A WEB-BASED, ENTERPRISE-WIDE, INTEGRATED INFORMATION SYSTEM AS THE SOURCE OF HIGH QUALITY INFORMATION FOR DECISION- MAKING PROCESSES IN THE DEPARTMENT OF EDUCATION IN SOUTH AFRICA

BY

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Declaration

I, the undersigned, hereby declare that the work contained in this assignment is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

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Abstract

The Education Management Information System (EMIS) is the business unit that is responsible for information management and business reporting in the Department of Education. EMIS finds it difficult to provide high quality information to the Department of Education internally and its stakeholders externally and attributes the reduction of the quality of its education information to factors such as the organisational nature of the South African education system, the lack of information management standards and practices, the low level of information technology skills in EMIS, the existence of a multitude of disparate information systems in the Department of Education and Provincial Education Departments, and the apparent discontinuity in the flow of information from education institution level to the national department and back. Most research in information management confirmed the state of EMIS as being typical of most large organisations whose functioning depends on the quality of their information. The factors that influence information quality in EMIS had been identified as accuracy, timeliness, consistency and relevance of the information. A “quick-fix” to the information problem is not possible but research in information systems management indicates that there are trends in the electronic business arena that may provide an acceptable solution to most of the problems encountered by EMIS. This report investigates the nature of EMIS problems in terms of information management and investigates possible solutions to the problems. The investigation is done within the framework of acknowledged information systems planning process and aligned to the process model of information management.

An exposition is given on the theory pertaining to information management, information systems and information systems management to give insight into the particular fields of study and their interdependencies. A section on business intelligence is included since business reporting is the primary function of EMIS. Investigations into information systems development indicate an exponential growth in electronic technology development specifically the Internet and the Web. The information systems plan provides the framework or set of guidelines to determine the information systems solution that will be able to solve their problems. The research report included four stages of the information systems plan framework. The first stage pertains to the identification of minimum information required from the education sector and supporting sectors to provide high quality education information for decision-making and planning. The second stage determines and benchmarks the state of EMIS in terms of information management processes. The third stage investigates the trends in electronic business and specifically electronic information systems applications. Current best practices indicate that a possible solution to information management problems in large organisations is the application of a web-based, electronic, enterprise-wide, integrated information system.

Opsomming

EMIS as ‘n besigheidseenheid in die nasionale Onderwysdepartement is verantwoordelik vir inligtingsbestuur en verslaggewing. EMIS vind dit moeilik om hoë kwaliteit inligting intern aan die onderwysdepartement en ekstern aan sy rolspelers te verskaf. en skryf die verlaging in die kwaliteit van inligting toe aan faktore soos die organisasiestruktuur van die Suid Afrikaanse onderwysstelsel, die gebrek aan standaarde vir inligtingsbestuur en -praktyke, die lae vlak van inligtingstegnologiekennis van die personeel in EMIS, die bestaan van ‘n magdom van ongelyksoortige inligtingstelsels in die nasionale onderwysdepartement en provinsiale onderwysdepartemente en die sigbare diskontinuïteit in die vloei van inligting vanaf die onderwysinrigtings na die nasionale onderwysdepartement en terug. Die meeste navorsing in inligtingsbestuur bevestig dat die toestand waarin EMIS verkeer tipies is van die meeste groot organisasies wie se funksionering van die kwaliteit van hulle inligting afhang. Die faktore wat ‘n rol speel in die kwaliteit van inligting in EMIS word geïdentifiseer as akkuraatheid, tydigheid, uniformiteit en geldigheid. ‘n Vinnige oplossing vir die inligtingsprobleem is nie moontlik nie maar navorsing in inligtingstelselsbestuur dui aan dat daar tendense in die rigting van elektroniese besigheidarena is wat aanvaarbare oplossings bied vir die meeste van EMIS se probleme. Hierdie verslag ondersoek die aard van EMIS se probleme in terme van inligtingsbestuur en ondersoek moontlike oplossings vir die probleme. Die ondersoek word gedoen binne die raamwerk van ‘n aanvaarde inligtingstelsel-beplanningsproses wat opgestel is om binne die prosesmodel vir inligtingsbestuur te val.

