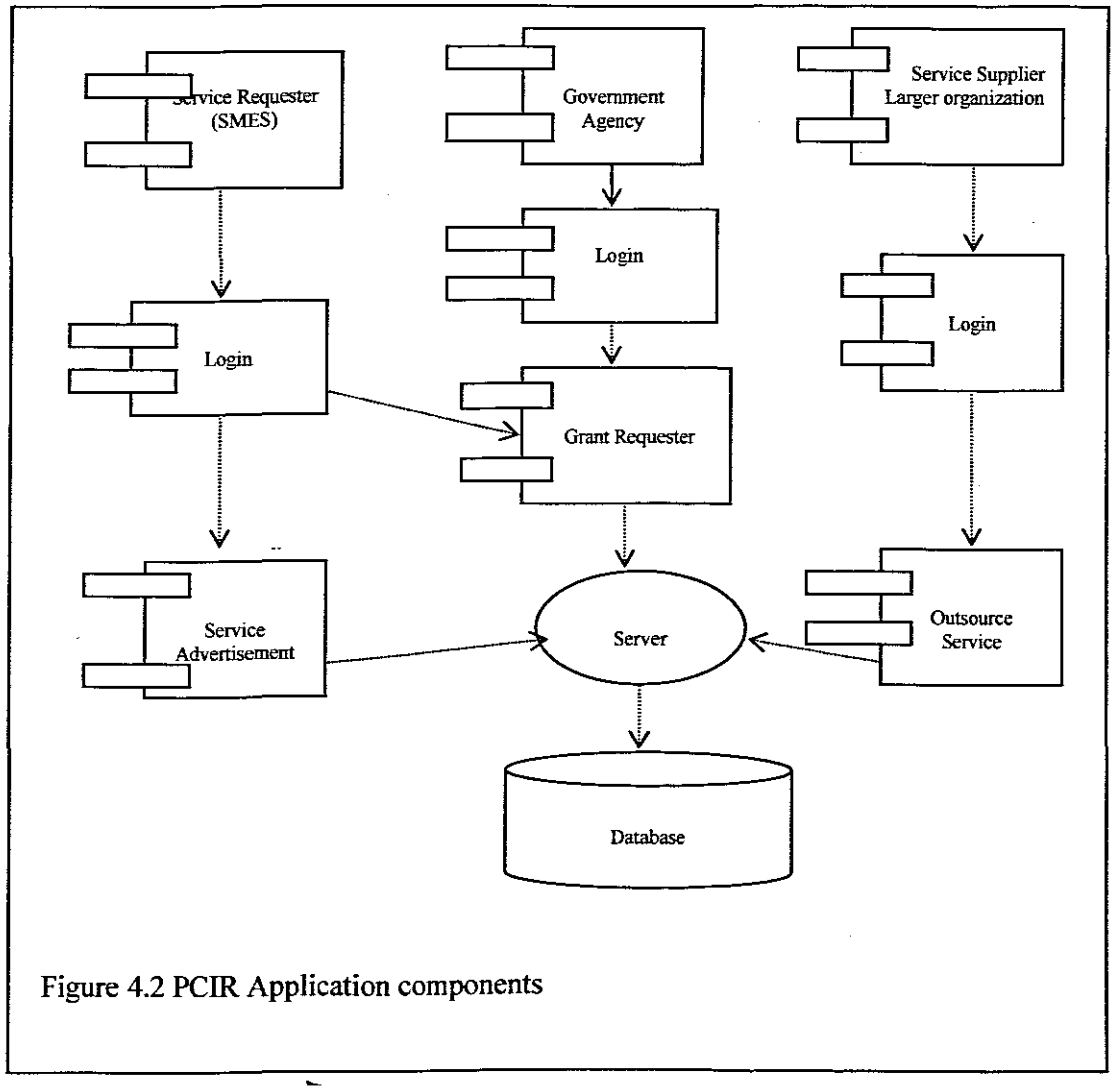

Figure 4.2 PCIR Application components

The stakeholders and the interacting services have a common database connected to one server owned by the larger organization. The larger organizations need to individually sponsor the development and maintenance of the system, because they have the resources to pay for the information system.

Figure 4.3 is the Home page of PCIR where the stakeholders can Login into the system, using a search engine.

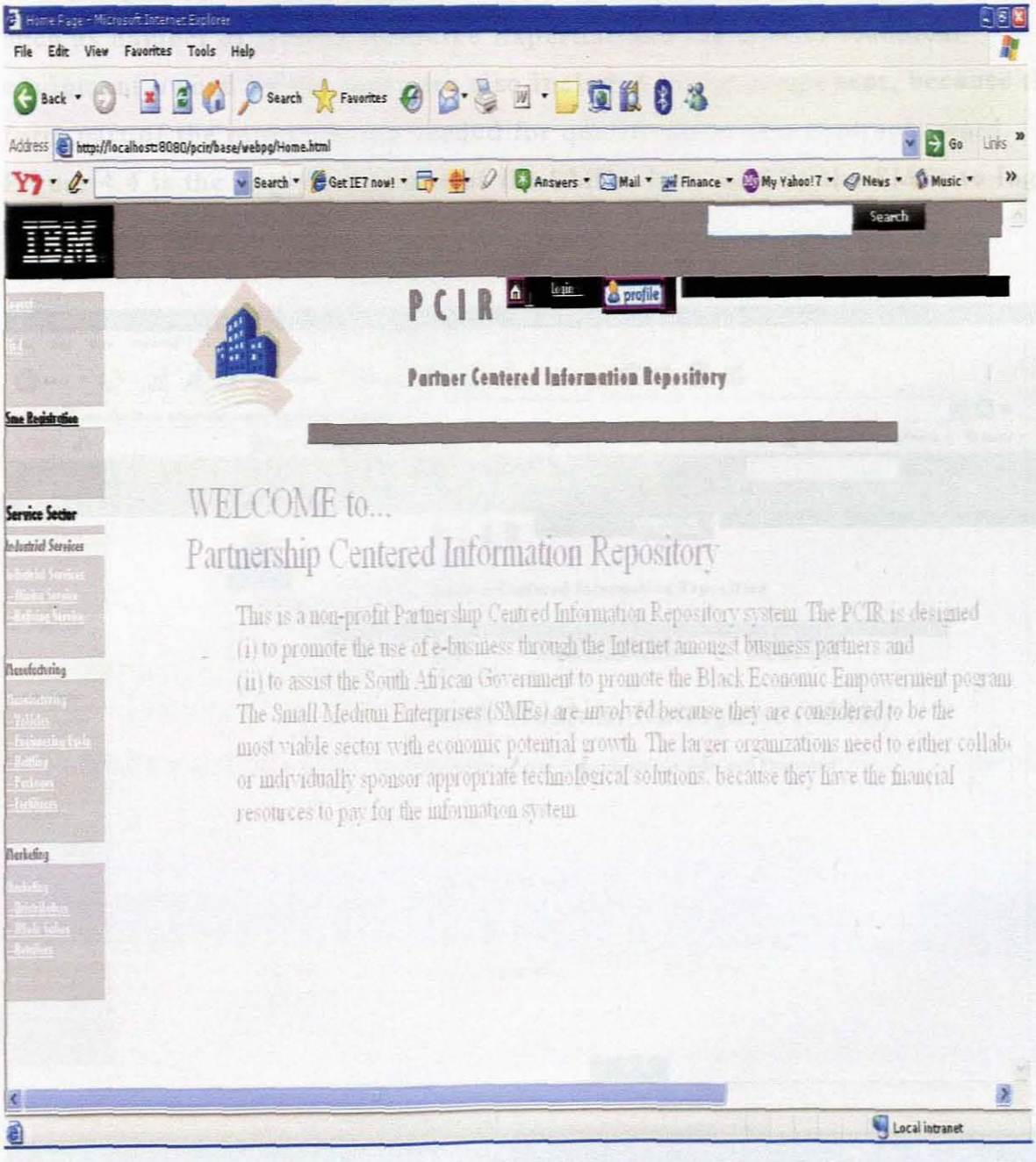

Figure 4.3 Home Page of PCIR

To achieve implementation, these components collaborate with each other, such that a component uses the services provided by another component as the case may be. A brief explanation of the components is given as follows:

4.8.1 The Service Requester Component (SRC):

This component represents the clients (SMEs), who interact with the application through advertisement of service. This class was designed to hold SME information profile; which includes capturing attributes such as the name of the

SME, Registration number, postal address, postal code, E-mail address. Features such as number of Human Resource Expertise and the type of technical equipment owned by the users are also included in the component, because they form part of the requirements needed for qualification of a contract award. Figure 4.4 is the Log-in interface of the SMEs. It is used by the SMEs to log into the system.

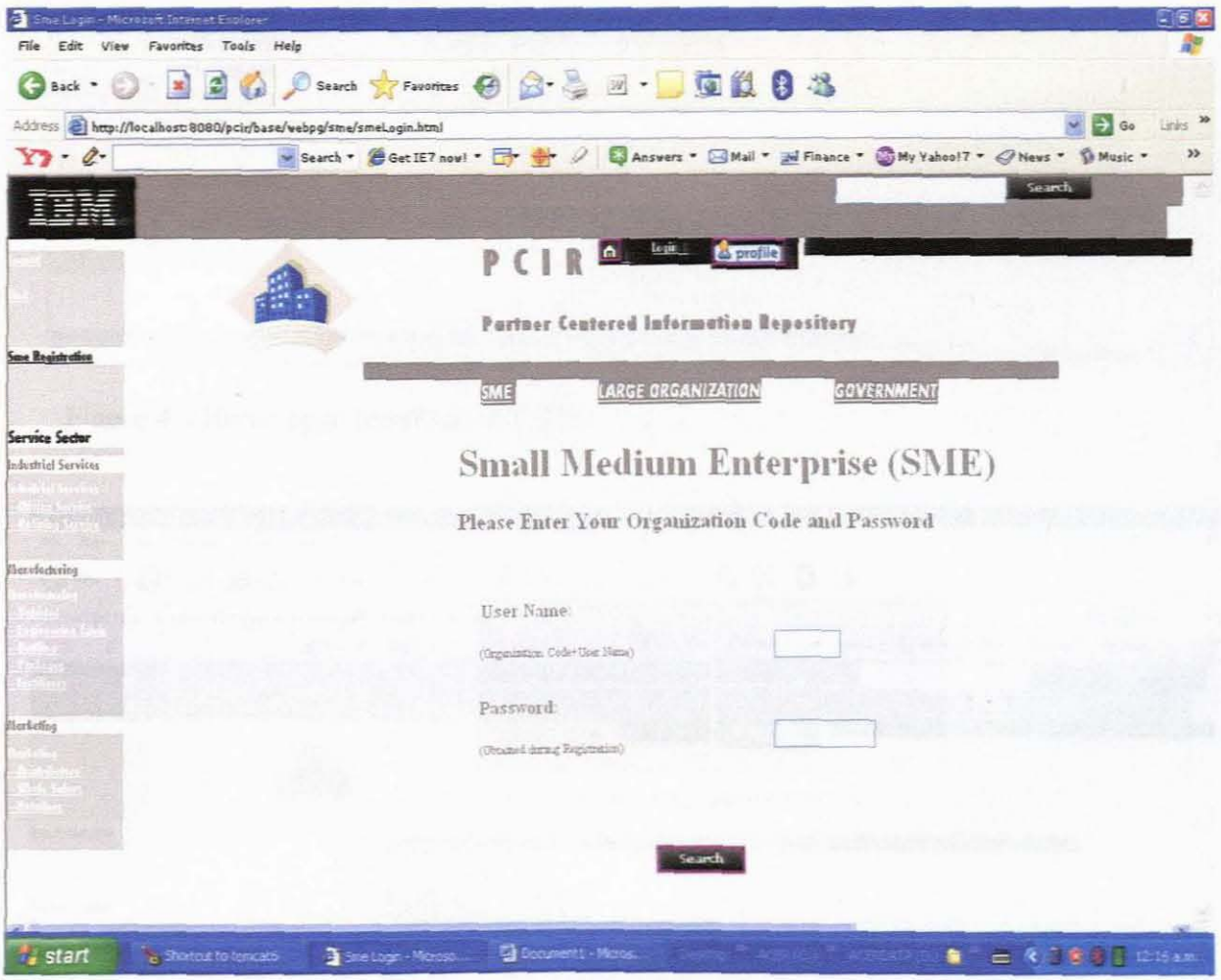

Figure 4.4 SMEs Login - Interface

The login was used to identify the SMEs and to take them to the Home page. Figure 4.5 represent the Home page interface of the SMEs. Figure 4.6 is the Service Advertisement of the SMEs. Information is captured in a database connected to this interface.

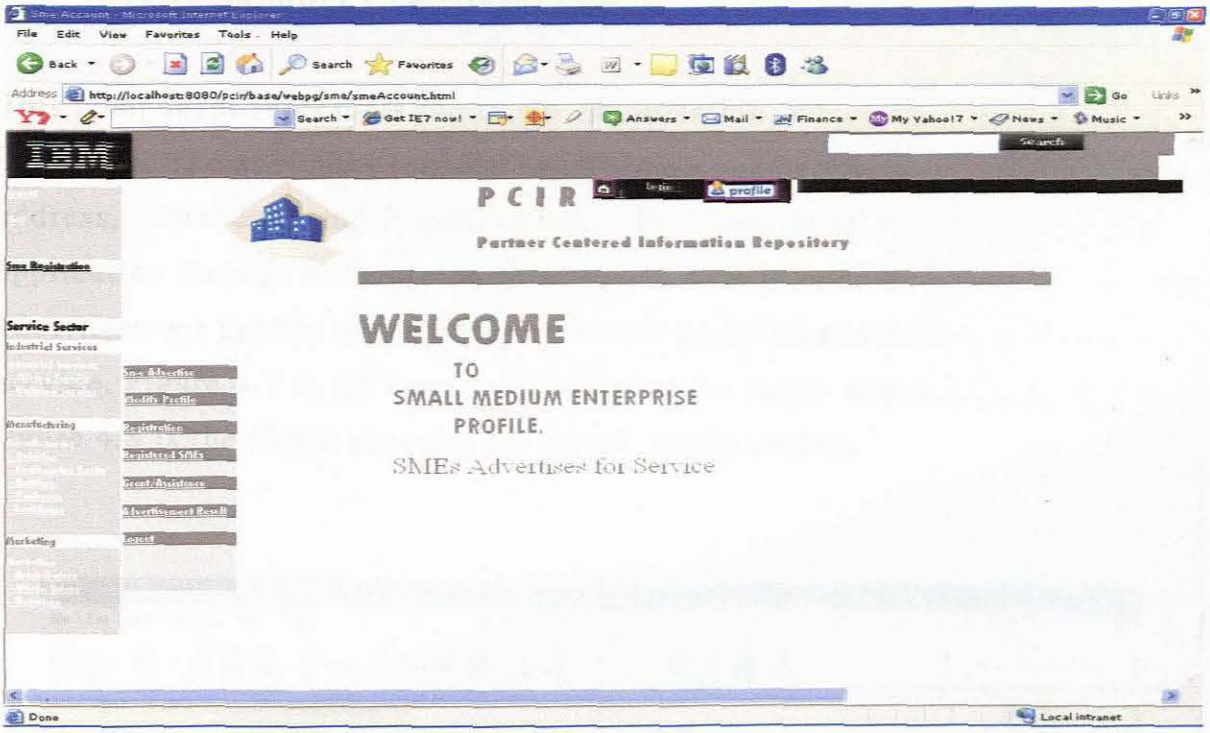

Figure 4.5 Home page Interface of SMEs

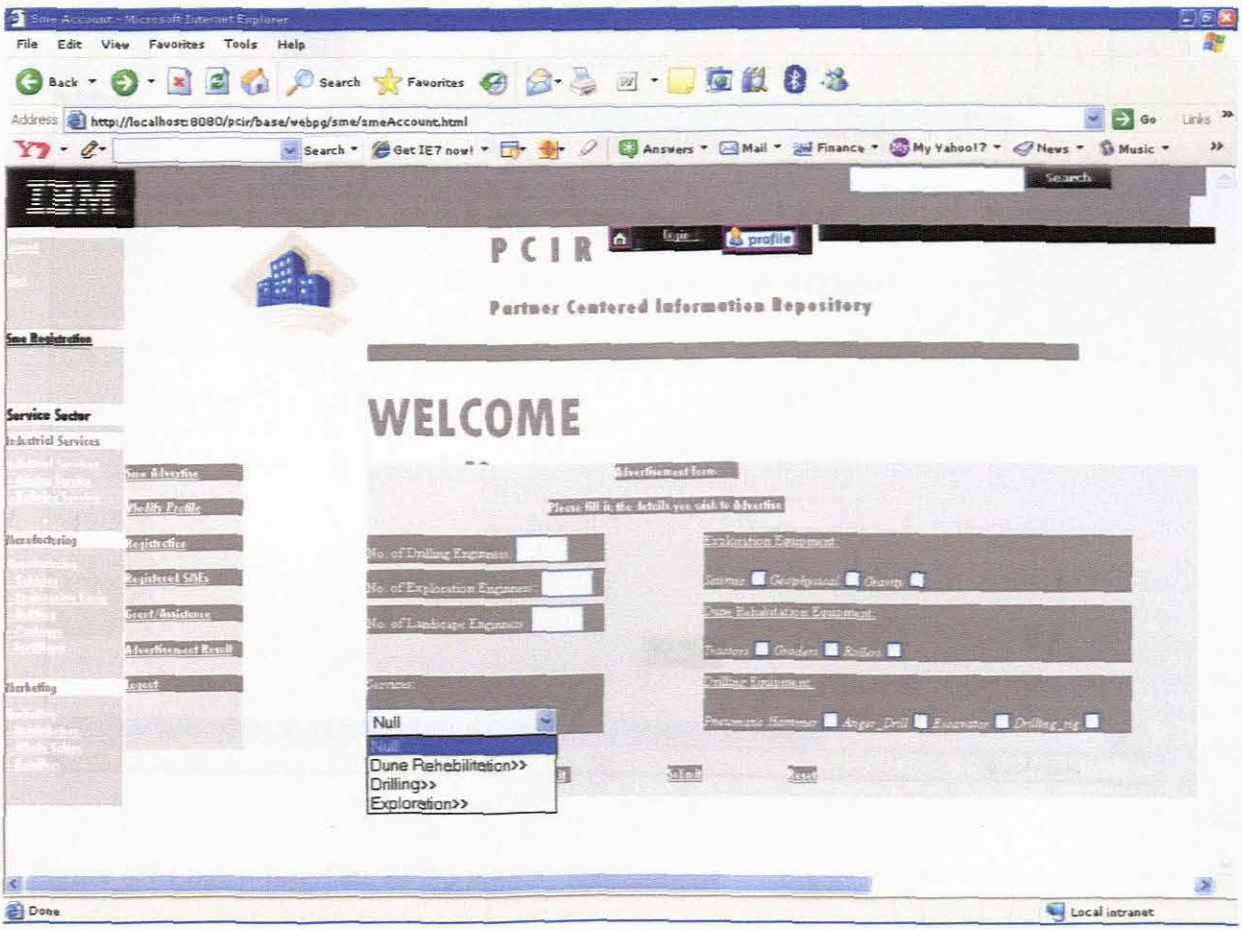

Figure 4.6 Service Advertisement Interface of SMEs

4.8.2 Service Supplier Component (SSC):

This component represents the larger organization, which has services to outsource. The attributes include Registration number, service name, postal address, postal code and E-mail address. This component interacts with the application through outsourcing of services. This is done by going through the advertisement profile of the SMEs to select qualified candidates to award a service. Figure 4.7 is the Log-in interface of the larger organizations, while figure 4.8 is the Home page for the larger organizations.

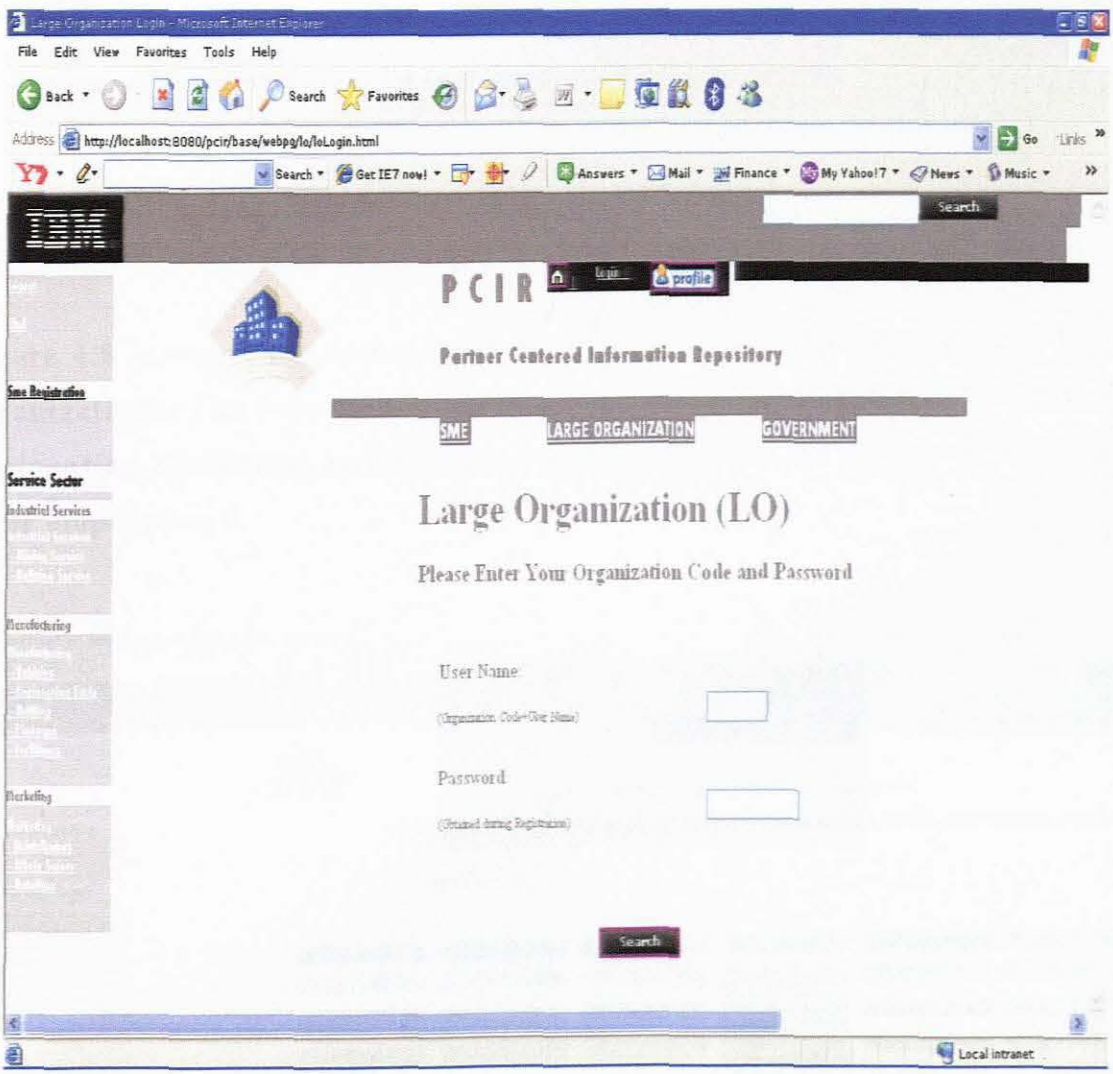

Figure 4.7 Login- Interface of the larger organizations

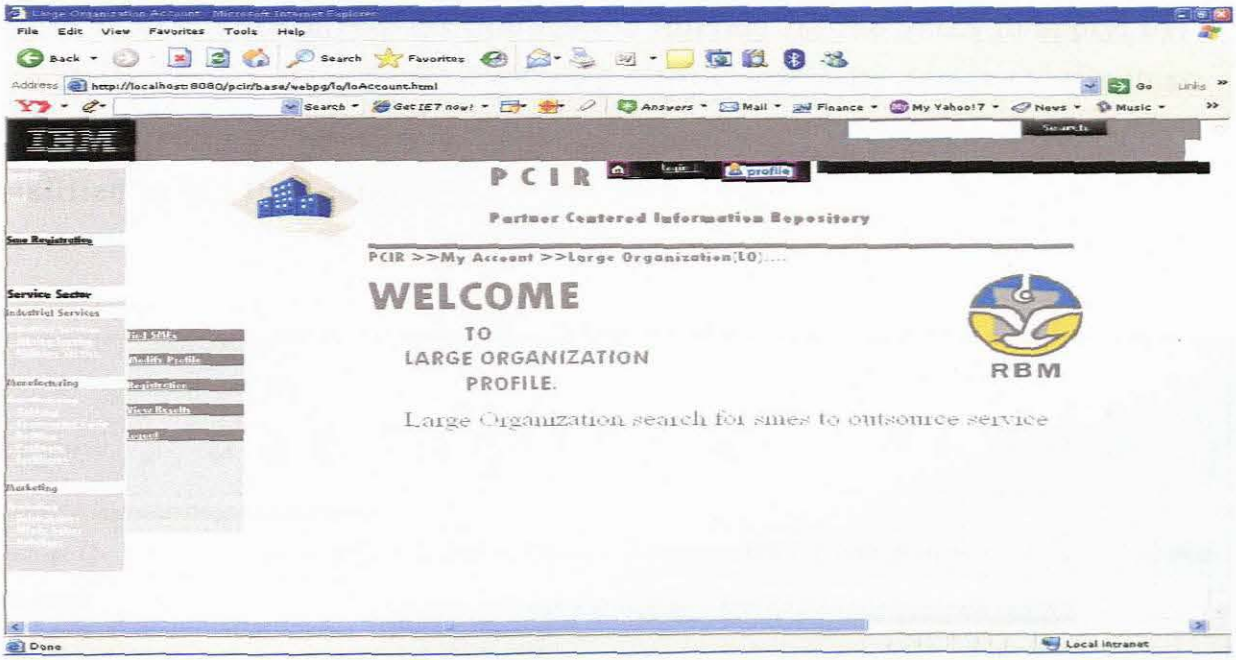

Figure 4.8 Home page Interface of the larger organizations

Figure 4.8 is where the actual selection of SMEs is carried out by the larger organizations. The selection is based on the SMEs' ownership of the required engineering equipment as well as having the qualified professional expertise in their employment.

Figure 4.9 Call for Tender—List of advertised contract

Figure 4.9 represents the list of contracts advertised by the larger organizations. These contracts are advertised through the Internet for the SMEs to apply, by completing an interface form (see figure 4.10) specifically designed to indicate certain requirements to enable the larger organization to determine the SMEs qualified to win the contract.

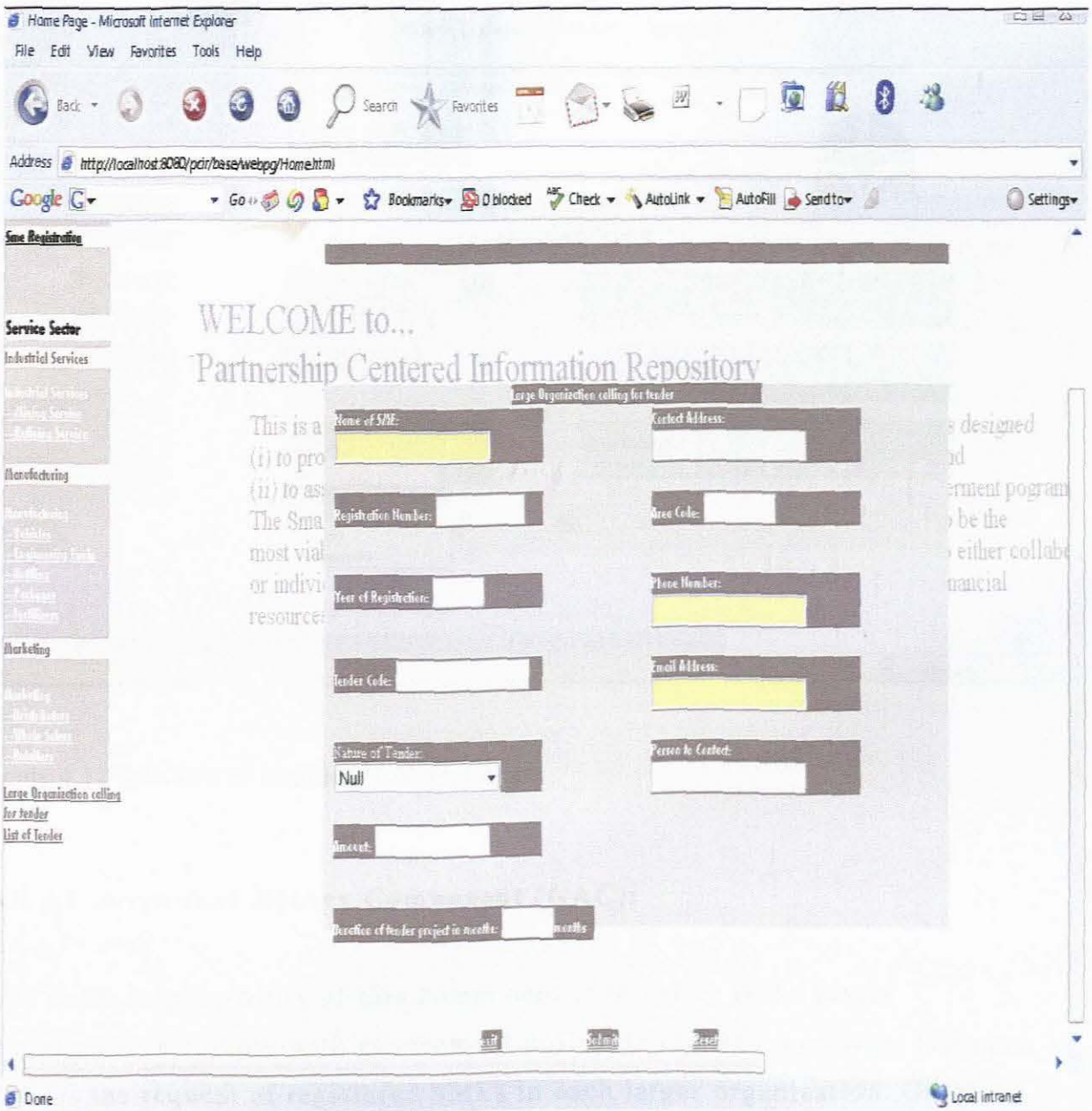

Figure 4.10 Interface Form for contract award

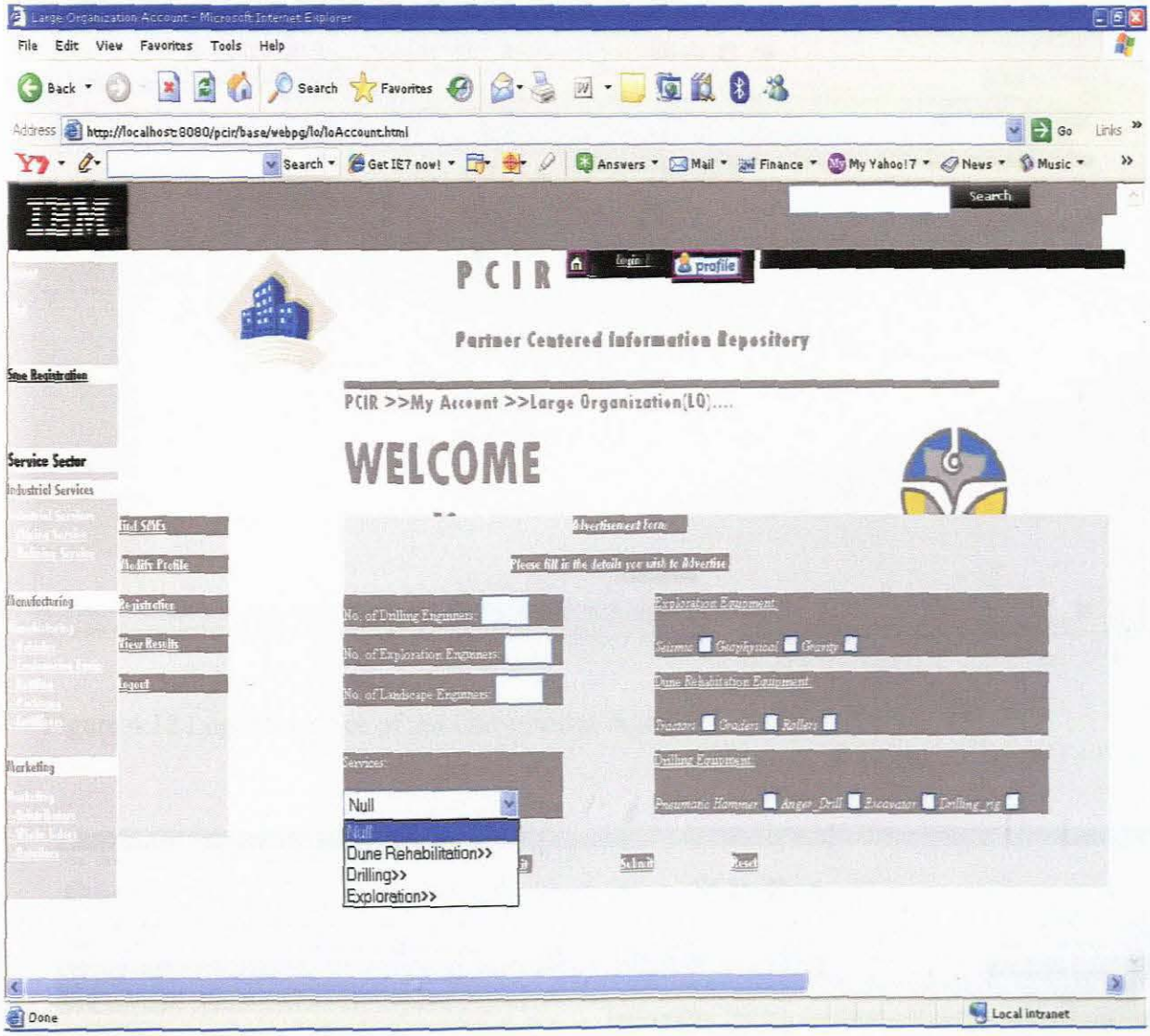

Figure 4.11 Selection of qualified SMEs Interface

4.8.3 Government Agency Component (GAC):

The main responsibility of this component is to verify if the larger organizations comply with government policy on the BEE program. Foremost in this, is the request of registered SMEs in each larger organization. Other responsibility includes approval of financial assistance to the needy SMEs. Figures 4.9 and 4.10 represent the Log-in and the Home page interfaces of the Government Agency.

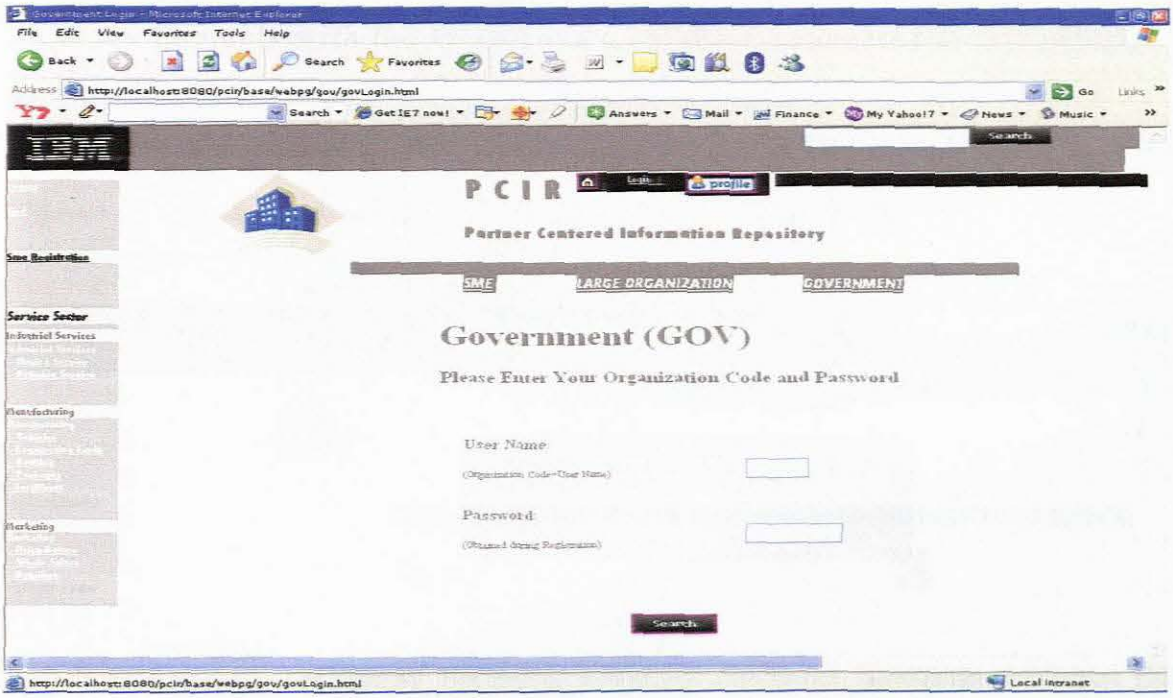

Figure 4.12 Login Interface of the Government Agency

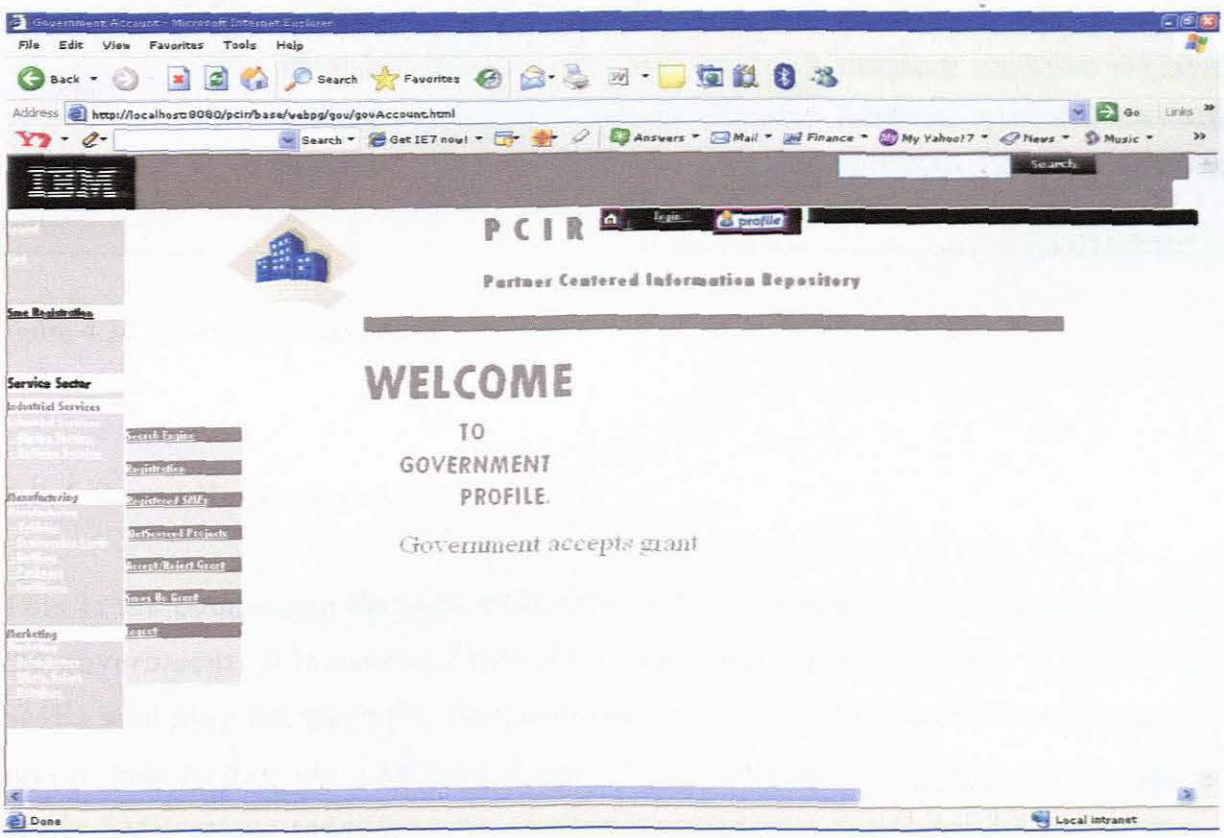

Figure 4.13 Home page Interface of the Government Agency

Figure 4.14 depicts the list of registered SMEs interface. The government Agency interacts with the system via a database connected to this interface.