‘n Uiteensetting van die teorie ten opsigte van inligtingsbestuur, inligtingstelsels en inligtingstelselbestuur word gegee ten einde insig oor die betrokke studieterreine en hul interafhanklikheid te gee. ‘n Afdeling oor besigheidsintelligensie word ingesluit aangesien besigheidsverslaggewing die primêre funksie van EMIS is. ‘n Ondersoek na inligtingstelselontwikkeling dui op ‘n eksponensiële groei in die ontwikkeling van die elektroniese tegnologiebedryf en spesifiek die Internet en Web. Die inligtingstelselsplan voorsien die raamwerk of riglyne waarbinne die inligtingstelseloplossing gesoek kan word. Die navorsingsverslag sluit vier fases van die raamwerk van die inligtingstelselsplan in. Die eerste fase het te make met die identifisering van die minimum inligting wat nodig is vir besluitneming en beplanning. Die tweede fase stel die toestand van EMIS ten opsigte van inligtingsbestuur vas. Die derde fase ondersoek die neigings in elektroniese besigheidstransaksies en toepassings. Huidige beste praktyke dui aan dat ‘n moontlike oplossing vir die inligtingsbestuurprobleme van groot organisasies die toepassing van ‘n web-gebaseerde, elektroniese, geïntegreerde inligtingstelsel, wat al die komponente van die onderneming insluit, is.

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CONTENT

Chapter One

1.1 Introduction

The South African Constitution (Act 200 of 1993), the National Education Policy Act (Act 27 of 1996) and the South African Schools Act (Act 84 of 1996) are the primary sources of the mandate, duties and functions of the Department of Education (DOE). The core functions of the DOE are the development and maintenance of the education and training system and the monitoring and evaluation of the progress made in terms of its duties (Department of Education, 2003). The DOE is responsible for developing policies and legislation to regulate the education system. In the eagerness to execute its duties, the DOE started to collect information on various aspects of the South African education system. Office automation packages from various vendors contained easy to use modules that enabled education personnel to develop database systems and data capturing tools without having advanced information technology skills. The amalgamation of the various education departments in the country that existed before 1994 resulted in the merging of many more data structures.

Cursory investigations into the status of data in the DOE lead to the following facts. Each business unit in the DOE had one or more database or data islands fulfilling its particular needs. Officials with limited information technology (IT) skills developed databases and applications on various development platforms and applied on different operating systems. There is evidence of the lack of particular database standards or validation procedures on application level. The apparent lack of standardisation and business unit-specific terminology lead to ambiguous interpretation of data extracted from these disparate and non-integratable databases systems. Since these systems were designed as data capturing applications and not as an information system, it was difficult – and still is - to extract meaningful information from them. Information extraction was time-consuming, labour-intensive and the resultant information yield was not of a high quality. Decisions made by the DOE based on these information sets, lead to various problems in the education sector as is evident by the numerous legal challenges that the DOE had to face over the years since 1996. Examples of these are the redeployment and retrenchment of educators and the lack of school facilities in fast growing urban areas.

A further complicating factor to the information dilemma is the organizational structure of the education system. The DOE consists of the national department of education and the nine provincial education departments. Education is a national competency according to section 126 of the South African Constitution (the Constitution). Each province has its own provincial constitution, subject to the Constitution.

The DOE attempted in 1996 to address the information problems of the education system. The DOE constituted an education management information system (EMIS) business unit in each provincial department of education and at the national department of education in terms of NEPA (s4a). These units were staffed by education specialists who had limited information technology (IT) skills. The lack of standards and the lack of capacity to manage IT projects added to the information problems that currently exist in the education system.

Certain provinces, for example the Western Cape and Gauteng, with the appropriate financial resources, attempted to rectify the information problems by separating the EMIS administrative functions from its IT functions. The Western Cape Education Department (WCED) standardised its development platforms and database applications based on recommendations of an information system plan process conducted as part of the year 2000 (Y2K) project. The questions posed to the rest of the country are: "How can all the EMIS units collectively solve the education information problems of the education system?" "How can the EMIS units utilize the latest information-centred electronic technology to solve their problems? What is the acceptable framework and methodology that all provinces can use to address the problem?