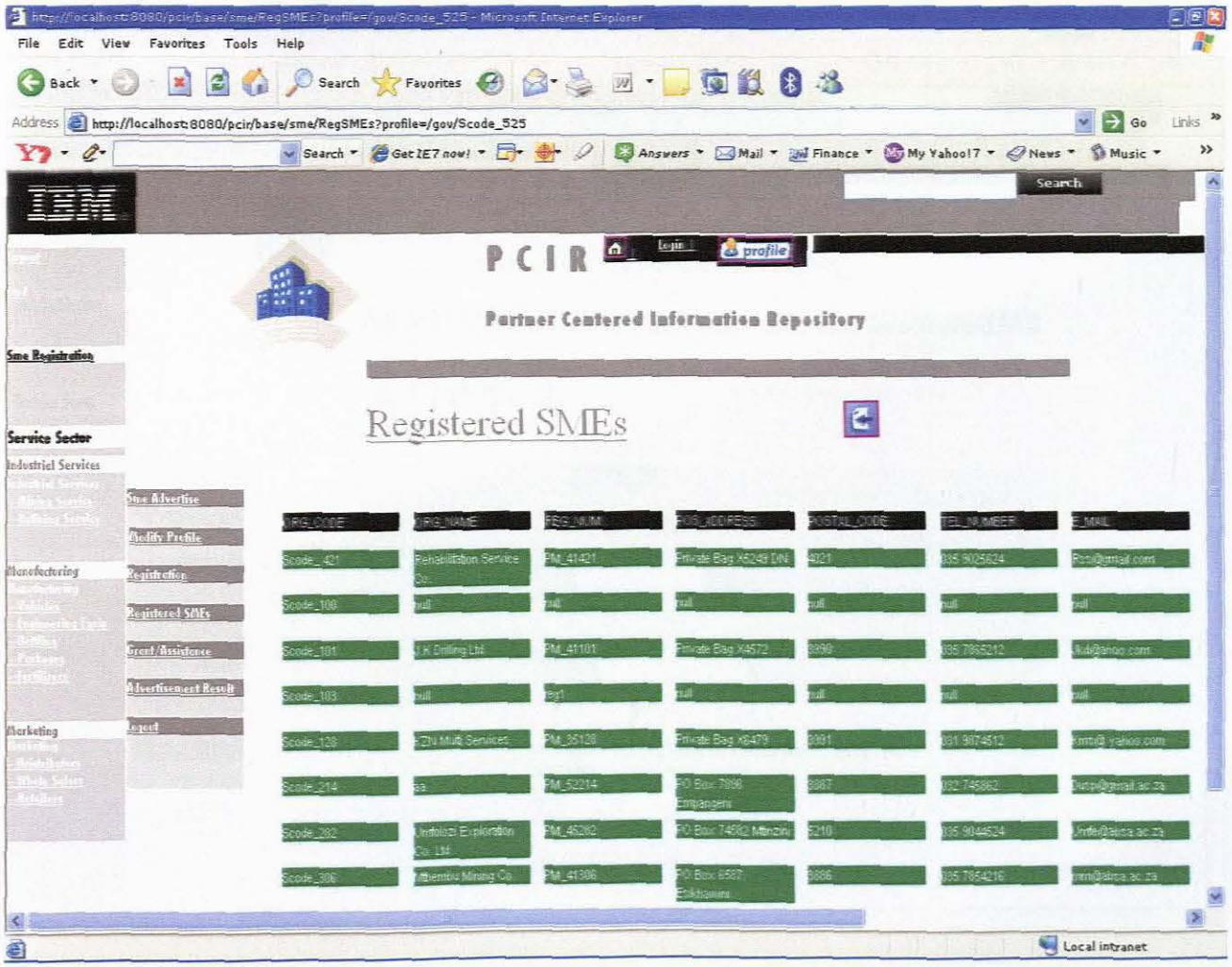

Figure 4.14 List of Registered SMEs Interface

4.8.4 Grant Requester (GR):

This is the component through which the SMEs can request for assistance from the government. It is assumed that the government should be able to assist some SMEs who may not have the financial resources or the collateral security to secure loan to execute a service. Figure 4.13 is the interface from where the needy SMEs make request to the Government Agency for financial assistance. This is done through the interaction with the system via the database connected to this interface.

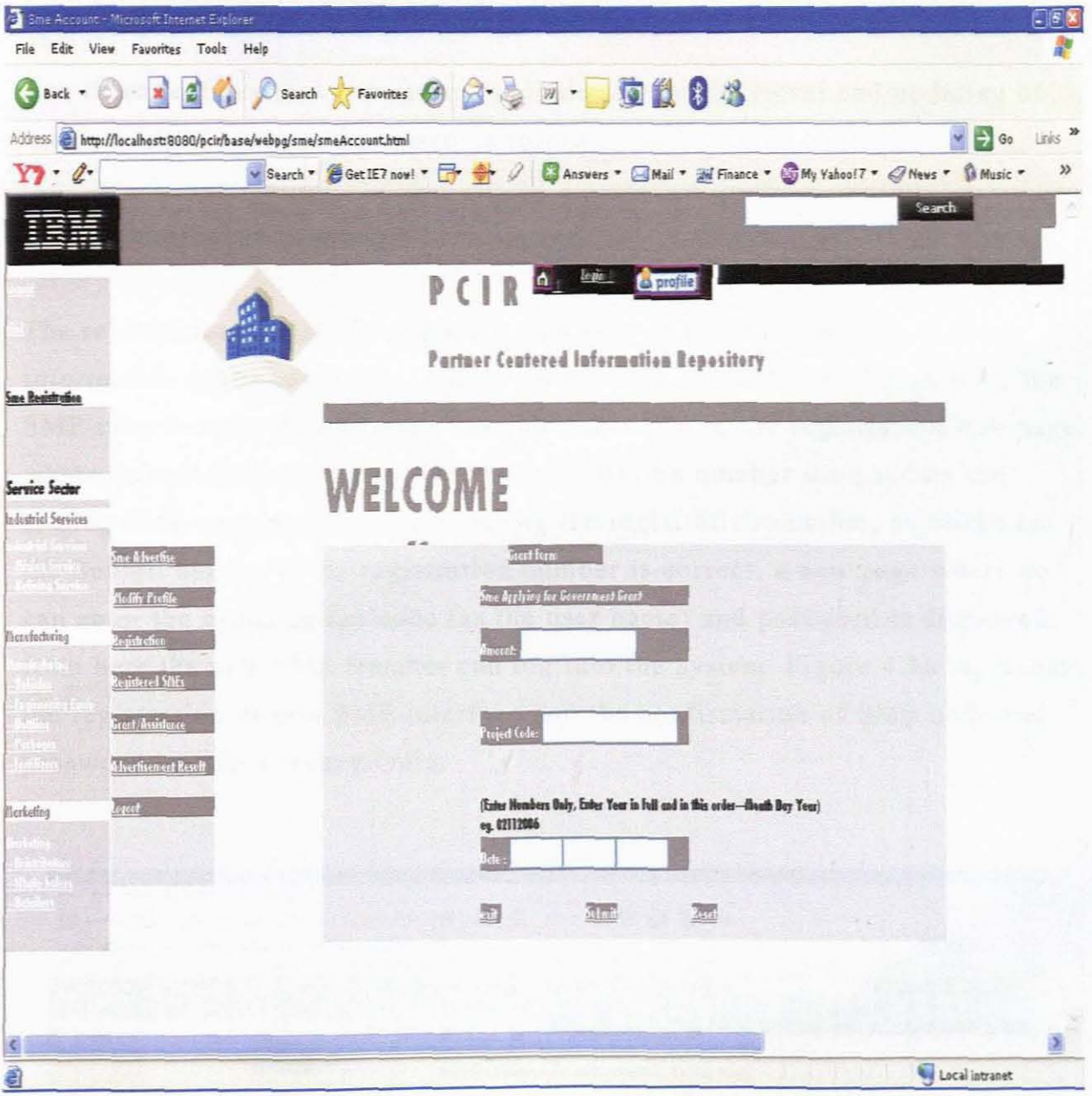

Figure 4.15 SMEs request for grant Interface

The next section discusses the testing of the prototype.

4.9 Testing PCIR Prototype

The application of XML and the Java technologies played important roles in the development and management of PCIR. XML application was used for the publication of web – pages and the exchange of information on the web. The

Java programming language provided facility for the use of access control of objects.

The three features that were tested include storage, retrieval and updating of information. These are discussed as follows:

4.9.1 The Storage Feature

The registration of SMEs component was used to demonstrate how to store information in the repository. On the Home page of PCIR (see figure 4.3), the SME clicks on the Registration link that takes him to the registration web page, where he will be required to enter his registration number assigned by the mining SME community. After entering the registration number, he clicks on the Submit button. If the registration number is correct, a new page where he can enter the organization code (as the user name) and password is displayed; from here the new SME member can log into the system. Figure 4.16 represents the registration of new SME interface and the confirmation of SME code and password interface respectively.

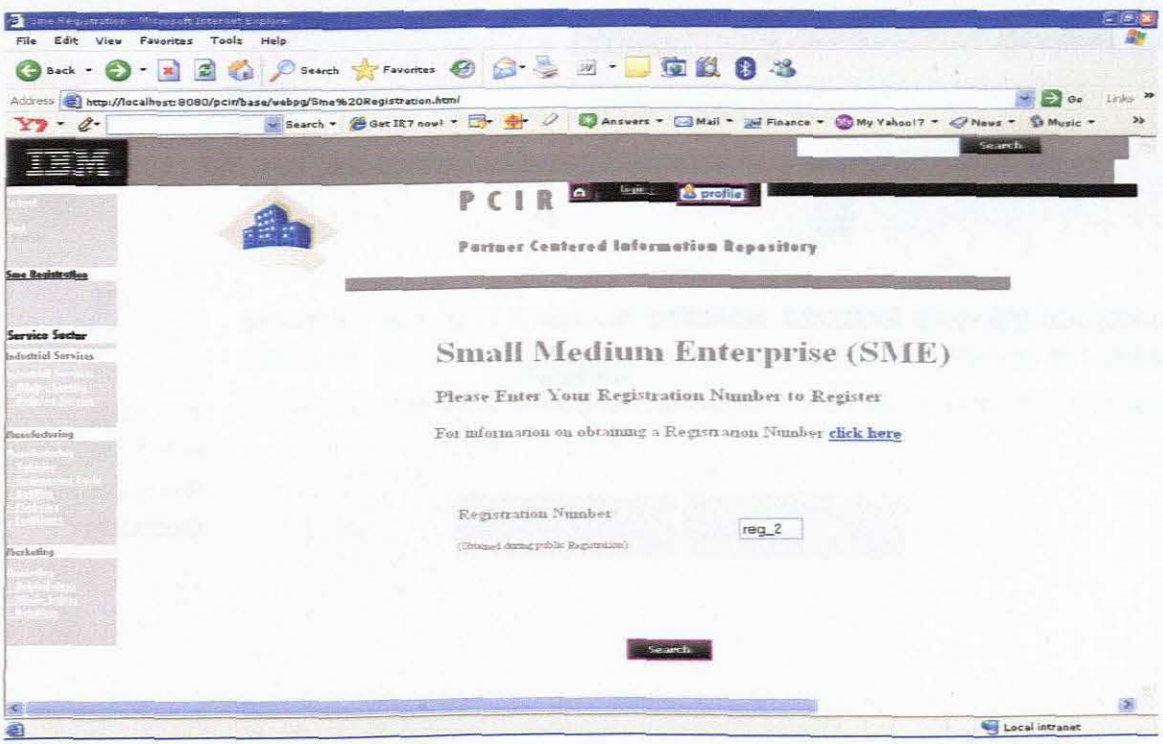

Figure 4.16: Registration of new SME Interface

4.9.2 The Retrieval Feature

The list of SME on grant component was used to demonstrate how to retrieve information from a repository. One of the responsibilities of the government Agency is to request for the list of SMEs that are on government grant. The retrieval of such information involves the following steps. On the government Home page of PCIR (see figure 4.13), the Government Agency clicks on the SMEs on grant link.

The linking takes the Agency to the list of all the registered SMEs (see figure4.14). From the details of these SMEs the Agency is able to select the SMEs that have received grant from the government. Figure 4.15 represents the SMEs on Government grant interface.

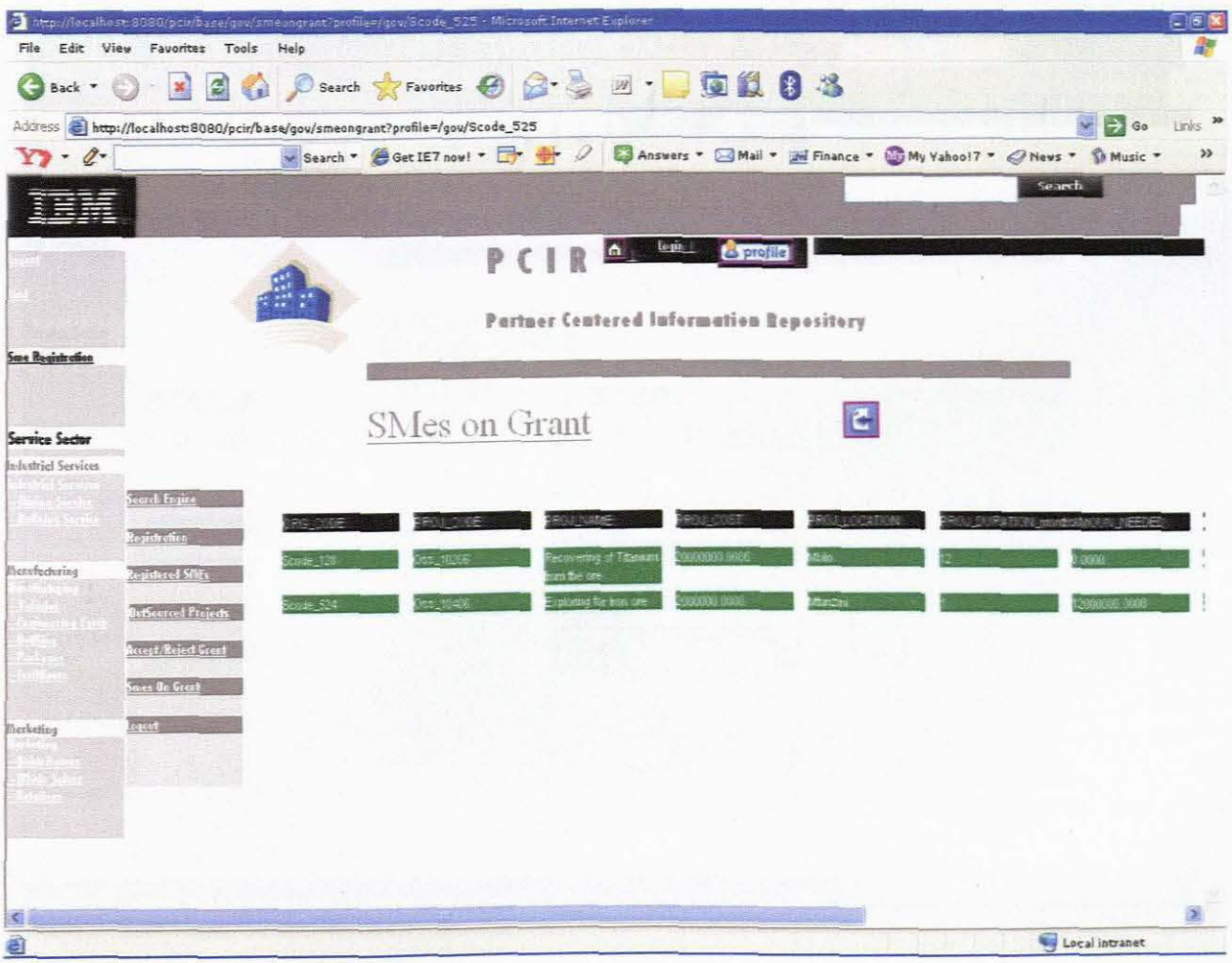

Figure 4.17: SMEs on Government grant Interface

4.9.3 The Update Feature

The SMEs Service Advertisement component was used to illustrate how to update the repository. On the SMEs Home page (see figure 4.5), click on the link to update / modify the SMEs profile. Upon clicking on this link, a form from where the SME can make changes to the profile is displayed for completion. After updating the profile, click on the submit button to check if the new details have been successfully updated. Figure 4.18 represents the interface where changes can be made on the existing information of the repository.

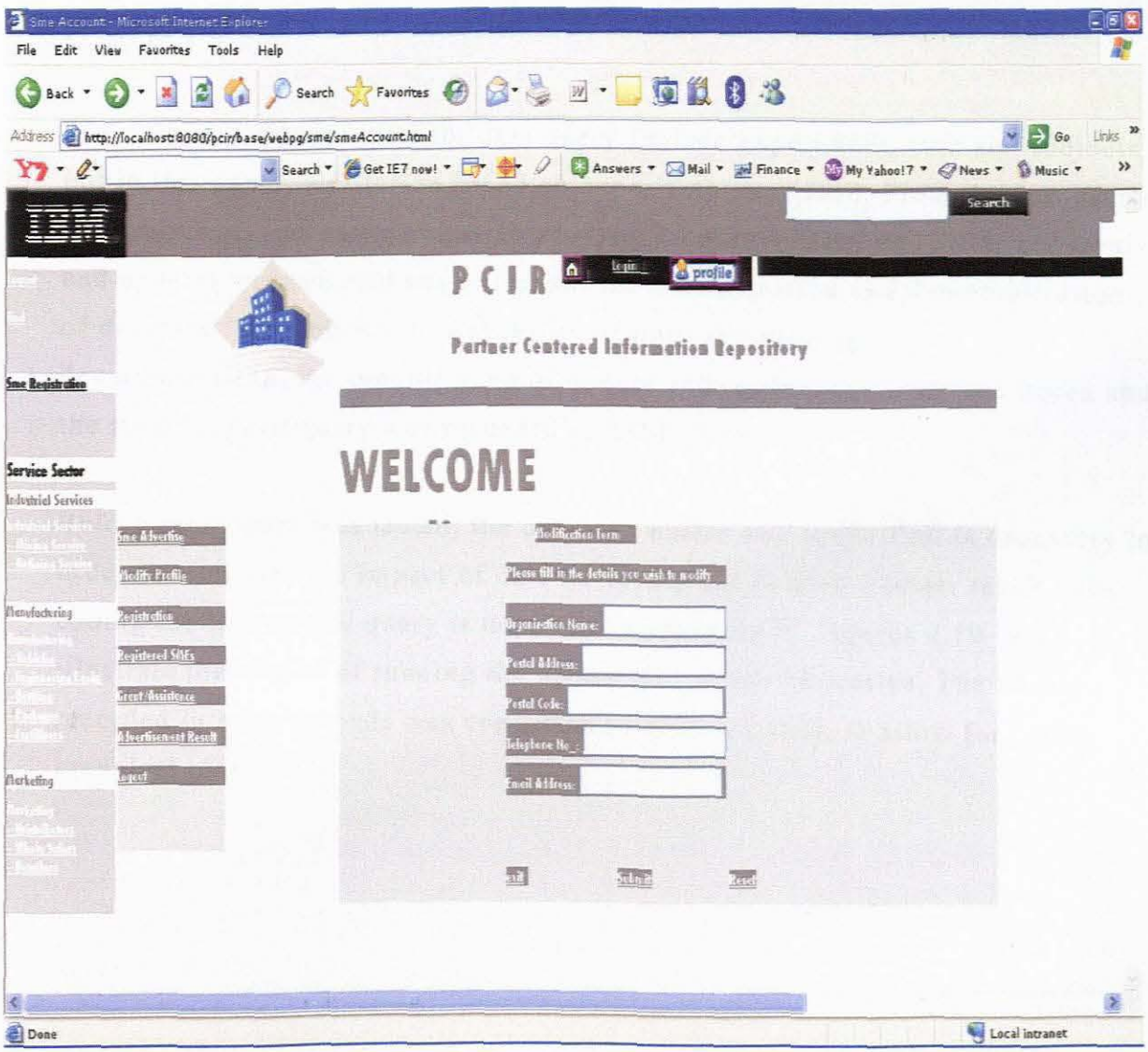

Figure 4.18: Updating of Information Interface

4.10 Test for Faster Query

The primary goal of this section is to test the capability of normalization or denormalization in the retrieval and the update of data in information repository. The testing outlined in this section was done on a computer with the following specifications:

(i) Operating system: Window xp professional.

(ii) Hard drive: 40GB

(III) Ram: 2GB

(IV) Net Beans 6.0 version

(v) Java 1.4.2

The different criteria used for data query include experiment, task and subjects, but in this paper, a criterion based on experiment was used. From the end-user's point of view, two types of queries that are frequently executed (Data retrieval and update) were carried out to test for the normalization and denormalization of database. To compare the capability of normalization against denormalization, the running time of update and retrieval queries was tested and the time for each query was recorded in Table 4.10.

Before each query was tested, the database buffer was reset. This is necessary in order to minimize the impact of data buffering and to give a better result. The coding for testing this query is depicted in appendix C. Figures 4.19--4.22 illustrate the results of running the update and retrieval queries. The timing recorded in nano seconds was converted to milli seconds, to allow for better graphical plot.

	NORMALIZATION	
	Time in Nano seconds	Time in Milli seconds
UPDATE	34169985	34.17
RETRIEVE	48888057	48.89
	DENORMALIZATION	
UPDATE	349027	34.90
RETRIEVE	49331410	4933

Table 4.10 Results of normilazation/denormalization for update and retrieve queries

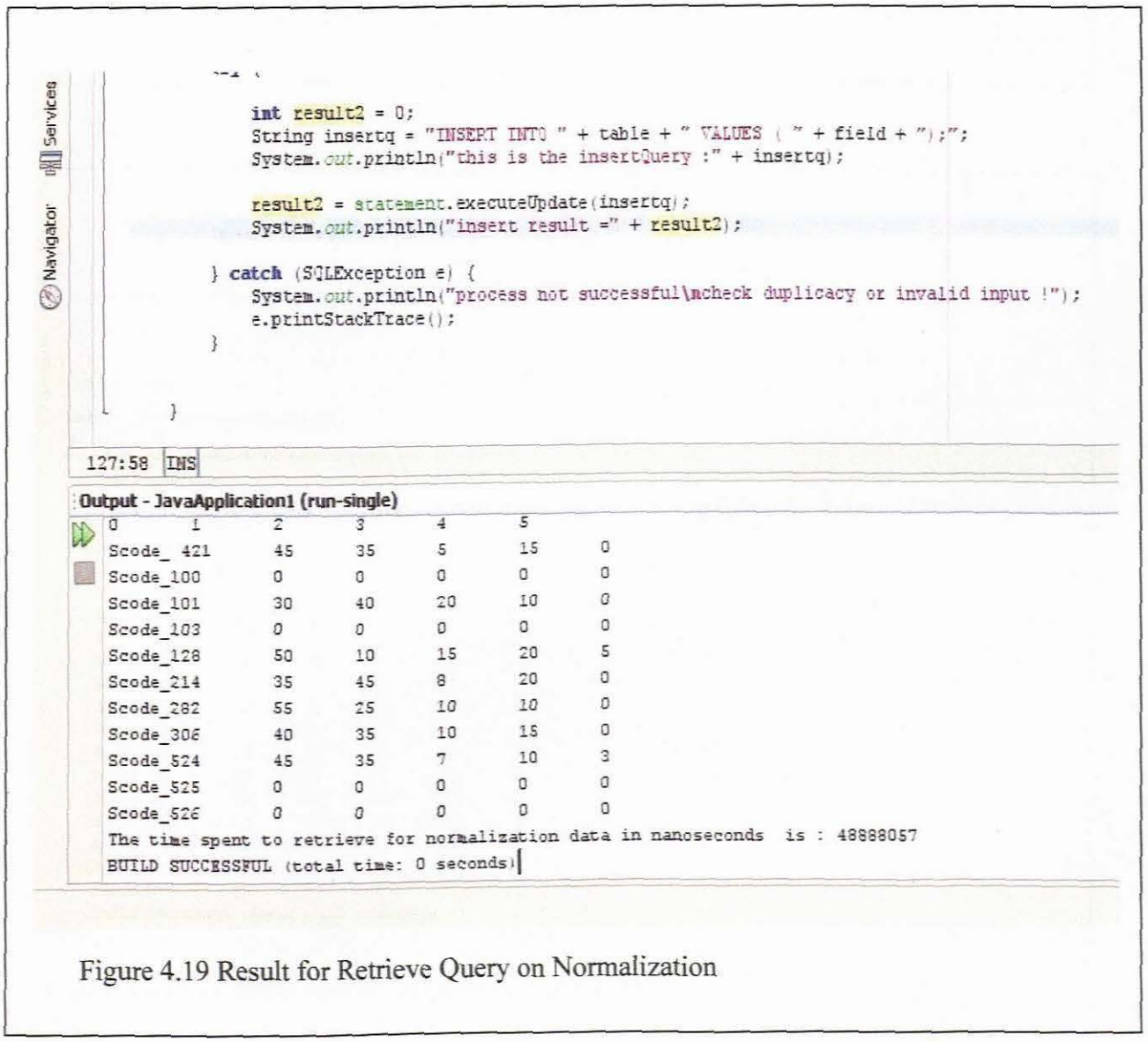

Figure 4.19 Result for Retrieve Query on Normalization

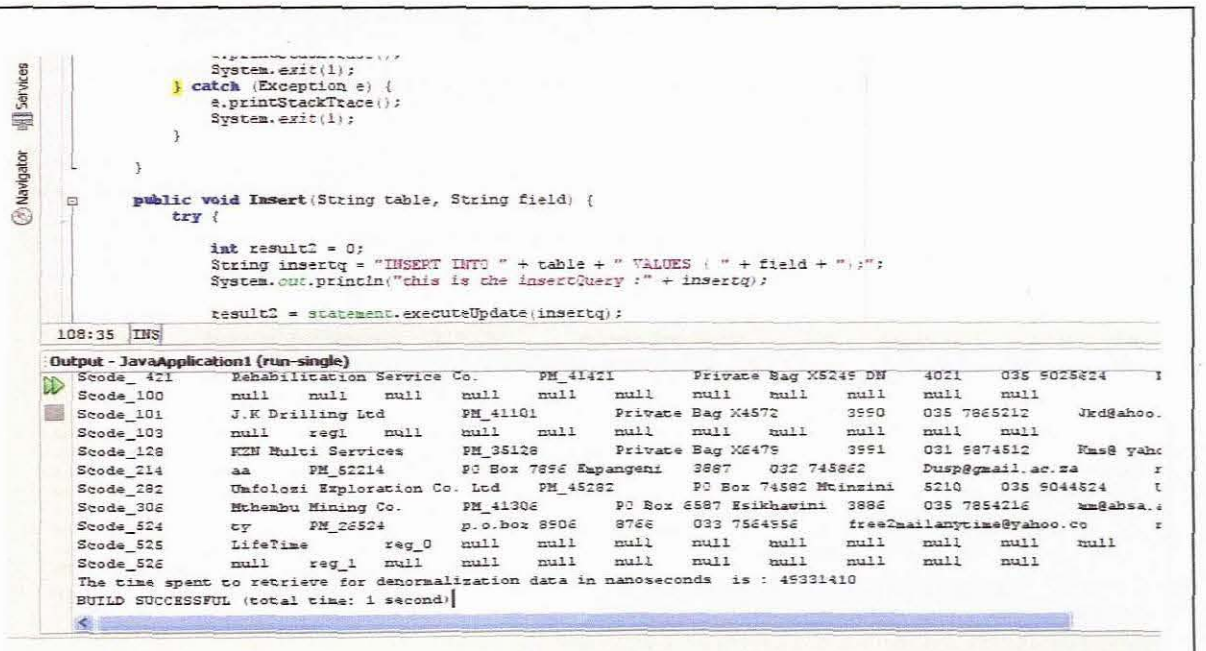

Figure 4.20 Result for Retrieve Query on Denormalization

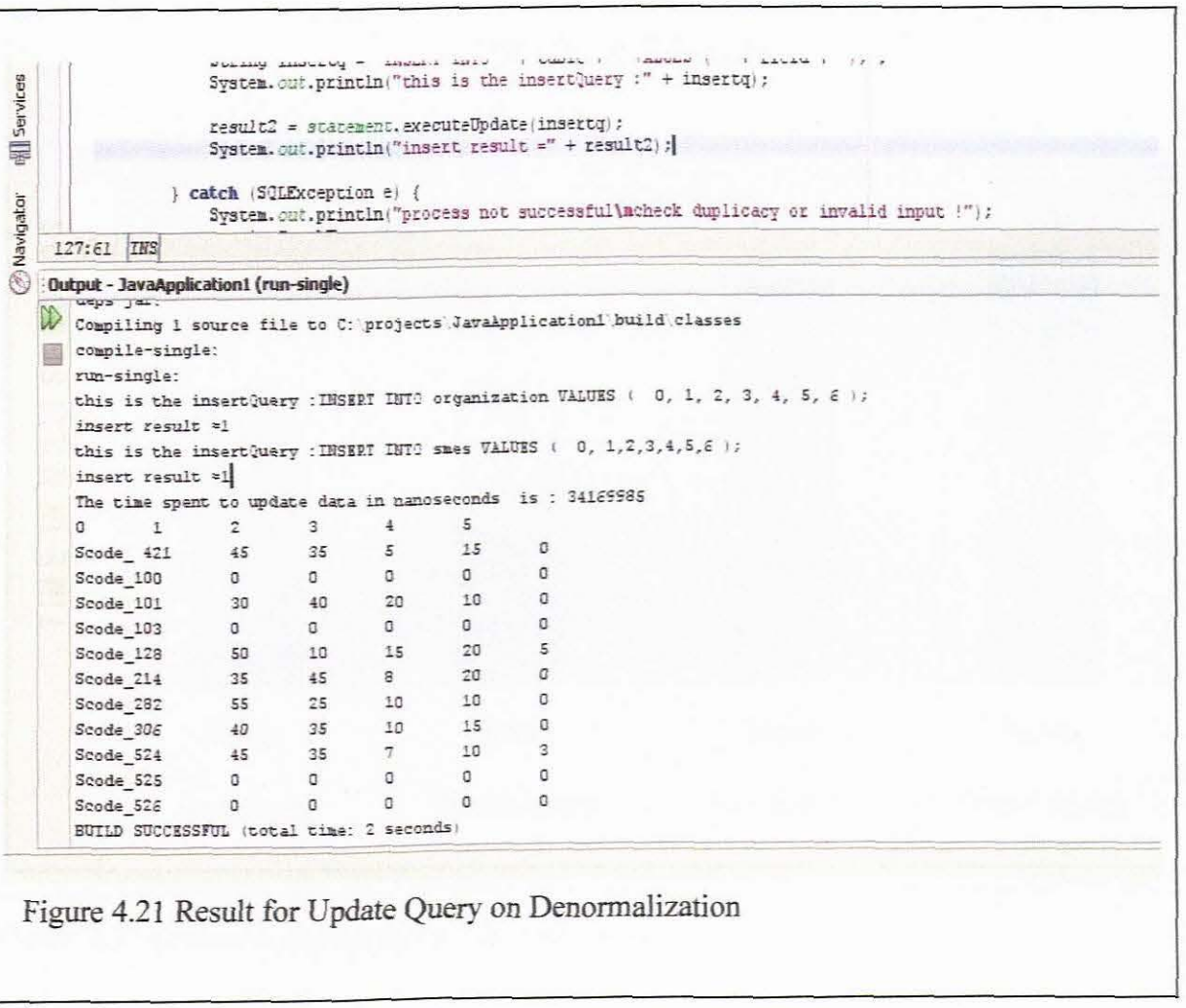

Figure 4.21 Result for Update Query on Denormalization

```
            result2 = statement.executeUpdate(insertq);
            System.out.println("insert result =" + result2);

        } catch (SQLException e) {
            System.out.println("process not successful\ncheck duplicacy or invalid input !");
            e.printStackTrace();
        }
```

125:56 INS

Output - JavaApplication1 (run-single)

```
run-single:
this is the insertQuery :INSERT INTO organization VALUES (  0,1,2,3,4,5,6,7,8,9,0,1,2 );
insert result =1
The time spent to update for denormalization data in nanoseconds  is : 34502760
0       1       2       3       4       5       6       7       8       9       0       1
EEMcode_5400    North East Coast Mining Company GM_41258        Private Bag 075652 New CASTLE   4005    034 7842125
Pbcode_4639     Richards Bay Minerals   GM_87120        Private Bag X04265      3991    035 9027865     rbmineral@gm
Scode_ 421      Rehabilitation Service Co.      PM_41421        Private Bag X5249 DN    4021    035 902S624     Rss6
Scode_100       null    null    null    null    null    null    null    null    null    null    null
Scode_101       J.K Drilling Ltd        PM_41101        Private Bag X4$72       3990    035 7865212     Jkd@ahoo.co
Scode_103       null    reg1    null    null    null    null    null    null    null    null
Scode_128       KZN Multi Services      PM_35128        Private Bag X6475       3991    031 9874512     Kms@ yahoo.c
Scode_214       aa      PM_52214        P0 Box 7896 Empangeni   3887    032 745862      Dusp@gmail.ac.za        null
Scode_282       Umfolozi Exploration Co. Ltd    PM_45282        P0 Box 74582 Mtinzini   5210    035 9044524     Umf
Scode_306       Mthembu Mining Co.      PM_41306        P0 Box 6587 Esikhawini  3886    035 7854216     mm@absa.ac.z
Scode_524       ty      PM_26524        p.o.box 8906    8766    033 7564956     free2mailanytime@yahoo.co       null
Scode_525       LifeTime        reg_0   null    null    null    null    null    null    null    null    null
Scode_526       null    reg_1   null    null    null    null    null    null    null    null
BUILD SUCCESSFUL (total time: 3 seconds)
```

Figure 4.22 Result for Update Query on Denormalization

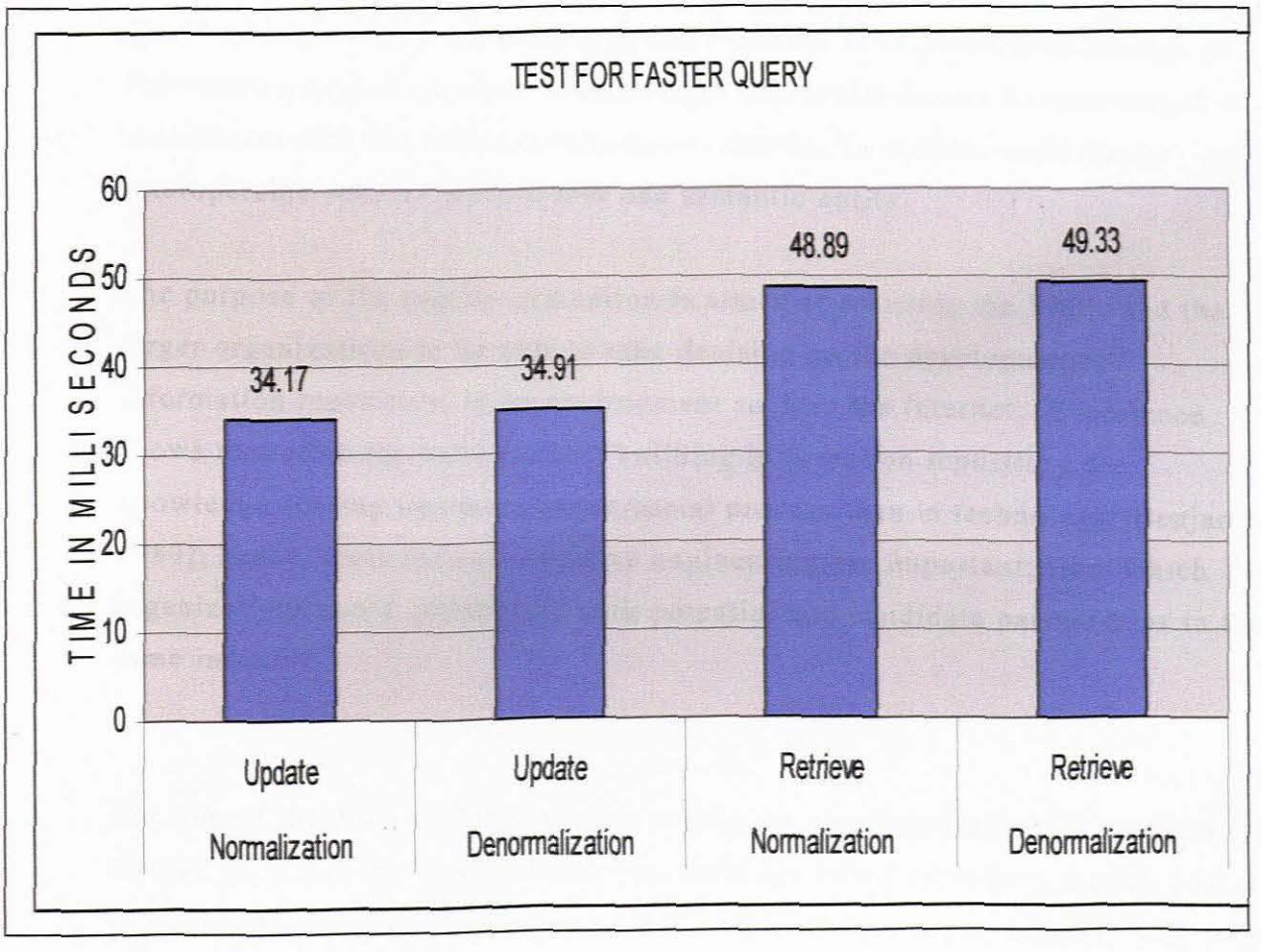

Figure 4.23 Graphical representation of result for faster Query Test

4.11 Result Analysis

The results of running the update and the retrieve query for normalization/denormalization as shown in figure 4.23 indicate that the timing for normalization is shorter in all the instances than denormalization. Despite a better relative performance compared to the update query, the denormalization was still very slower than the normalization; an indication of an efficient performance on the part of normalization.

The speed up difference can be attributed to normalization's ability to retrieve and update the relevant data faster into the buffer memory as against the denormalization, where the presence of data redundancy and anomaly can not be ruled out.

4.12 Quality Evaluation of PCIR

Quality evaluation in the context of this research is to quantify the design of Information Repository from which larger organizations can be encouraged to collaborate with the SMEs in response to queries on metadata and easily interoperable sources merged into one semantic entity.

The purpose of the quality evaluation is aimed at assisting the SMEs and the larger organizations to be able to take decision on the development of information repository, in an environment such as the Internet. Experience shows that often the bottleneck of building information repository for knowledge sharing lies more in the social process than in technology [Benjamin, 1980]; hence, tools for collaborative engineering are important; from which organizations could collaborate with potential and candidate partnerships in the same industry.

The aim of the design of information repository as acknowledged in sections 1.4 (i) and 1.5 (ii) is the formulation of an ontology based repository model, useful in knowledge sharing amongst the SMEs and the larger organizations. XML and knowledge sharing ontology technology was adopted because it has the facility to specify the structure of the document and the semantics of various applications; thus able to integrate unstructured data with the semantics to

provide a complete set of interoperable mechanism. The influence of XML as a database enabling technology is important because it provides a way to describe data sets and their contents and to define how the data should be output or displayed on a web page. The importance of XML is further supported by the fact that Microsoft SQL Server 2005 supports XML and the result sets can be returned directly in XML format or data can be retrieved from an XML document as if it were a SQL Sever table.

Another aspect that is paramount to the design of information repository is the need to explore and consider the perspective of Power and Interest of the junior and senior partners, so that implementation does not become a disappointing and a troublesome affair. The degree to which partners are interested in information repository vary from low to high [Coltman, 2001]. In the case of low interest level, the partner may be inclined to believe the information repository will lead to increasing operational costs, as well as a decrease in efficiency due to incompatible internal and external technologies. On the other hand, a high degree of interest relates to the perception that information repository contributes to the overall goal of the organizations [Chen, S. 2003].

Power is defined as the capacity to exert one's will over others in order to realize certain intended benefits. A powerful partner with a clear interest in information repository design can apply its power to force less powerful partner to start using information repository, independent of their perceived interest on it [Standifera et.,al 2003]. However, this is not the situation in this study, but what is being addressed is that the bigger corporates need to either collaborate or individually sponsor appropriate technological solutions; because they have the resources to pay for information system (see section 1.2).

Against the afore-mentioned background, metrics based on the development process and services were applied to measure the quality of the information repository system. The term metrics is defined as "measurement method and its measurement scale which is used in measurement process to assign numerical values from the measurement scale to the measured attributes" [ISO/IEC FDIS9 126-1, 1990]. Metrics are essential for the detection of problems early in an information system; thus they serve as an early warning sign for potential problems in the system.

4.12.1 Evaluation Framework

Quality is always prone to subjective interpretation unless it is quantified. In order to quantify the quality of this information repository, there is the need to define requirements that the information repository has to meet. From each of the requirements, a set of measurable attributes that are measured according to the specified procedure are identified. In other words, to evaluate the quality of the repository, the appropriate metrics have to be defined.

The framework for the evaluation of this information repository emanates from the establishment of two series of standards by the International Standards Organization (ISO) in cooperation with the International Electro-technical Commission (IEC) in the 90`s. These series are ISO 9126 which defined quality model and ISO 14598 which described quality evaluation process. ISO standard defined quality as "the totality of characteristics of the entity that bear on its ability to satisfy stated and implied needs"[ISO/IEC FDIS9 126-1, 1990]. Based on ISO standards [Olsina, L. et. Al., 1999] [Brajinik, 2001] and [Signore, O. 2005], the following characteristics / parameters were chosen to represent requirements to evaluate the quality of the information repository. These parameters were chosen from the point of view of the perception of the stake holders (SMEs, larger organizations and the Government Agency), in terms of their expectation of a good quality information repository.

(i) Functionality: Functionality was considered as one of the parameters because of the need of an editor to facilitate repository development in a professional manner. Adding, removing and modification of elements form part of the function of repository development and they are one of the important features of repository construction tool. Adding enables one to add classes, attributes, relationships and instances to the repository model. Modifying allows changes to be made to the added classes, attributes, relationships and instances from the repository model. Removing enables the deletion of the added or changed classes, attributes, relationships and instances from the repository model;

(ii) Scalability: This refers to the incremental and expandable development of PCIR, such that, it can integrate gradually over time, without losing

operational continuity and structural integrity. Scalability helps to improve the repository by adding, changing and deleting classes, attributes, relations and instances from time to time. Hence a built-in method is required for the editor to allow changes to the repository as the domain knowledge is constantly changing;

(iii) Utility: This is the measure of the extent to which the information repository meets the needs of the users. It covers (i) how easy the information repository system is to use (ii) whether it has support for the various platform and (iii) whether the information system is cost effective compared to exiting information system and

(iv) Collaboration: This criterion is seen as the key to knowledge sharing amongst business-partners. Business experts and analysts need a tool that allows them to work collaboratively to create and maintain repository even if they work in different geographic localities.

To evaluate PCIR in terms of the above parameters, a check list was created for each parameter. The check list consists of a number of questions for each criterion, which helped in allocating values to the weights of each criterion. Table 4.11 depicts the check list for the repository evaluation.

Table 4.11 Check list for Repository Evaluation

1	**Functionality**
a	Add: Degree to which the editor tool enables the addition of classes, attributes, relations and instances.
b	Modify: The level to which the tool enables the modification of the repository classes, attributes, relations and instances.
c	Delete: Degree to which the tool enables the removal of classes, attributes, relations and instances.
2	**Scalability**
a	Add new class: Did the editor allow the addition of a new class to an existing repository.
b	Modify class to sub class: Degree to which the editor allows the modification of a class to a sub class.
c	Delete existing class: Degree to which the editor allows the deletion of an existing class.
3	**Utility**
a	User's needs: The degree to which the repository meets the needs of the end-users.
b	Platform requirement: Degree to which the repository is capable on running in different platforms.
c	Interface: Degree to which the editor offers user friendly interface.
4	**Collaboration**
a	Collaborating with construction tool: Degree to which the editor is able to collaborate with XML tool.
b	Maintenance: Degree to which the editor allows for the creation and maintenance of the repository.

4.12.2 Ranking Approach

In the preceding section the sub-criteria of each criterion was defined. A straight forward approach proposed by [D.Line's Home page, 2005] was adapted to compute numerical values for evaluating the repository.

The Ranking formulae represented below were used for the calculation of each criterion.

(i) $x = \frac{\sum w_y x_y}{\sum w_y}$ and

$$\text{(ii)} \quad R = \frac{\sum w_i x_i}{\sum w_i}$$

Where:

k = number of sub-criteria in a criterion i.

x_y = ranking of jth sub-criteria of a criterion i

w_y = weighting factor of jth sub-criteria of criteria i and

$0 \leq x_i \leq 1$, and $0 \leq x_y \leq 1$

Formula (ii) represents the overall weighted average of all aspects of the criteria. Random values which ranged from 1 to 5 were assigned to the weight of each criterion and based upon the use of the above formulae in the JBuilder environment (See Appendix B-1 for the JBuilder listing), the under listed iterations were obtained.

WEIGHT	CRITERIA	RANKING
4	0.9698178533346191	0.9698178533346191
4	0.7616882122408263	1.7315060655754455
5	0.8000864779376037	2.531592543513049
1	0.7625863652511097	3.2941789087641586
4	0.7309960062633215	4.02517491502748
5	0.7022207670850381	4.727395682112518
2	0.7246837340604202	5.452079416172938
3	0.7450700623241013	6.19714947849704
5	0.6750953144138782	6.872244792910918
1	0.6696450135751634	7.541889806486081
4	0.7041576951600435	8.246047501646125
1	0.7001677035211454	8.94621520516727
5	0.6463139062950067	9.592529111462277

To create Table 4.12, the last iteration in each criterion was considered. A multiplication factor of 10 was used for the ranking to enable the plotting of graph for comparison of the parameters in percentage values.

Table 4.12 A summary of listed Iteration

	Weighted value	Criteria	Ranking ®	Multiplication factor (x 10)
Functionality	5	0.646	9.592	95.9
Scalability	3	0.745	6.189	61.9
Utility	4	0.704	8.246	82.5
Collaboration	2	0.724	5.452	54.5

4.12.3 Result Analysis and Discussion

The goal of developing Information Repository for the SMEs and the larger organizations is to create a scenario where both partners can exchange information in an environment that is faster and more reliable such as the Internet. The consolidated result from Table 4.11 is represented graphically (see Figure 4.24). A comparative analysis was performed on the four parameters of Functionality, Scalability, Utility and Collaboration to determine whether the parameters satisfy the development of a reliable information repository. On a general assessment, the four parameters scored above 50 %; an indication of a repository that can be reliable.

The result from the graph shows that functionality has the highest value of 95.9 %, followed by utility with 82.5 % and least value of 54.5 % for the collaboration parameter. With a higher value for functionality, it is evident that much problem would not be encountered with the storage, retrieval and deletion of data from the repository. Utility with a percentage of 82.5 % showed that the repository can meet the needs of the end users in the sense that it is easy to use. However, there is no record to show whether the repository is cost effective when compared to existing repository system; this is a possible area for a research to be carried out.

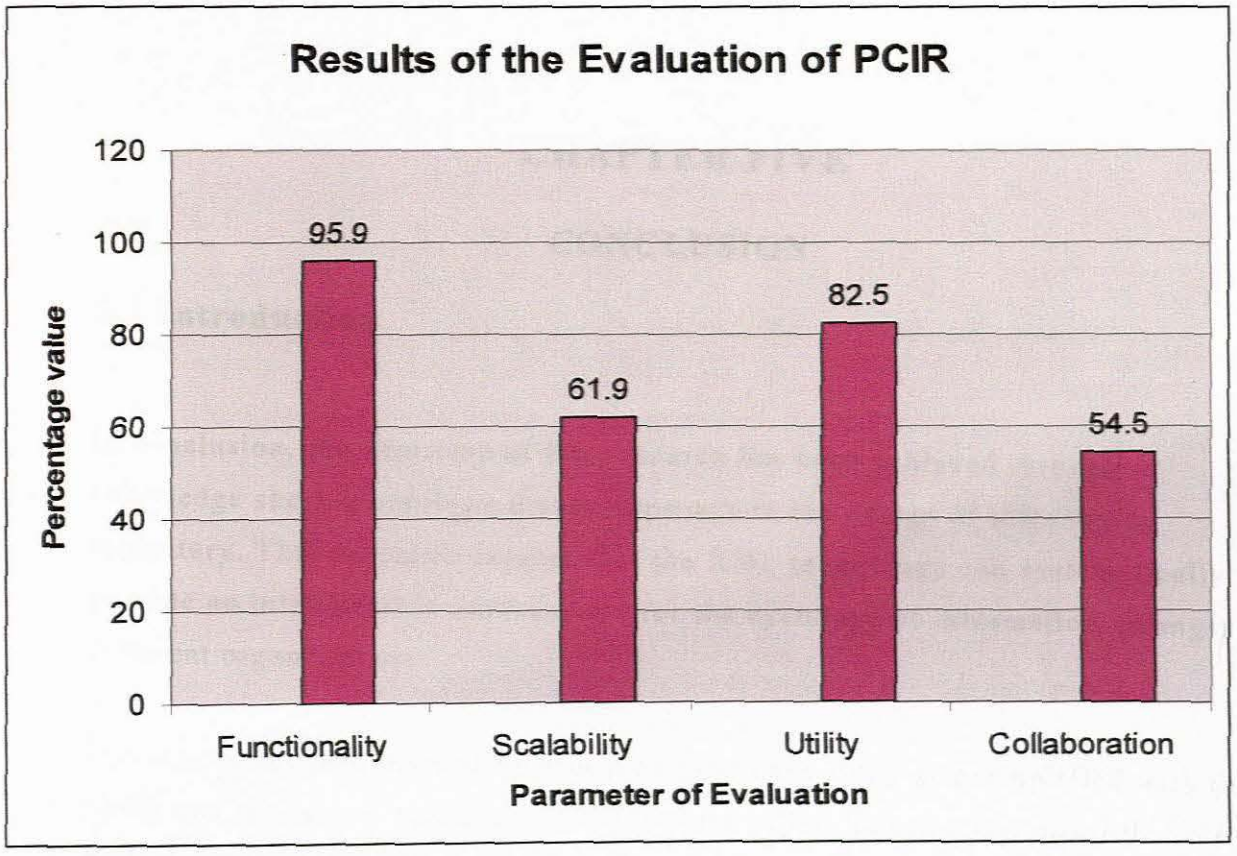

Figure 4.24: Evaluation of PCIR

Scalability with a good average of 61.9 % indicates that the repository would be able to gradually support the integration of information from various sources over time. Such integration is feasible because of the application of the XML technology in the development of the repository.

And finally, collaboration with the least value of 54.5% showed that more work has to be done for both partners to be able to share knowledge collaboratively. There is a problem for partners from different geographical locality to be able to understand one another. To some extent XML as a Mark up language is able to provide descriptive document that can be interchanged on the web without any ambiguity.

CHAPTER FIVE

5.0 CONCLUSION

5.1 Introduction

In conclusion, the objective of this research has been achieved through knowledge sharing ontology-driven approach to the design of information repository. This approach ensures that the XML technology can systematically provide an interoperable environment for the exchange of information amongst different organizations.

The successful implementation of a prototype case study as exemplified with the SMEs and the larger organization in the same allied industry is a proof that the design of Information Repository for the exchange of information among different organizations has been achieved. The testing of the prototype for services in terms of Storage, Retrieval and Updating of information was achieved; this is illustrated in sections 4.9.1 to 4.9.3.

The adoption of XML documentation provided the facility that facilitated Knowledge Sharing Ontology for the repository. XML mapping (see appendix A-3) was particularly useful for the exchange of information among the different organizations and to some extent was able to provide answer to the problem of (i) the integration of heterogeneous databases and (ii) the provision of an interoperable environment for document description that can be interchanged on the web without ambiguity.

An evaluation performance of the repository in terms of Functionality, Scalability, Utility and Collaboration was analyzed and validated. On a general assessment, the above four parameters scored above 50%; an indication of a reliable repository, (see Figure 4.24 - a graphical representation of the result).

5.2 Future Work

A critical evaluation of this dissertation for the design of Information Repository showed that there are some areas that require further research in order for the repository to meet the needs of the different organizations. The identified areas include (i) cost effectiveness of the repository and (ii) replacing / eliminating XML with Gateways between the database and the web server.

For the different business partners to embrace the XML technology in the implementation of Information Repository via Knowledge Sharing Ontology, no doubt, the stakeholders would want to know among other things, the cost of developing the repository. Unfortunately, this research could not delve into such area because the task is enormous and it requires the attention of another research altogether.

The implementation of the prototype towards industrial application, as exemplified in the application of XML requires the design and implementation of standards that will enable industry –specific repository to be built on an interoperable system environment. In the implementation of the repository, XML could not eliminate or take the place of Gateways between the database system and the web server. More research work is required in this area so that documents expressed in XML for the data output can be expressed using only XML, for the data output to be interpreted by web servers as well as the clients. In this way the need for gateways can be eliminated.

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APPENDICES

Appendix A-1: Database Prototype Table from Microsoft Access

ORGANIZATION : Table

ORG_CODE	ORG_NAME	REG_NUM	POS_ADDRES	POSTAL_CODE	TEL_NUMBER	E_MAIL
EEMcode_5400	North East Coa	GM_41258	Private Bag 075	4005	034 7842125	eem@gmail.ac.
Rbcode_4639	Richards Bay M	GM_87120	Private Bag X04	3991	035 9027865	rbmineral@gma
Scode_ 421	Rehabilitation S	PM_41421	Private Bag X52	4021	035 9025624	Rss@gmail.cor
Scode_101	J.K Drilling Ltd	PM_41101	Private Bag X45	3990	035 7865212	Jkd@ahoo.com
Scode_128	KZN Multi Servi	PM_35128	Private Bag X64	3991	031 9874512	Kms@ yahoo.c
Scode_214	Dube & Sons P	PM_52214	PO Box 7896 E	3887	032 745862	Dusp@gmail.ac
Scode_282	Umfolozi Explor	PM_45282	PO Box 74582	5210	035 9044524	Umfe@absa.ac
Scode_306	Mthembu Minin	PM_41306	PO Box 6587 E	3886	035 7854216	mm@absa.ac.z
Scode_524	Mother Cat Co.	PM_26524	Private Bag X11	4021	033 7564956	Mcat@yahoo.c

SMEs : Table

ORG_CODE	percentage_BL	percentage_WH	percentage_IND	percentage_CO	percentage_OT	REG_NUM
Scode_421	45	35	5	15	0	PM_41421
Scode_101	30	40	20	10	0	PM_41101
Scode_128	50	10	15	20	5	PM_35128
Scode_214	35	45	8	20	0	PM_52214
Scode_282	55	25	10	10	0	PM_45282
Scode_306	40	35	10	15	0	PM_41306
Scode_524	45	35	7	10	3	PM_26524
	0	0	0	0	0	

SME_SERVICE : Table

ORG_CODE	SERVICE_COD
Scode_421	DRScode_023
Scode_101	Dscode_012
Scode_128	Escode_001
Scode_214	DRScode_023
Scode_282	Escode_001
Scode_306	Dscode_012
Scode_524	Escode_001

MINING_SERVICE : Table

SERVICE_COD	SERVICE_NAME
DRScode_023	Dune Rehabilitation
Dscode_012	Drilling
Escode_001	Exploration

HREs : Table

ORG_CODE	DRILLING_ENG	EXPLORATION	LANDSCAPE_E
Scode_421	0	0	2
Scode_101	3	0	0
Scode_128	0	0	0
Scode_214	2	0	0
Scode_282	0	2	1
Scode_306	2	0	1
Scode_524	2	2	1
	0	0	0

SME_SERVICE : Table

ORG_CODE	SERVICE_COD
Scode_421	DRScode_023
Scode_101	Dscode_012
Scode_128	Escode_001
Scode_214	DRScode_023
Scode_282	Escode_001
Scode_306	Dscode_012
Scode_524	Escode_001

GOV_GRANT : Table

REG_NUM	GOV_AGENCY	AMOUNT	DATE	ORG_CODE
+ PM_26524		$20,000,000.00	2007/11/20	Scode_524
+ PM_35128		$30,000,000.00	2004/08/11	Scode_128
+ PM_45282		$5,000,000.00	2006/04/15	Scode_282
*		$0.00		

SME_PROJ : Table

ORG_CODE	PROJ_CODE
+ Scode_421	Oss_10306
+ Scode_306	Oss_10706
+ Scode_282	Oss_10906
*	

EQUIP_EXPL : Table

ORG_CODE	SEISMIC	GEOPHYSICAL	GRAVITY
+ Scode_421	No	Yes	Yes
+ Scode_101	No	Yes	No
+ Scode_128	Yes	Yes	Yes
+ Scode_214	Yes	Yes	Yes
+ Scode_282	Yes	No	No
+ Scode_306	No	Yes	Yes
+ Scode_524	Yes	No	Yes
*			

EQUIP_DUNE_REHAB : Table

ORG_CODE	TRACTORS	GRADERS	ROLLERS
+ Scode_421	No	Yes	Yes
+ Scode_101	Yes	Yes	Yes
+ Scode_128	No	Yes	No
+ Scode_214	No	Yes	Yes
+ Scode_282	Yes	No	No
+ Scode_306	Yes	Yes	Yes
+ Scode_524	Yes	No	Yes
*			

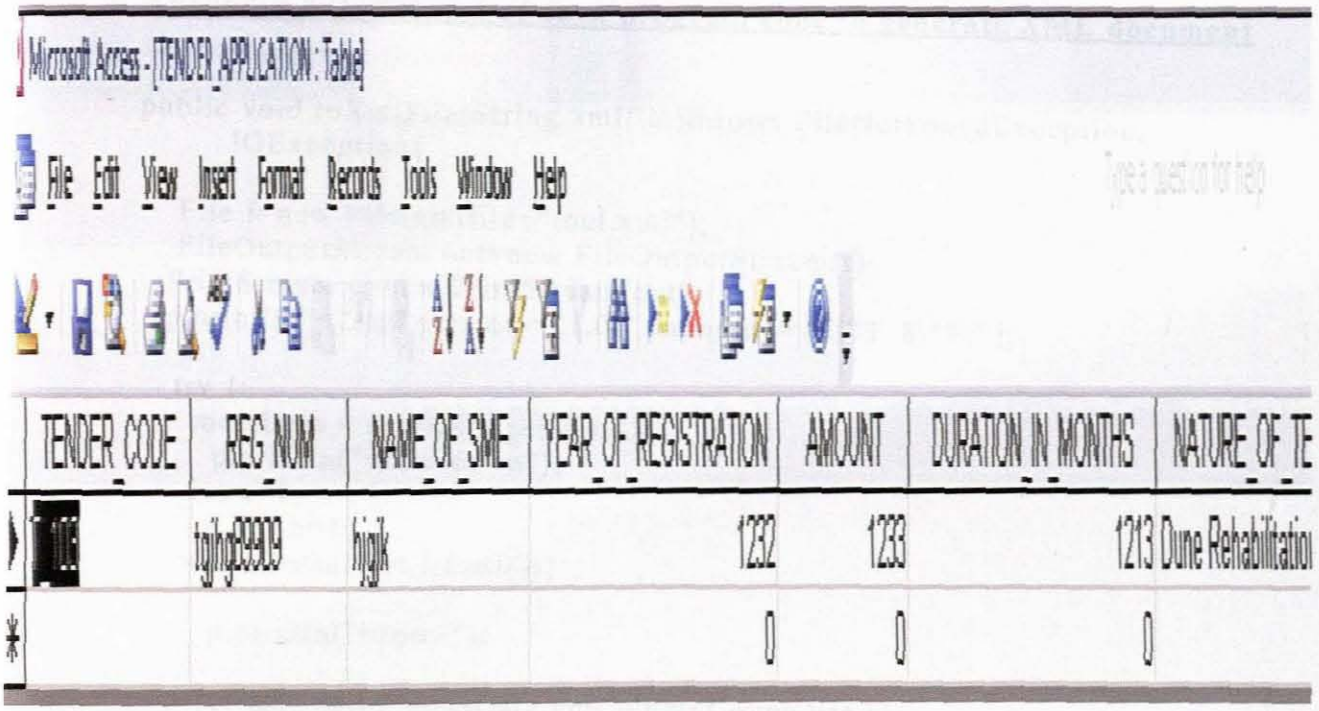
EQUIP_DRILLING : Table

ORG_CODE	PNEUMATIC_H	ANGER_DRILL	EXCAVATORS	DRILLING_RIG
+ Scode_421	Yes	Yes	Yes	Yes
+ Scode_101	Yes	Yes	No	Yes
+ Scode_128	No	No	Yes	No
+ Scode_214	Yes	Yes	No	Yes
+ Scode_282	Yes	No	Yes	No
+ Scode_306	No	Yes	Yes	Yes
+ Scode_524	Yes	No	Yes	Yes
*				

Microsoft Access - [TENDER_APPLICATION : Table]

File Edit View Insert Format Records Tools Window Help

TENDER_CODE	REG_NUM	NAME_OF_SME	YEAR_OF_REGISTRATION	AMOUNT	DURATION_IN_MONTHS	NATURE_OF_TE
101	tgjhg89909	hjgjk	1232	1233	1213	Dune Rehabilitatio
*			0	0	0	



Microsoft Access - [TENDER_APPLICATION : Table]

File Edit View Insert Format Records Tools Window Help

TENDER_CODE	REG_NUM	NAME_OF_SME	YEAR_OF_REGISTRATION	AMOUNT	DURATION_IN_MONTHS	NATURE_OF_TE
[redacted]	tgjhgg99909	hjgjk	1232	1233	1213	Dune Rehabilitation
*			0	0	0	

TENDER : Table

	ORG_CODE	NATURE_OF_TENDER	DESCRIPTION	BLK_AREA_KM_SQ	DATE_OF_TENDER_RELEASE	LAST_DATE_TO_SUBMIT_TENDER
+	Rbcode_4639	Exploration	recover pure iron from the ore	0	2/02/2007	5/03/2007
+	Rbcode_4639	Drilling	to explore for iron ore(magnetism method)	4	3/04/2007	24/05/2007
+	Rbcode_4639	Dune Rehabilitation	drilling /mining (wet method)	2.5	5/05/2007	27/05/2007
+	Rbcode_4639	Process of heaving miner	rehabilitate excavated area for agric purpos	3.5	24/05/2007	15/06/2007
+	Rbcode_4639	Mining for heaving mineral	surface mining (dry method)	8.7	20/06/2007	10/07/2007
+	EEMcode_5400	Dune rehabilitation	to rehabilitate the land for recreation purpos	10.2	22/06/2007	
*				0		

Appendix A.2: Snippet of Java program code to generate XML document

```
public void toXmlFile(String xmlfile)throws FileNotFoundException,
      IOException{

   File f=new File(xmlfile+"/out.xml");
   FileOutputStream out=new FileOutputStream(f);
  PrintStream p=new PrintStream(out);
  p.println("<?xml version=\"1.0\" encoding=\"UTF-8\"?>");

   try {
    metaData = resultSet.getMetaData();
     p.println("<rowset>\n");
    int a=1;
        int b=1;
    while(!resultSet.isLast()){

     p.println("<row>");

    for(int i=1;i<=metaData.getColumnCount();i++)
    {
       p.print("<" + metaData.getColumnName(i) + ">");
       resultSet.absolute(a);
      p.print(resultSet.getObject(b));
      p.println("</" + metaData.getColumnName(i) + ">");
             b++;
    }
    p.println("</row>");

  a++;
  b=1;

    }
        p.println("</rowset>");

p.close();

   }

catch (SQLException ex) {System.out.println("error !");ex.printStackTrace();}

}
```

Appendix A-3: Listing of XML Document

```
<?xml version="1.0" encoding="UTF-8" ?>
<rowset>
<row>
 <ORG_CODE>EEMcode_5400</ORG_CODE>
 <PROJ_CODE>Oss_10206</PROJ_CODE>
 <PROJ_NAME>Recovering of Titanium from the ore</PROJ_NAME>
 <PROJ_COST>20000000.0000</PROJ_COST>
 <PROJ_LOCATION>Mbilo</PROJ_LOCATION>
 <PROJ_DURATION_months>12</PROJ_DURATION_months>
   </row>
<row>
 <ORG_CODE>Rbcode_4639</ORG_CODE>
 <PROJ_CODE>Oss_10306</PROJ_CODE>
 <PROJ_NAME>Rehabilitation for Agriculture</PROJ_NAME>
 <PROJ_COST>13000000.0000</PROJ_COST>
 <PROJ_LOCATION>Empangeni</PROJ_LOCATION>
 <PROJ_DURATION_months>23</PROJ_DURATION_months>
   </row>
<row>
 <ORG_CODE>EEMcode_5400</ORG_CODE>
 <PROJ_CODE>Oss_10406</PROJ_CODE>
 <PROJ_NAME>Exploring for Iron ore</PROJ_NAME>
 <PROJ_COST>2000000.0000</PROJ_COST>
 <PROJ_LOCATION>Mtunzini</PROJ_LOCATION>
 <PROJ_DURATION_months>1</PROJ_DURATION_months>
   </row>
<row>
 <ORG_CODE>Rbcode_4639</ORG_CODE>
 <PROJ_CODE>Oss_10506</PROJ_CODE>
 <PROJ_NAME>Dry drilling for heavy mineral</PROJ_NAME>
 <PROJ_COST>15000000.0000</PROJ_COST>
 <PROJ_LOCATION>Mzingazi</PROJ_LOCATION>
 <PROJ_DURATION_months>7</PROJ_DURATION_months>
   </row>
<row>
 <ORG_CODE>Rbcode_4639</ORG_CODE>
 <PROJ_CODE>Oss_10606</PROJ_CODE>
 <PROJ_NAME>Rehabilitation for recreation</PROJ_NAME>
 <PROJ_COST>100000000.0000</PROJ_COST>
 <PROJ_LOCATION>Esikhaweni</PROJ_LOCATION>
 <PROJ_DURATION_months>34</PROJ_DURATION_months>
   </row>
<row>
 <ORG_CODE>EEMcode_5400</ORG_CODE>
 <PROJ_CODE>Oss_10706</PROJ_CODE>
 <PROJ_NAME>Rehabilitation for Iron Ore</PROJ_NAME>
 <PROJ_COST>64000000.0000</PROJ_COST>
 <PROJ_LOCATION>Richards Bay</PROJ_LOCATION>
 <PROJ_DURATION_months>23</PROJ_DURATION_months>
   </row>
<row>
 <ORG_CODE>Rbcode_4639</ORG_CODE>
 <PROJ_CODE>Oss_10806</PROJ_CODE>
 <PROJ_NAME>Exploring for Agriculture</PROJ_NAME>
 <PROJ_COST>1000000.0000</PROJ_COST>
```

```
<PROJ_LOCATION>Pretoria</PROJ_LOCATION>
<PROJ_DURATION_months>15</PROJ_DURATION_months>
  </row>
<row>
<ORG_CODE>EEMcode_5400</ORG_CODE>
<PROJ_CODE>Oss_10906</PROJ_CODE>
<PROJ_NAME>Dry drilling for Iron ore</PROJ_NAME>
<PROJ_COST>3000000.0000</PROJ_COST>
<PROJ_LOCATION>Johannesberg</PROJ_LOCATION>
<PROJ_DURATION_months>6</PROJ_DURATION_months>
  </row>
  </rowset>
```

Appendix A-4: Snippet t to verify the login of stakeholders.

```
public String authorization(String password)  {
    boolean found=false;
   File f=new File("C:\\Program Files\\Apache Software Foundation\\Tomcat 6.0\\webapps\\pcir\\base\\psd.txt");
    try  {
       String query;
      FileReader fr = new FileReader(f);
      BufferedReader bfr=new BufferedReader(fr);
      while(!found) {
       query=bfr.readLine();
       System.out.println(query);
       System.out.println(password);
       if(query.equals(password))
       found=true;  }  }
   catch (Exception ex) {return "invalid password !\ncheck your local administrator for
authorization(fnfexception)"+password; }
    if (!found)
 return "invalid password !\ncheck your local administrator for authorization";
 return "successful";  }
```

Appendix A-5: Snippet for SMEs to advertise for service

```
public void doPost(HttpServletRequest request, HttpServletResponse response) throws
    ServletException, IOException {
   response.setContentType(CONTENT_TYPE);
   PrintWriter out = response.getWriter();
   String drill = request.getParameter("drill");
   String expl = request.getParameter("expl");
   String land = request.getParameter("land");
   String service = request.getParameter("service");

          String seismic=request.getParameter("s_exploration_equip");
          String geophysical=request.getParameter("g_exploration_equip");
          String gravity=request.getParameter("gr_exploration_equip");
          String tractors=request.getParameter("t_dr_equip");
          String graders=request.getParameter("g_dr_equip");
          String rollers=request.getParameter("r_dr_equip");
          String ph=request.getParameter("p_drill_equip");
          String ad=request.getParameter("a_drill_equip");
          String ex=request.getParameter("e_drill_equip");
```

```
        String dr=request.getParameter("d_drill_equip");

  String q = request.getRequestURI();
        System.out.println("this is pathinfo: "+q);
        Cookie cookies2[]=request.getCookies();
      String value=cookies2[0].getValue();

        File f=new File("C:/Program Files/Apache Software Foundation/Tomcat
6.0/webapps/pcir/profile"+value+"/details.txt");
 FileReader fr=new FileReader(f);
BufferedReader bfr=new BufferedReader(fr);
 String org_code=bfr.readLine();

        if( service!="Null"){
 XmlFile n=new XmlFile();
 n.UpdateAD2("SME_SERVICE","SERVICE_CODE",service,"ORG_CODE",org_code);

        System.out.println("successfully modified service !");}
                if( seismic!=null){

 int Seismic=Integer.parseInt(seismic);
 XmlFile n=new XmlFile();
 n.UpdateAD1("EQUIP_EXPL","SEISMIC",Seismic,"ORG_CODE",org_code);
        System.out.println("successfully modified seismic !");}

        if( geophysical!=null){

 int Geo=Integer.parseInt(geophysical);
 XmlFile n=new XmlFile();
 n.UpdateAD1("EQUIP_EXPL","GEOPHYSICAL",Geo,"ORG_CODE",org_code);
        System.out.println("successfully modified geophysical !");}

        if( gravity!=null){

 int Gravity=Integer.parseInt(gravity);
 XmlFile n=new XmlFile();
 n.UpdateAD1("EQUIP_EXPL","GRAVITY",Gravity,"ORG_CODE",org_code);
        System.out.println("successfully modified gravity !");}

        if( tractors!=null){

 int Tractors=Integer.parseInt(tractors);
 XmlFile n=new XmlFile();
 n.UpdateAD1("EQUIP_EXPL","TRACTORS",Tractors,"ORG_CODE",org_code);
        System.out.println("successfully modified tractors !");}

        if( graders!=null){

 int Graders=Integer.parseInt(graders);
 XmlFile n=new XmlFile();
 n.UpdateAD1("EQUIP_EXPL","GRADERS",graders,"ORG_CODE",org_code);
        System.out.println("successfully modified graders !");}

        if( rollers!=null){

 int Rollers=Integer.parseInt(rollers);
 XmlFile n=new XmlFile();
 n.UpdateAD1("EQUIP_EXPL","ROLLERS",Rollers,"ORG_CODE",org_code);
        System.out.println("successfully modified rollers !");}

        if( ph!=null){

 int Ph=Integer.parseInt(ph);
 XmlFile n=new XmlFile();
```

```
n.UpdateAD1("EQUIP_EXPL","PNEUMATIC_HAMMER",Ph,"ORG_CODE",org_code);
        System.out.println("successfully modified pneumatic hammer !");}

        if( ad!=null){

 int Ad=Integer.parseInt(ad);
XmlFile n=new XmlFile();
n.UpdateAD1("EQUIP_EXPL","ANGER_DRILL",Ad,"ORG_CODE",org_code);
        System.out.println("successfully modified anger drill !");}

        if( ex!=null){
   int Ex=Integer.parseInt(ex);
XmlFile n=new XmlFile();
n.UpdateAD1("EQUIP_EXPL","EXCAVATORS",Ex,"ORG_CODE",org_code);
        System.out.println("successfully modified excavators !");}

        if( dr!=null){

 int Dr=Integer.parseInt(dr);
XmlFile n=new XmlFile();
n.UpdateAD1("EQUIP_EXPL","DRILLING_RIG",Dr,"ORG_CODE",org_code);
        System.out.println("successfully modified drilling rig !");}

if( drill!=""||drill!=null){
int Drill=Integer.parseInt(drill);
XmlFile n=new XmlFile();
n.UpdateAD1("HREs","DRILLING_ENGIN",Drill,"ORG_CODE",org_code);
        System.out.println("successfully modified drilling eng !");}

  if( expl!=""||expl!=null){
int Expl=Integer.parseInt(expl);
XmlFile n=new XmlFile();
n.UpdateAD1("HREs","EXPLORATION_ENGIN",Expl,"ORG_CODE",org_code);
        System.out.println("successfully modified exploration eng !");}

if( land!=""||land!=null){
int Land=Integer.parseInt(land);
XmlFile n=new XmlFile();
n.UpdateAD1("HREs","LANDSCAPE_ENGIN",Land,"ORG_CODE",org_code);
        System.out.println("successfully modified landscape !");}

        response.sendRedirect("http://localhost:8080/pcir/base/webpg/sme/smeAccount.html");}
```

Appendix A-6: Snippet for the Larger Organizations to outsource service

```
public void doPost(HttpServletRequest request, HttpServletResponse response) throws
   ServletException, IOException {
response.setContentType(CONTENT_TYPE);

if(request.getParameter("drill")!=""){
 drill = request.getParameter("drill");
        drill="((HREs.DRILLING_ENGIN)>="+drill+")";}
       else drill="((HREs.DRILLING_ENGIN)>=0)";

        if(request.getParameter("expl")!=""){
expl = request.getParameter("expl");
expl="((HREs.EXPLORATION_ENGIN)>="+expl+")";}
        else expl="((HREs.EXPLORATION_ENGIN)>=0)";

                if(request.getParameter("land")!=""){
land = request.getParameter("land");
```

```
        land="((HREs.LANDSCAPE_ENGIN)>="+land+")";}
        else land="((HREs.LANDSCAPE_ENGIN)>=0)";

  if (request.getParameter("service").equals("Null")){
        service="((MINING_SERVICE.SERVICE_CODE)='DRScode_023') Or
((MINING_SERVICE.SERVICE_CODE)='Dscode_012') Or
((MINING_SERVICE.SERVICE_CODE)='Escode_001')";}

        else {service=request.getParameter("service");
        service = "((MINING_SERVICE.SERVICE_CODE)='"+service+"')";}

   if(request.getParameter("s_exploration_equip")!=null)
        seismic="((EQUIP_EXPL.SEISMIC)=-1)" ;
        else seismic="((EQUIP_EXPL.SEISMIC)=0 Or (EQUIP_EXPL.SEISMIC)=-1)";

        if(request.getParameter("g_exploration_equip")!=null)
        geophysical="((EQUIP_EXPL.GEOPHYSICAL)=-1)" ;
        else geophysical="((EQUIP_EXPL.GEOPHYSICAL)=0 Or (EQUIP_EXPL.GEOPHYSICAL)=-1)";


        if(request.getParameter("gr_exploration_equip")!=null)
        gravity="((EQUIP_EXPL.GRAVITY)=-1)";
        else gravity="((EQUIP_EXPL.GRAVITY)=0 Or (EQUIP_EXPL.GRAVITY)=-1)";

        if(request.getParameter("t_dr_equip")!=null)
        tractors="((EQUIP_DUNE_REHAB.TRACTORS)=-1)";
        else tractors="((EQUIP_DUNE_REHAB.TRACTORS)=0 Or (EQUIP_DUNE_REHAB.TRACTORS)=-
1)";

        if(request.getParameter("g_dr_equip")!=null)
        graders="((EQUIP_DUNE_REHAB.GRADERS)=-1)" ;
        else graders="((EQUIP_DUNE_REHAB.GRADERS)=0 Or (EQUIP_DUNE_REHAB.GRADERS)=-1)";


            if(request.getParameter("r_dr_equip")!=null)
        rollers="((EQUIP_DUNE_REHAB.ROLLERS)=-1)";
        else rollers="((EQUIP_DUNE_REHAB.ROLLERS)=0 Or (EQUIP_DUNE_REHAB.ROLLERS)=-1)";


        if(request.getParameter("p_drill_equip")!=null)
        ph="((EQUIP_DRILLING.PNEUMATIC_HAMMER)=-1)";
        else ph="((EQUIP_DRILLING.PNEUMATIC_HAMMER)=0 Or
(EQUIP_DRILLING.PNEUMATIC_HAMMER)=-1)";

        if(request.getParameter("a_drill_equip")!=null)
        ad="((EQUIP_DRILLING.ANGER_DRILL)=-1)";
        else ad="((EQUIP_DRILLING.ANGER_DRILL)=0 Or (EQUIP_DRILLING.ANGER_DRILL)=-1)";


        if(request.getParameter("e_drill_equip")!=null)
        ex="((EQUIP_DRILLING.EXCAVATORS)=-1)";
        else ex="((EQUIP_DRILLING.EXCAVATORS)=0 Or (EQUIP_DRILLING.EXCAVATORS)=-1)";


        if(request.getParameter("d_drill_equip")!=null)
        dr="((EQUIP_DRILLING.DRILLING_RIG)=-1)";
        else dr="((EQUIP_DRILLING.DRILLING_RIG)=0 Or (EQUIP_DRILLING.DRILLING_RIG)=-1)";

  String q = request.getRequestURI();
        System.out.println("this is pathinfo: "+q);

        Cookie cookies2[]=request.getCookies();
      String value=cookies2[0].getValue();
```

```
        File f=new File("C:/Program Files/Apache Software Foundation/Tomcat
6.0/webapps/pcir/profile"+value+"/details.txt");
 FileReader fr=new FileReader(f);
BufferedReader bfr=new BufferedReader(fr);
 String org_code=bfr.readLine();

 XmlFile xml=new XmlFile();
 String query="SELECT ORGANIZATION.ORG_CODE, ORGANIZATION.ORG_NAME,
MINING_SERVICE.SERVICE_CODE, HREs.DRILLING_ENGIN, HREs.EXPLORATION_ENGIN,
HREs.LANDSCAPE_ENGIN, EQUIP_EXPL.SEISMIC, EQUIP_EXPL.GEOPHYSICAL,
EQUIP_EXPL.GRAVITY, EQUIP_DUNE_REHAB.TRACTORS, EQUIP_DUNE_REHAB.GRADERS,
EQUIP_DUNE_REHAB.ROLLERS, EQUIP_DRILLING.PNEUMATIC_HAMMER,
EQUIP_DRILLING.ANGER_DRILL, EQUIP_DRILLING.EXCAVATORS,
EQUIP_DRILLING.DRILLING_RIG "+
" FROM MINING_SERVICE INNER JOIN (HREs INNER JOIN ((((EQUIP_DRILLING INNER JOIN
EQUIP_DUNE_REHAB ON EQUIP_DRILLING.ORG_CODE = EQUIP_DUNE_REHAB.ORG_CODE) INNER
JOIN EQUIP_EXPL ON EQUIP_DRILLING.ORG_CODE = EQUIP_EXPL.ORG_CODE) INNER JOIN
ORGANIZATION ON EQUIP_DRILLING.ORG_CODE = ORGANIZATION.ORG_CODE) INNER JOIN
SME_SERVICE ON EQUIP_DRILLING.ORG_CODE = SME_SERVICE.ORG_CODE) ON (HREs.ORG_CODE
= EQUIP_EXPL.ORG_CODE) AND (HREs.ORG_CODE = EQUIP_DUNE_REHAB.ORG_CODE) AND
(HREs.ORG_CODE = EQUIP_DRILLING.ORG_CODE)) ON MINING_SERVICE.SERVICE_CODE =
SME_SERVICE.SERVICE_CODE "+
" WHERE  "+drill+" AND "+expl+" AND "+land+" AND "+service+" AND "+seismic+" AND "+geophysical+"
AND "+gravity+" AND "+tractors+" AND "+graders+" AND "+rollers+" AND "+ph+" AND "+ad+" AND "+ex+"
AND "+dr;
 xml.Query(query);
 xml.toXmlFile("C:/Program Files/Apache Software Foundation/Tomcat 6.0/webapps/pcir/profile"+value);
        response.sendRedirect("http://localhost:8080/pcir/base/webpg/lo/loAccount.html");
```

Appendix A-7: Snippet to request for grant from the Government Agency

```
 public void doPost(HttpServletRequest request, HttpServletResponse response) throws
    ServletException, IOException {
  response.setContentType(CONTENT_TYPE);
  PrintWriter out = response.getWriter();
  String month[]={" ","-Jan-","-Feb-","-Mar-","-Apr-","-May-","-June-","-July-","-Aug-","-Sep-","-Oct-","-Nov-
","-Dec-"};

  String amount = request.getParameter("amount");
  String proj= request.getParameter("proj");
  String date1 = request.getParameter("date1");
  String date2 = request.getParameter("date2");
  int Date2 = Integer.parseInt(date2);
  String date3 = request.getParameter("date3");
  String Date="";

        for(int i=1;i<=12;i++){
        if (Date2==i){ Date=date1+month[i]+date3;}}

  String q = request.getRequestURI();
        System.out.println("this is pathinfo: "+q);
Cookie cookies2[]=request.getCookies();
      String value=cookies2[0].getValue();
        File f=new File("C:/Program Files/Apache Software Foundation/Tomcat
6.0/webapps/pcir/profile"+value+"/details.txt");
 FileReader fr=new FileReader(f);
BufferedReader bfr=new BufferedReader(fr);
 String org_code=bfr.readLine();

        XmlFile xml=new XmlFile();
```

```
xml.Query("select PROJ_NAME FROM PROJECT WHERE PROJ_CODE= '"+proj+"'");
String name=xml.getQuery();

if(name.equals("failed"))
{
out.println("<html>");
out.println("<head>");
out.println("</head>");
out.println("<body>");
out.println("<h1>incorrect Project Code</h1>");
out.println("</body>");
out.println("</html>");
out.close();
}
xml.Query("select PROJ_COST FROM PROJECT WHERE PROJ_CODE= '"+proj+"'");
String cost=xml.getQuery();

xml.Query("select PROJ_LOCATION FROM PROJECT WHERE PROJ_CODE= '"+proj+"'");
String location=xml.getQuery();

xml.Query("select PROJ_DURATION_months FROM PROJECT WHERE PROJ_CODE= '"+proj+"'");
String duration=xml.getQuery();

xml.Query("select ORG_CODE FROM SME_PROJ WHERE PROJ_CODE= '"+proj+"'");
String check_org_code=xml.getQuery();

if(!check_org_code.equals(org_code)){
out.println("<html>");
out.println("<head>");
out.println("</head>");
out.println("<body>");
out.println("<h1>No Project Has been OutSourced to Your Organization !</h1>");
out.println("</body>");
out.println("</html>");
out.close();}

else{ System.out.println(name);
System.out.println(cost);
System.out.println(location);
System.out.println(duration);
System.out.println(check_org_code);

xml.Insert("GOV_GRANT",""+org_code+"','"+proj+"','"+name+"',"+cost+",'"+location+"',"+duration+","+amount
+",'"+Date+"'"+",0");

response.sendRedirect("http://localhost:8080/pcir/base/webpg/sme/smeAccount.html"); }
```

Appendix A-8: Snippet to store Information— Registration of new SMEs

```
public void doGet(HttpServletRequest request, HttpServletResponse response) throws
    ServletException, IOException {
  response.setContentType(CONTENT_TYPE);
  PrintWriter out = response.getWriter();
  String RegCode = request.getParameter("code");
  String q = request.getRequestURI();
        System.out.println("this is pathinfo: "+q);
   String reg = d.Register(RegCode);
   System.out.println(reg);
   if (reg.equals("successful")){
        File f=new File("C:\\Program Files\\Apache Software Foundation\\Tomcat
6.0\\webapps\\pcir\\base\\gen.txt");
```

```
        File g=new File("C:\\Program Files\\Apache Software Foundation\\Tomcat
6.0\\webapps\\pcir\\base\\psd.txt");
                FileReader fr=new FileReader(f);
                BufferedReader bfr=new BufferedReader(fr);
                FileReader fr2=new FileReader(g);
                BufferedReader bfr2=new BufferedReader(fr2);
                String gen=bfr.readLine();
                int Gen=Integer.parseInt(gen);

          String SmeCode="Scode_"+gen;
          XmlFile xml=new XmlFile();
          xml.Insert("ORGANIZATION","'"+SmeCode+"','null','"+RegCode+"','null','null','null','null'");
          xml.Insert("SMEs","'"+SmeCode+"',0,0,0,0,0,'"+RegCode+"'");
          xml.Insert("SME_SERVICE","'"+SmeCode+"','Null'");
          xml.Insert("HREs","'"+SmeCode+"',0,0,0");
          xml.Insert("EQUIP_DRILLING","'"+SmeCode+"',0,0,0,0");
          xml.Insert("EQUIP_DUNE_REHAB","'"+SmeCode+"',0,0,0");
          xml.Insert("EQUIP_EXPL","'"+SmeCode+"',0,0,0");

 FileOutputStream fo=new FileOutputStream(f);
 PrintStream p=new PrintStream(fo);
 Gen++;
 p.println(Gen);
 p.close();

 xml.Password();

 String psd=" ";
 String ret_psd="";

 while(psd!=null){
  psd=bfr2.readLine();
        if(psd.startsWith(SmeCode)){
        System.out.println(psd);
         ret_psd=psd;
         psd=null;} }
 out.println("your org code and password is "+ret_psd);
 out.close();
   }
        else {
   response.sendRedirect("http://localhost:8080/pcir/base/webpg/Sme Invalid Registration.html");
  } }
```

Appendix A-9: Snippet to Retrieve Information ——List of Registered SMEs and their profile

```
 public void doGet(HttpServletRequest request, HttpServletResponse response) throws
   ServletException, IOException {
  response.setContentType(CONTENT_TYPE);
  PrintWriter out = response.getWriter();
  String profile = request.getParameter("profile");


  String q = request.getRequestURI();
        System.out.println("profiler received: "+profile);
        XmlFile xml=new XmlFile();
        xml.Query("SELECT * from SMEs");
xml.toXmlFile("C:/Program Files/Apache Software Foundation/Tomcat 6.0/webapps/pcir/profile"+profile);
        out.println("<!DOCTYPE html PUBLIC \"-//W3C//DTD XHTML 1.0 Strict//EN\"\n" +
   " \"http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd\">");
```

```
            out.println("<html>");
            out.println("<head>");
            out.println("<script src=\"http://localhost:8080/pcir/base/webpg/hideloginbar.js\"> </script>");
            out.println("<style type=\"text/css\">");
 out.println(".menu{  position:absolute; width:100%;  height:100%; top:0%;left:0%;visibility:visible;");
 out.println("background-color:gray; font-family:Tw Cen MT Condensed Extra Bold; color:white;align:center;");
 out.println("font-weight:Regular; font-size:11px; }");
 out.println(".sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;");
 out.println("background-color:red; font-family:lucida console; color:white;align:center;");
 out.println("font-weight:bold; font-size:11px; border-width:3px;}");
  out.println(".menu2{  position:absolute; width:100%;  height:100%; top:0%;left:90%;visibility:visible;");
 out.println("background-color:gray; font-family:Tw Cen MT Condensed Extra Bold; color:white;align:center;");
 out.println("font-weight:Regular; font-size:11px; }");
 out.println(".sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;");
 out.println("background-color:gray; font-family:lucida console; color:white;align:center;");
 out.println("font-weight:bold; font-size:16px; border-width:3px;}</style>");

            out.println("</head>");
            out.println("<body>");
            out.println("<div id=\"label\" class=\"menu\" style=\"top:30.5%;left:30%;background:white;font-
family:Times New Roman;color:gray;font-size:2em;width:25%\"><u>Registered SMEs</u></div>");

            out.println("<div id=\"label\" class=\"menu\" style=\"top:30.5%;left:70%;background:white;font-
family:Times New Roman;color:gray;font-size:2em;width:25%\"><a
href=\"http://localhost:8080/pcir/base/webpg/gov/govAccount.html\"><img
src=\"http://localhost:8080/pcir/base/pics/PreviousArrow.gif\"></a></div>");

            out.println("<script src=\"http://localhost:8080/pcir/base/webpg/header.js\"></script>  ");
     out.println("<script src=\"http://localhost:8080/pcir/base/webpg/gov/sidebar.js\"></script>  ");
            out.println("<script src=\"http://localhost:8080/pcir/profile"+profile+"/table.js\">");
            out.println("</script>");
            out.println("</body>");
            out.println("</html>");
           }
```

Appendix A- 10: Snippet to Update Information —Modification of SMEs' Profile

```
 public void doPost(HttpServletRequest request, HttpServletResponse response) throws
    ServletException, IOException {
  response.setContentType(CONTENT_TYPE);
  PrintWriter out = response.getWriter();
  String name = request.getParameter("name");
  String post = request.getParameter("post");
  String tel = request.getParameter("tel");
  String email = request.getParameter("email");
          String p_c=request.getParameter("post_code");
  String q = request.getRequestURI();
          System.out.println("this is pathinfo: "+q);
          Cookie cookies2[]=request.getCookies();
       String value=cookies2[0].getValue();

          File f=new File("C:/Program Files/Apache Software Foundation/Tomcat
6.0/webapps/pcir/profile"+value+"/details.txt");
 FileReader fr=new FileReader(f);
BufferedReader bfr=new BufferedReader(fr);
 String org_code=bfr.readLine();

 if( name!=""){
 XmlFile n=new XmlFile();
 n.Update("Organization","ORG_NAME",name,"ORG_CODE",org_code);
          System.out.println("successfully modified name !");}
```

```
 if( p_c!=""){
 XmlFile n=new XmlFile();
 n.Update("Organization","POSTAL_CODE",p_c,"ORG_CODE",org_code);
        System.out.println("successfully modified post_code !");}

if( post!=""){
 XmlFile n=new XmlFile();
 n.Update("Organization","POS_ADDRESS",post,"ORG_CODE",org_code);
        System.out.println("successfully modified post !");}

if( tel!=""){
 XmlFile n=new XmlFile();
 n.Update("Organization","TEL_NUMBER",tel,"ORG_CODE",org_code);
        System.out.println("successfully modified tel !");}

 if( email!=""){
 XmlFile n=new XmlFile();
 n.Update("Organization","E_MAIL",email,"ORG_CODE",org_code);
        System.out.println("successfully modified email !");} }
```

Appendix B-1: Snippet to display Home Interface Text in XHML Format

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>

<style type="text/css">
.menu{  position:absolute; width:100%;  height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}
</style>

<title>
Home Page
</title>
</head>


<body bgcolor="white">
<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

<p class="menu" style="left:18%;top:31%;font-family:Times New Roman;font-
size:30px;background:white;color:#bbc">
WELCOME to...<br>
Partnership Centered Information Repository</p>
        <p class="menu" style="left:23%;top:45%;font-family:Times New Roman;font-
size:20px;background:white;color:#bbb">
        This is a non-profit
Partnership Centred Information Repository system. The PCIR is designed <br>(i) to promote
the use of e-business
through the Internet amongst business partners and<br> (ii) to assist the South African
Government to promote the Black
 Economic Empowerment pogramme.<br>

The Small Medium Enterprises (SMEs) are involved because they are considered to be the<br>
most viable sector
 with economic potential growth. The larger organizations need to either collaborate<br> or
individually
 sponsor appropriate technological solutions, because they have the financial <br> resources to
pay for
 the information system.</p>
```

```
 <div id ="t11"
class="menu"style="top:42%;background:#ddd;left:30%;width:60%;visibility:hidden">
<p id="t12" class="menu"style="left:30%;font-family:Tw Cen MT Condensed Extra
Bold;width:40%;visibility:hidden">
Large Organization calling for
tender</p><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><b
r><br><br><br><br><br><br><br><br><br></div>



<form name="tenderform" method="post" action="/pcir/base/tenderform">

<p id="t1"class="menu"style="top:95%;left:31%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Amount: <input name="amount"type="text"
size="14" ></p>
<p id="t2"class="menu"style="top:75%;left:31%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Tender Code: <input name="proj" type="text"
size="17" ></p>

<p id="t14"class="menu"style="top:85%;left:31%;width:20%;font-family:Times New
Roman;visibility:hidden" >Nature of Tender:<br>
        <select name="service" >
            <option value selected="Null">Null
            <option value="Dune Rehabilitation">Dune Rehabilitation>>
            <option value="Drilling">Drilling>>
            <option value="Exploration">Exploration>>
            <option value="Exploration">Processing>>
            </select>
            </p>


<p id="t4"class="menu"style="top:105%;left:31%;width:25%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Duration of tender project in months: <input
name="duration"type="text" size="4" maxlength="6">months</p>

<p id="t3"class="menu"style="top:45%;left:61%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Contact Address: <input name="address"type="text"
size="20" maxlength="100"></p>
<p id="t13"class="menu"style="top:65%;left:61%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Phone Number: <input name="tel"type="text"
size="20" maxlength="20"></p>
<p id="t15"class="menu"style="top:55%;left:61%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Area Code: <input name="areacode"type="text"
size="7" maxlength="7"></p>
<p id="t16"class="menu"style="top:75%;left:61%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Email Address: <input name="email"type="text"
size="20" maxlength="20"></p>
<p id="t17"class="menu"style="top:85%;left:61%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Person to Contact: <input name="person"type="text"
size="20" maxlength="20"></p>
<p id="t18"class="menu"style="top:45%;left:31%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Name of SME: <input name="name"type="text"
size="20" maxlength="20"></p>
```

```
<p id="t19"class="menu"style="top:55%;left:31%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Registration Number: <input name="reg"type="text"
size="10" maxlength="10"></p>
<p id="t20"class="menu"style="top:65%;left:31%;width:20%;font-family:Tw Cen MT
Condensed Extra Bold;visibility:hidden" >Year of Registration: <input name="year"type="text"
size="4" maxlength="4"></p>


<div id ="t5" class="menu"style="top:120%;font-
family:Veranda;background:#ddd;color:gray;font-
size:1em;left:45%;width:2%;visibility:hidden">
<p id="t6" class="menu"style="font-family:Tw Cen MT Condensed Extra
Bold;visibility:hidden"><a href="javascript:tenderH()"style="color:white">exit</a></p></div>

<div id ="t7" class="menu"style="top:120%;font-
family:Veranda;background:#ddd;color:gray;font-
size:1em;left:55%;width:2%;visibility:hidden">
<p id="t8" class="menu"style="font-family:Tw Cen MT Condensed Extra
Bold;visibility:hidden"><a href="javascript:check_tender()"style="color:white">
Submit</a></p></div>

<div id ="t9" class="menu"style="top:120%;font-
family:Veranda;background:#ddd;color:gray;font-
size:1em;left:65%;width:2%;visibility:hidden">
<p id="t10" class="menu"style="font-family:Tw Cen MT Condensed Extra
Bold;visibility:hidden"><a href="javascript:clean_tender()"style="color:white" >
Reset</a></p></div>

</form>

</body>
</html>
```

Appendix B-2 Snippet to display log-in Interface for the stakeholders in XHML Format.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>



<style type="text/css">

.menu{ position:absolute; width:100%;  height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
```

```
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.sub2{ position:absolute; width:50%;  height:60%; top:57%;left:40%;visibility:visible;
background-color:#eee;font-family:Times New Roman; color:gray;align:center;
font-weight:Regular; font-size:15px; }



</style>


<title>
Large Organization Login</title>
</head>


<body bgcolor="white">


<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

  <div id="tomcat" class="menu"style='top:35.5%;left:38%;background:white;color:gray; font-
family:Times New Roman' onmouseover="subMenuH()"><h1>Large Organization
(LO)</h1><h3>Please Enter Your Organization Code and Password</h3></div>

<p class="menu" style="font-
size:16px;;top:27.3%;left:40%;background:gray;color:red;width:3%"><a
href="http://localhost:8080/pcir/base/webpg/sme/smeLogin.html"style="color:white"
>SME</a></p>
<p class="menu" style="font-
size:16px;;top:27.3%;left:50%;background:gray;color:red;width:14%"><a
href="http://localhost:8080/pcir/base/webpg/lo/loLogin.html"style="color:white" >LARGE
ORGANIZATION</a></p>
<p class="menu" style="font-
size:16px;;top:27.3%;left:70%;background:gray;color:red;width:9%"><a
href="http://localhost:8080/pcir/base/webpg/gov/govLogin.html"style="color:white"
>GOVERNMENT</a></p>


<div class="sub2"style='width:20%;top:57%;left:39.8%;'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:39.8%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:57%;left:60%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:60%'><br><br><br><br></div>


  <form name="f" action="/pcir/base/loLogin" method="get">
```

```
<div class="sub2"style='width:18%'><p style="font-weight:bold">User Name:</p>
<p style="font-size:10px;">(Organization Code+User Name)</p></div>
<div class="sub2"style='left:65%;width:10%;top:61%'><p><input type="text" name="code"
size= "5" maxlength="12"/></p></div>

<div class="sub2"style='width:18%;top:70%'><p style="font-weight:bold">Password:</p>
<p style="font-size:10px">(Obtained during Registration)</p></div>

<div class="sub2"style='left:65%;width:10%;top:73%'><p><input type="password"
name="password" size= "10" maxlength="10"/></p></div>



<div class="sub2"style='width:5%;top:90%;left:55%'><a
href="javascript:document.f.submit()"onClick="check(this.form)"><img src="C:\\Program
Files\\Apache Software Foundation\\Tomcat 6.0\\webapps\\pcir\\base\\pics\\search.gif"></a>
</div>

  </form>

</body></html>
```

Appendix B-3 Snippet to display log-in Interface of SMEs registration in XHML Format.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>


<style type="text/css">

.menu{  position:absolute; width:100%;  height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.sub2{ position:absolute; width:50%;  height:60%; top:66%;left:40%;visibility:visible;
background-color:#eee;font-family:Times New Roman; color:gray;align:center;
font-weight:Regular; font-size:15px; }
```

```
</style>

<title>
Sme Registration
</title>
</head>


<body bgcolor="white">


<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

  <div id="tomcat" class="menu"style='top:35.5%;left:38%;background:white;color:gray; font-
family:Times New Roman' onmouseover="subMenuH()"><h1>Small Medium Enterprise
(SME)</h1><h3>Please Enter Your Registration Number to Register</h3>
  <h4>For information on obtaining a Registration Number <a
href="http://localhost:8080/pcir/base/webpg/Registration.html" style="color:blue">click
here</a></h4></div>



<div class="sub2"style='width:20%;top:64%;left:39.8%;'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:64%;left:60%'><br><br><br><br></div>


  <form name="fr" action="/pcir/base/Register" method="get">

<div class="sub2"style='width:18%'><p style="font-weight:bold">Registration Number:</p>
<p style="font-size:10px;">(Obtained during public Registration)</p></div>
<div class="sub2"style='left:65%;width:10%;top:68%'><p><input type="text" name="code"
size= "5" maxlength="12"/></p></div>


<div class="sub2"style='width:5%;top:90%;left:55%'><a
href="javascript:document.fr.submit()"onClick="check_fr(this.form)"><img src="C:\\Program
Files\\Apache Software Foundation\\Tomcat 6.0\\webapps\\pcir\\base\\pics\\search.gif"></a>
</div>

  </form>

</body>
</html>
```

Appendix B-4 Snippet to display log-in of Government Agency Interface in XHML Format.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>

<style type="text/css">

.menu{  position:absolute; width:100%;  height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.sub2{ position:absolute; width:50%;  height:60%; top:57%;left:40%;visibility:visible;
background-color:#eee;font-family:Times New Roman; color:gray;align:center;
font-weight:Regular; font-size:15px; }



</style>


<title>
Government Login
</title>
</head>


<body bgcolor="white">


<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

  <div id="tomcat" class="menu"style='top:35.5%;left:38%;background:white;color:gray; font-
family:Times New Roman' onmouseover="subMenuH()"><h1>Government
(GOV)</h1><h3>Please Enter Your Organization Code and Password</h3></div>

<p class="menu" style="font-
size:16px;;top:27.3%;left:40%;background:gray;color:red;width:3%"><a
href="http://localhost:8080/pcir/base/webpg/sme/smeLogin.html"style="color:white"
>SME</a></p>
```

```
<p class="menu" style="font-
size:16px;;top:27.3%;left:50%;background:gray;color:red;width:14%"><a
href="http://localhost:8080/pcir/base/webpg/lo/loLogin.html"style="color:white" >LARGE
ORGANIZATION</a></p>
<p class="menu" style="font-
size:16px;;top:27.3%;left:70%;background:gray;color:red;width:9%"><a
href="http://localhost:8080/pcir/base/webpg/gov/govLogin.html"style="color:white"
>GOVERNMENT</a></p>


<div class="sub2"style='width:20%;top:57%;left:39.8%;'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:39.8%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:57%;left:60%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:60%'><br><br><br><br></div>


  <form name="f" action="/pcir/base/govLogin" method="get">

<div class="sub2"style='width:18%'><p style="font-weight:bold">User Name:</p>
<p style="font-size:10px;">(Organization Code+User Name)</p></div>
<div class="sub2"style='left:65%;width:10%;top:61%'><p><input type="text" name="code"
size= "5" maxlength="12"/></p></div>

<div class="sub2"style='width:18%;top:70%'><p style="font-weight:bold">Password:</p>
<p style="font-size:10px">(Obtained during Registration)</p></div>

<div class="sub2"style='left:65%;width:10%;top:73%'><p><input type="password"
name="password" size= "10" maxlength="10"/></p></div>



<div class="sub2"style='width:5%;top:90%;left:55%'><a
href="javascript:document.f.submit()"onClick="check(this.form)"><img src="C:\\Program
Files\\Apache Software Foundation\\Tomcat 6.0\\webapps\\pcir\\base\\pics\\search.gif"></a>
</div>

  </form>

</body>
</html>
```

Appendix B-5 Snippet to display log-in of larger organization Interface in XHML Format.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>


<style type="text/css">

.menu{ position:absolute; width:100%; height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%; height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.menu2{ position:absolute; width:110%; height:100%; top:0%;left:50%;visibility:visible;
background-color:gray; font-family:Arial Narrow; color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

</style>

<title>
Large Organization Account
</title>
</head>

<body bgcolor="white">
<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

<div id="tomcat" class="menu"style='top:26%;left:30%;background:white;color:gray'
><h4>PCIR >>My Account >>Large Organization(LO)....</h4></div>
        <div id ="msg"class="menu"style='top:30.5%;left:30%;background:white;font-
family:veranda;color:gray;font-size:3em;width:50%'>
        WELCOME </div>

        <div id ="msg"class="menu"style='top:30.5%;left:80%;background:white;font-
family:veranda;color:gray;font-size:3em;width:50%'>
        <img src="C:\\Program Files\\Apache Software Foundation\\Tomcat
6.0\\webapps\\pcir\\base\\pics\\rbm.gif" width="20%"></div>

        <div id ="msg"class="menu"style='top:40.5%;left:38%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>
```

```
  TO </div>

        <div id ="msg"class="menu"style='top:45.5%;left:33%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  LARGE ORGANIZATION
  </div>
        <div id ="msg"class="menu"style='top:50.5%;left:38%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  PROFILE.</div>
        <div id ="msg" class="menu"style='top:58%;font-family:Times New
Roman;background:white;color:gray;font-size:1.5em;left:33%'>
        Large Organization search for smes to outsource service</div>

 <script src="http://localhost:8080/pcir/base/webpg/lo/sidebar.js">
</script>
</body>
</html>
```

Appendix B-6 Snippet to displace log-in of SMEs Interface in XHML Format.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>


<style type="text/css">

.menu{  position:absolute; width:100%;  height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.sub2{ position:absolute; width:50%;  height:60%; top:57%;left:40%;visibility:visible;
background-color:#eee;font-family:Times New Roman; color:gray;align:center;
font-weight:Regular; font-size:15px; }



</style>
```

```
<title>
Sme Login
</title>
</head>


<body bgcolor="white">


<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

  <div id="tomcat" class="menu"style='top:35.5%;left:38%;background:white;color:gray; font-
family:Times New Roman' onmouseover="subMenuH()"><h1>Small Medium Enterprise
(SME)</h1><h3>Please Enter Your Organization Code and Password</h3></div>

<p class="menu" style="font-
size:16px;;top:27.3%;left:40%;background:gray;color:red;width:3%"><a
href="http://localhost:8080/pcir/base/webpg/sme/smeLogin.html"style="color:white"
>SME</a></p>
<p class="menu" style="font-
size:16px;;top:27.3%;left:50%;background:gray;color:red;width:14%"><a
href="http://localhost:8080/pcir/base/webpg/lo/loLogin.html"style="color:white" >LARGE
ORGANIZATION</a></p>
<p class="menu" style="font-
size:16px;;top:27.3%;left:70%;background:gray;color:red;width:9%"><a
href="http://localhost:8080/pcir/base/webpg/gov/govLogin.html"style="color:white"
>GOVERNMENT</a></p>


<div class="sub2"style='width:20%;top:57%;left:39.8%;'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:39.8%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:57%;left:60%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:60%'><br><br><br><br></div>


  <form name="f" action="/pcir/base/smeLogin" method="get">

<div class="sub2"style='width:18%'><p style="font-weight:bold">User Name:</p>
<p style="font-size:10px;">(Organization Code+User Name)</p></div>
<div class="sub2"style='left:65%;width:10%;top:61%'><p><input type="text" name="code"
size= "5" maxlength="12"/></p></div>

<div class="sub2"style='width:18%;top:70%'><p style="font-weight:bold">Password:</p>
<p style="font-size:10px">(Obtained during Registration)</p></div>

<div class="sub2"style='left:65%;width:10%;top:73%'><p><input type="password"
name="password" size= "10" maxlength="10"/></p></div>
```

```
<div class="sub2"style='width:5%;top:90%;left:55%'><a
href="javascript:document.f.submit()"onClick="check(this.form)"><img src="C:\\Program
Files\\Apache Software Foundation\\Tomcat 6.0\\webapps\\pcir\\base\\pics\\search.gif"></a>
</div>

  </form>

</body>
</html>
```

Appendix B-6 Snippet to display log-in of Tender application Interface in XHML Format

```
import java.sql.*;
import javax.servlet.*;


import javax.servlet.*;
import javax.servlet.http.*;
import java.io.*;
import java.util.*;

public class TenderApplication
   extends HttpServlet {
 public TenderApplication() { }

 private static final String CONTENT_TYPE = "text/html";
 private static final String DOC_TYPE =
    "<!DOCTYPE html PUBLIC \"-//W3C//DTD XHTML 1.0 Strict//EN\"\n" +
    " \"http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd\">";
//private static DataBase d=new DataBase();
 //Initialize global variab
 public void init() throws ServletException {

 }

 public void doGet(HttpServletRequest request, HttpServletResponse response) throws
    ServletException, IOException {
  response.setContentType(CONTENT_TYPE);
  PrintWriter out = response.getWriter();
        XmlFile xml=new XmlFile();
          xml.Query("SELECT * from tender_application");
xml.toXmlFile("C:/Program Files/Apache Software Foundation/Tomcat 6.0/webapps/pcir");
        out.println("<!DOCTYPE html PUBLIC \"-//W3C//DTD XHTML 1.0
Transitional//EN\""+
  "\"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd\">");
out.println("<html xmlns=\"http://www.w3.org/1999/xhtml\" xml:lang=\"en\" lang=\"en\">");

out.println("<head >");
out.println("<script src=\"http://localhost:8080/pcir/base/webpg/hideloginbar.js\">");
out.println("</script>");

out.println("<style type=\"text/css\">");
```

```
out.println(".menu{  position:absolute; width:100%;  height:100%;
top:0%;left:0%;visibility:visible;");
out.println("background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;");
out.println("font-weight:Regular; font-size:11px; border-width:3px;}");

out.println(".sub{ position:absolute; width:5.5%;  height:60%;
top:50%;left:56%;visibility:hidden;");
out.println("background-color:gray; font-family:lucida console; color:white;align:center;");
out.println("font-weight:bold; font-size:11px; border-width:3px;}");
out.println(".menu2{  position:absolute; width:110%;  height:100%;
top:0%;left:50%;visibility:visible;"+
"background-color:gray; font-family:Arial Narrow; color:white;align:center;");
out.println("font-weight:Regular; font-size:11px; border-width:3px;}");
out.println("</style>");

out.println("<title>");
out.println(" Tender Application List");
out.println("</title>");
out.println("</head>");


out.println("<body bgcolor=\"white\">");
out.println("<script src=\"http://localhost:8080/pcir/base/webpg/header.js\">");
out.println("</script>");
out.println("<div id=\"label\" class=\"menu\"
style=\"top:30.5%;left:30%;background:white;font-family:Times New Roman;color:gray;font-
size:2em;width:25%\"><u>Tender Application List</u></div>");
out.println("<script src=\"http://localhost:8080/pcir/base/webpg/header.js\"></script>  ");
out.println("<script src=\"http://localhost:8080/pcir/table.js\">");
out.println("</script>");
out.println("</body>");
out.println("</html>");

        }

 //Process the HTTP Get request

 }
```

Appendix B-7 Snippet to displace log-in of Tender Form design Interface in XHML Format

```
import java.sql.*;
import javax.servlet.*;


import javax.servlet.*;
import javax.servlet.http.*;
import java.io.*;
import java.util.*;

public class Tender
   extends HttpServlet {
 public Tender() { }

 private static final String CONTENT_TYPE = "text/html";
 private static final String DOC_TYPE =
    "<!DOCTYPE html PUBLIC \"-//W3C//DTD XHTML 1.0 Strict//EN\"\n" +
    " \"http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd\">";
//private static DataBase d=new DataBase();
 //Initialize global variab
 public void init() throws ServletException {

 }

 public void doGet(HttpServletRequest request, HttpServletResponse response) throws
    ServletException, IOException {
  response.setContentType(CONTENT_TYPE);
  PrintWriter out = response.getWriter();
       XmlFile xml=new XmlFile();
         xml.Query("SELECT * from tender");
xml.toXmlFile("C:/Program Files/Apache Software Foundation/Tomcat 6.0/webapps/pcir");
       out.println("<!DOCTYPE html PUBLIC \"-//W3C//DTD XHTML 1.0
Transitional//EN\""+
  "\"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd\">");
out.println("<html xmlns=\"http://www.w3.org/1999/xhtml\" xml:lang=\"en\" lang=\"en\">");

out.println("<head >");
out.println("<script src=\"http://localhost:8080/pcir/base/webpg/hideloginbar.js\">");
out.println("</script>");

out.println("<style type=\"text/css\">");
out.println(".menu{ position:absolute; width:100%; height:100%;
top:0%;left:0%;visibility:visible;");
out.println("background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;");
out.println("font-weight:Regular; font-size:11px; border-width:3px;}");

out.println(".sub{ position:absolute; width:5.5%; height:60%;
top:50%;left:56%;visibility:hidden;");
out.println("background-color:gray; font-family:lucida console; color:white;align:center;");
out.println("font-weight:bold; font-size:11px; border-width:3px;}");
```

```
out.println(".menu2{ position:absolute; width:110%; height:100%;
top:0%;left:50%;visibility:visible;"+
"background-color:gray; font-family:Arial Narrow; color:white;align:center;");
out.println("font-weight:Regular; font-size:11px; border-width:3px;}");
out.println("</style>");

out.println("<title>");
out.println(" Tender List");
out.println("</title>");
out.println("</head>");


out.println("<body bgcolor=\"white\">");
out.println("<script src=\"http://localhost:8080/pcir/base/webpg/header.js\">");
out.println("</script>");
out.println("<div id=\"label\" class=\"menu\"
style=\"top:30.5%;left:30%;background:white;font-family:Times New Roman;color:gray;font-
size:2em;width:25%\"><u>Tender List</u></div>");
out.println("<script src=\"http://localhost:8080/pcir/base/webpg/header.js\"></script> ");
out.println("<script src=\"http://localhost:8080/pcir/table.js\">");
out.println("</script>");
out.println("</body>");
out.println("</html>");

        }
  //Process the HTTP Get request
  public void doPost(HttpServletRequest request, HttpServletResponse response) throws
     ServletException, IOException {
    response.setContentType(CONTENT_TYPE);
    PrintWriter out = response.getWriter();

    String name = request.getParameter("name");
    String address = request.getParameter("address");
    String tel = request.getParameter("tel");
    String email = request.getParameter("email");
          String areacode=request.getParameter("areacode");
          String amount=request.getParameter("amount");
          String service=request.getParameter("service");
          String reg=request.getParameter("reg");
          String year=request.getParameter("year");
          String person=request.getParameter("person");
          String duration=request.getParameter("duration");
          String tendercode=request.getParameter("proj");
          String list=request.getParameter("list");

    String q = request.getRequestURI();
         System.out.println("this is pathinfo: "+q);
         String
field=""+tendercode+"',"'+reg+"',"'+name+"',"+year+","+amount+","+duration+","'+service+"',"
"+person+"',"'+address+"',"'+areacode+"',"'+tel+"',"'+email+"'";

         XmlFile xml=new XmlFile();
  xml.Insert("TENDER_APPLICATION",field);
```

```
}

}
```

Appendix B-8 Snippet to display log-in of Mining Services Interface in XHML Format

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>
<title>

Mining Services
</title>

<style type="text/css">

.menu{ position:absolute; width:100%; height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; }

.sub{ position:absolute; width:5.5%; height:60%; top:50%;left:56%;visibility:hidden;
background-color:red; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.menu2{ position:absolute; width:110%; height:100%; top:0%;left:50%;visibility:visible;
background-color:gray; font-family:Arial Narrow; color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

</style>

</head>

<body bgcolor="white">
<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>
<div id="title"
class="menu"style="top:26%;left:30%;width:60%;background:white;color:gray;font-
family:Times New Roman;"><br><br><h1>Mining Services</h1></div>

<div id="title2"
class="menu"style="top:39%;left:11%;width:60%;background:white;color:gray;font-
family:Times New Roman;"><br><br><h2>Organizations (Stake Holders)</h2></div>

<div id="title3" class="menu"style="top:51%;left:11%;width:80%;background:#ccc;font-
family:Times New Roman;color:gray;font-size:130%"><b>Small Medim Enterprise
(SME)</b></div>
```

```
<div id="link" class="menu"style="top:57%;left:11%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Registration</b></div>
<div id="link" class="menu"style="top:57%;left:25%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Registered SMEs</b></div>
<div id="link" class="menu"style="top:57%;left:42%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Profile Advertisement</b></div>
<div id="link" class="menu"style="top:57%;left:63%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Work Assistance</b></div>

<div id="title3" class="menu"style="top:67%;left:11%;width:80%;background:#ccc;font-
family:Times New Roman;color:gray;font-size:130%"><b>Large Organization (LO)</b></div>

<div id="link" class="menu"style="top:73%;left:11%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Information profile</b></div>
<div id="link" class="menu"style="top:73%;left:27%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Outsource Services</b></div>
<div id="link" class="menu"style="top:73%;left:44%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Service Award
Requirements</b></div>

<div id="title3" class="menu"style="top:82%;left:11%;width:80%;background:#ccc;font-
family:Times New Roman;color:gray;font-size:130%"><b>Government Agency
(GOV)</b></div>

<div id="link" class="menu"style="top:90%;left:11%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Receipient of Contract Award
(Racial Grouping)</b></div>
<div id="link" class="menu"style="top:90%;left:57%;width:80%;background:white;font-
family:Times New Roman;color:skyblue;font-size:100%"><b>Application for
Grant/Assistance</b></div>



</body>
</html>
```

Appendix B-9 Snippet to display SMEs Home page Interface in XHML Format

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >

<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>
<title>
Sme Home page
</title>
```

```
<style type="text/css">

.menu{ position:absolute; width:100%; height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; }

.sub{ position:absolute; width:5.5%; height:60%; top:50%;left:56%;visibility:hidden;
background-color:red; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.menu2{ position:absolute; width:110%; height:100%; top:0%;left:50%;visibility:visible;
background-color:gray; font-family:Arial Narrow; color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

<script src="http://localhost:8080/pcir/base/webpg/sme/title.js">
</style>

</head>


<body bgcolor="white">


<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

<div id ="msg"class="menu"style='top:30.5%;left:30%;background:white;font-
family:veranda;color:gray;font-size:3em;width:50%'>
        WELCOME  </div>

        <div id ="msg"class="menu"style='top:40.5%;left:38%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  TO </div>

        <div id ="msg"class="menu"style='top:45.5%;left:33%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  SMALL MEDIUM ENTERPRISE
  </div>
        <div id ="msg"class="menu"style='top:50.5%;left:38%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  PROFILE.</div>
        <div id ="msg" class="menu"style='top:58%;font-family:Times New
Roman;background:white;color:gray;font-size:1.5em;left:33%'>
        SMEs Advertises for Service</div>

 <script src="http://localhost:8080/pcir/base/webpg/sme/sidebar.js">
</script>
</body>
```

```
</html>
```

Appendix B-10 Snippet to display larger organization Home page Interface in XHML Format

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>


<style type="text/css">

.menu{ position:absolute; width:100%; height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%; height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.menu2{ position:absolute; width:110%; height:100%; top:0%;left:50%;visibility:visible;
background-color:gray; font-family:Arial Narrow; color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

</style>

<title>
Large Organization Account
</title>
</head>


<body bgcolor="white">
<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

<div id="tomcat" class="menu"style='top:26%;left:30%;background:white;color:gray'
><h4>PCIR >>My Account >>Large Organization(LO)....</h4></div>
        <div id ="msg"class="menu"style='top:30.5%;left:30%;background:white;font-
family:veranda;color:gray;font-size:3em;width:50%'>
        WELCOME </div>

        <div id ="msg"class="menu"style='top:30.5%;left:80%;background:white;font-
family:veranda;color:gray;font-size:3em;width:50%'>
```

```
        <img src="C:\\Program Files\\Apache Software Foundation\\Tomcat
6.0\\webapps\\pcir\\base\\pics\\rbm.gif" width="20%"></div>

        <div id ="msg"class="menu"style='top:40.5%;left:38%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  TO </div>

        <div id ="msg"class="menu"style='top:45.5%;left:33%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  LARGE ORGANIZATION
  </div>
        <div id ="msg"class="menu"style='top:50.5%;left:38%;background:white;font-
family:veranda;color:gray;font-size:1.5em;width:30%'>

  PROFILE.</div>
        <div id ="msg" class="menu"style='top:58%;font-family:Times New
Roman;background:white;color:gray;font-size:1.5em;left:33%'>
        Large Organization search for smes to outsource service</div>

 <script src="http://localhost:8080/pcir/base/webpg/lo/sidebar.js">
</script>
</body>
</html>
```

Appendix B-11 Snippet to display Government Agency Home page Interface in XHML Format

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >
<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>

<style type="text/css">

.menu{  position:absolute; width:100%;  height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

.sub{ position:absolute; width:5.5%;  height:60%; top:50%;left:56%;visibility:hidden;
background-color:gray; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.sub2{ position:absolute; width:50%;  height:60%; top:57%;left:40%;visibility:visible;
```

```
background-color:#eee;font-family:Times New Roman; color:gray;align:center;
font-weight:Regular; font-size:15px; }


</style>


<title>
Government Login
</title>
</head>


<body bgcolor="white">


<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

  <div id="tomcat" class="menu"style='top:35.5%;left:38%;background:white;color:gray; font-
family:Times New Roman' onmouseover="subMenuH()"><h1>Government
(GOV)</h1><h3>Please Enter Your Organization Code and Password</h3></div>

<p class="menu" style="font-
size:16px;;top:27.3%;left:40%;background:gray;color:red;width:3%"><a
href="http://localhost:8080/pcir/base/webpg/sme/smeLogin.html"style="color:white"
>SME</a></p>
<p class="menu" style="font-
size:16px;;top:27.3%;left:50%;background:gray;color:red;width:14%"><a
href="http://localhost:8080/pcir/base/webpg/lo/loLogin.html"style="color:white" >LARGE
ORGANIZATION</a></p>
<p class="menu" style="font-
size:16px;;top:27.3%;left:70%;background:gray;color:red;width:9%"><a
href="http://localhost:8080/pcir/base/webpg/gov/govLogin.html"style="color:white"
>GOVERNMENT</a></p>


<div class="sub2"style='width:20%;top:57%;left:39.8%;'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:39.8%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:57%;left:60%'><br><br><br><br></div>
<div class="sub2"style='width:20%;top:69%;left:60%'><br><br><br><br></div>


  <form name="f" action="/pcir/base/govLogin" method="get">

<div class="sub2"style='width:18%'><p style="font-weight:bold">User Name:</p>
<p style="font-size:10px;">(Organization Code+User Name)</p></div>
<div class="sub2"style='left:65%;width:10%;top:61%'><p><input type="text" name="code"
size= "5" maxlength="12"/></p></div>

<div class="sub2"style='width:18%;top:70%'><p style="font-weight:bold">Password:</p>
<p style="font-size:10px">(Obtained during Registration)</p></div>
```

```
<div class="sub2"style='left:65%;width:10%;top:73%'><p><input type="password"
name="password" size= "10" maxlength="10"/></p></div>


<div class="sub2"style='width:5%;top:90%;left:55%'><a
href="javascript:document.f.submit()"onClick="check(this.form)"><img src="C:\\Program
Files\\Apache Software Foundation\\Tomcat 6.0\\webapps\\pcir\\base\\pics\\search.gif"></a>
</div>

  </form>

</body>
</html>
```

Appendix B-12 Snippet to display SMEs Account Interface in XHML Format

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
   "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">

<head >


<script src="http://localhost:8080/pcir/base/webpg/hideloginbar.js">
</script>
<title>
Sme Account
</title>

<style type="text/css">

.menu{ position:absolute; width:100%; height:100%; top:0%;left:0%;visibility:visible;
background-color:gray; font-family:Tw Cen MT Condensed Extra Bold;
color:white;align:center;
font-weight:Regular; font-size:11px; }

.sub{ position:absolute; width:5.5%; height:60%; top:50%;left:56%;visibility:hidden;
background-color:red; font-family:lucida console; color:white;align:center;
font-weight:bold; font-size:11px; border-width:3px;}


.menu2{ position:absolute; width:110%; height:100%; top:0%;left:50%;visibility:visible;
background-color:gray; font-family:Arial Narrow; color:white;align:center;
font-weight:Regular; font-size:11px; border-width:3px;}

</style>

</head>
```

```
<body bgcolor="white">


<script src="http://localhost:8080/pcir/base/webpg/header.js">
</script>

<div id ="msg"class="menu"style='top:30.5%;left:30%;background:white;font-
family:veranda;color:gray;font-size:3em;width:12%'>
        REGISTRATION_____</div>
        <div id ="msg" class="menu"style='top:46%;font-
family:Veranda;background:white;color:gray;font-size:1em;left:30%'>


                <table border="0">
                 <tr>
                 <th style="%;font-family:Veranda;background:white;color:gray;font-
size:1.5em;">
                                For Details on the registration of SMEs, <br>please contact the
Secretary
                                to THE SME Community

                </th>
                </tr>
                <tr><td align="center"><br><br><br>
                Postal Address: P.O. Box 5417, Pretoria<br>
                Postal Code: 0041<br>
                        E-mail Address: scomm@g.ac.za<br>
                        Telphone Number: (012) 4287650<br>
                        Fax Number: (012) 4277710<br>
                </td></tr>
                </table>
                                                                        </div>


</body>
</html>
```

Appendix C: Snippet to test faster query on normalization/denormalization in database

```
import java.awt.*;
import java.sql.Connection;
import java.sql.*;
import java.io.*;
import java.util.logging.Level;
import java.util.logging.Logger;

public class NormalizationTest {

   ResultSet resultSet;
   ResultSetMetaData metaData;
   Connection connection = null;
   Statement statement = null;
   static final String JDBC_DRIVER = "sun.jdbc.odbc.JdbcOdbcDriver";
   static final String DB_URL = "jdbc:odbc:pcir";
   public String query;

   public NormalizationTest() {
      try {

         Class.forName(JDBC_DRIVER);


         connection = DriverManager.getConnection(DB_URL);
         statement = connection.createStatement(ResultSet.TYPE_SCROLL_INSENSITIVE,
               ResultSet.CONCUR_UPDATABLE);
      } catch (SQLException sql) {
         sql.printStackTrace();
         System.exit(1);
      } catch (ClassNotFoundException cnf) {
         cnf.printStackTrace();
         System.exit(1);
      }
   }

   public void getSme() {

      String query = "select * from smes";
      long l1 = System.nanoTime();
      Query(query);
      long l2 = System.nanoTime();
      print();
      System.out.println("The time spent to retrieve for normalization data in nanoseconds  is : "
+ (l2 - l1));
   }

   public void print() {
      try {
         while (resultSet.next()) {
```

```
            for (int i = 1; i < metaData.getColumnCount(); i++) {

                System.out.print(resultSet.getObject(i) + "\t");
            }
            System.out.println();
        }

    } catch (SQLException ex) {
        Logger.getLogger(NormalizationTest.class.getName()).log(Level.SEVERE, null, ex);

}
}

public void insertSme() {
    try {

        String values = " 0, 1,2,3,4,5,6 ";
        String table = "smes";
        String values2 = " 0, 1, 2, 3, 4, 5, 6 ";
        String tables2 = "organization";

        String query = "select * from smes";
        long l1 = System.nanoTime();


        Insert(tables2, values2);
        Insert(table, values);

        long l2 = System.nanoTime();


        System.out.println("The time spent to update data in nanoseconds  is : " + (l2 - l1));

        statement.close();
        connection.close();
        Query("select * from smes");
        print();
    } catch (SQLException ex) {
        Logger.getLogger(NormalizationTest.class.getName()).log(Level.SEVERE, null, ex);
    }

}


public void Query(String query) {

    try {

        connection = DriverManager.getConnection(DB_URL);
        statement = connection.createStatement(ResultSet.TYPE_SCROLL_INSENSITIVE,
            ResultSet.CONCUR_UPDATABLE);
        resultSet = statement.executeQuery(query);
        metaData = resultSet.getMetaData();
```

```
        } catch (SQLException e) {
            e.printStackTrace();
            System.exit(1);
        } catch (Exception e) {
            e.printStackTrace();
            System.exit(1);
        }

    }

    public void Insert(String table, String field) {
        try {

            int result2 = 0;
            String insertq = "INSERT INTO " + table + " VALUES ( " + field + ");";
            System.out.println("this is the insertQuery :" + insertq);

            result2 = statement.executeUpdate(insertq);
            System.out.println("insert result =" + result2);

        } catch (SQLException e) {
            System.out.println("process not successful\ncheck duplicacy or invalid input !");
            e.printStackTrace();
        }

    }

    public static void main(String args[]) {
        new NormalizationTest().getSme();
    //  new NormalizationTest().insertSme();
    }
}
```

Appendix – D: Java code to calculate values for the different parameters using Ranking formula.

```
import java.awt.*; //BorderLayout;
// import java.awt.Dimension;
import javax.swing.*; //JFrame;
// import javax.swing.JPanel;
/**
 * <p>Title: </p>
 *
 * <p>Description: </p>
 * <p>Copyright: Copyright (c) 2007</p>
 * <p>Company: </p>
 * @author not attributable
 * @version 1.0
 */
public class RankingFrame extends JFrame {
```

```
JPanel contentPane;
BorderLayout borderLayout1 = new BorderLayout();
public RankingFrame() {
  try {
    setDefaultCloseOperation(EXIT_ON_CLOSE);
    jbInit();
  } catch (Exception exception) {
    exception.printStackTrace();
  }
}
/**
 * Component initialization.
 *
 * @throws java.lang.Exception
 */
private void jbInit() throws Exception {
  contentPane = (JPanel) getContentPane();
  contentPane.setLayout(borderLayout1);
  setSize(new Dimension(400, 300));
  setTitle("Ranking Formula for Data Repository");
  int wij;
 int criteria, sub_criteria;
 int count1 = 100;
 int count2 = 100;
 double sumwiyi = 0;
 int sumwi = 0;
 int sumwij = 0;
 double sumxij = 0;
 double sumwijxij = 0;
 double rank;
 double r[] = new double[count1];
 double x[][] = new double[count1][count2];
 double y[] = new double[count1];
 int w[] = new int[count1];
 String output = "weight\tcriteria\t\trank\n";
 for(int i = 1; i<= count1; i++)
  {
   JTextArea outputArea = new JTextArea();
   w[i] = (1 + (int)(Math.random()) * 100);
   sumwi += w[i];
   for(int j = 1; j<=count2; j++)
    {
      x[i][j] = (0 + Math.random() * 1);
      wij = (30 + (int)(Math.random()*100));
      sumwijxij += wij * x[i][j];
      sumwij += wij;
      // }
      y[i] = sumwijxij / sumwij;
      sumwiyi += w[i] * y[i];
      r[i] = sumwiyi/sumwi;
      output += wij + "\t" + y[i]  + "\t" + r[i] + "\n";
  //  }
   outputArea.setText(output);
```

```
            JOptionPane.showMessageDialog(null, outputArea,
                "Repository Ranking Formula", JOptionPane.INFORMATION_MESSAGE);
              // System.exit(0);
        }
         }
    }
}
```