1.2 Public and private sector organization approach to information management

An organization consists of people, standard operating procedures, politics and structure, organized in such a way that its business functions are performed in a structured hierarchy according to standard operating procedures (Laudon, 2002:12-13). The differences in terms of commercial transactions between public and private sector organisations are distinct. However, the principles of information management and information systems management are the same. The primary focus of private sector organizations is to create wealth by manufacturing, marketing and selling products or services, while the primary function of public sector organizations such as the Department of Education is to render a service to the public or citizens of the country, mostly free of charge and ensure proper governance of the country's resources. Information requirements or business needs are based on the strategic vision and mission of the business managers as well as the needs and requirement of the particular industry. The vision, mission and strategies of public sector organizations are directed by the legislative frameworks. The question posed is: What are the primary legislative sources that will inform the DOE what information requirements it should impose on its information system so that it is able to acquire the appropriate information effectively, efficiently and in the most economical way by using the latest electronic technology possible? A follow-up question is: How will the DOE ensure that scientifically valid procedures are used to

construct an efficient and effective information system that is able to service the South African education system?

Organizations cannot make decisions using low quality information. Proper information management is therefore a critical success factor and entails management of information flows from start to finish. An information system, based on a generic systems model, consists of an input, process and output part. Because of the necessity to be adaptive, i.e. be able to adapt to its environment, a formal feedback process must be included.

1.3 Information flow processes

Information flow analysis starts with an identification of the sources of information and what information is needed as input to the information system. The Department of Education has to acquire information from a proliferation of sources that are mostly disparate and heterogeneous, which add to the complexity of information acquisition.

Acquiring and making sense of the information requires processes including data management, information extraction, reorganization and integration of information. These processes are made possible using information products or services that need to be properly chosen and managed in order to be effective. The proper distribution of information for usage is included as a process. A critical success factor is the proper alignment of information systems with the business processes of the organization. The information system need to include a component and processes that effectively and efficiently handles the organization, storage and retrieval of information.

To fully understand information systems, managers must understand the broader organization, management and information technology dimensions of systems and their power to provide solutions to challenges and problems in the business environment. An information system equates to management, organization and technology management and gives rise to business solutions.

1.4 Finding a solution to information management problems

The search for information system solutions in organizations, especially the Department of Education must be done scientifically. A “quick-fix” solution is not possible but trends in the information systems industry points towards “best practices” developed by “best-in-class” solution providers. The solutions must be recommended in terms of a well-defined framework and methodology that is included in an

information system plan (ISP). This plan includes a needs analysis or business information requirements of its business processes, an investigation into the information technology and information systems status of the organization, “best practices” methods, a gap analysis and recommendations based on the findings. The question that needs to be answered is: “What is the scientific basis of such a master information system plan and how can it be used to solve the information dilemma of the DOE?”

Most major South African companies, including the government sector, have a well-developed and advanced information technology infrastructure. The question is not so much as to what the status of information management is in the Department of Education, but why it cannot give access to the relevant information that is critical for decision-making. The need is therefore to align the business information requirements with its business processes through utilizing properly an information system. Instead of “re-inventing the wheel”, it is acceptable to find “best practices” methods used by successful organizations both in the private and public sector, and using those to achieve its objectives. An obvious environment to search for such solutions is in the electronic business (e-business) arena.

1.5 E-Business, models and strategies, trends

A solution to the information system problems of an organization may be a paper-based system instead of an electronic system. However, the development of electronic technology caused an unimaginable explosion in the degree of effectiveness and efficiency of electronic enabled information systems in some organisations. The rapid growth of the Internet technology and the pervasiveness of the World Wide Web (“Web”) made electronic transactions a possibility and a preferred mode.

In the electronic business (e-business) arena, certain trends are clearly recognizable. Examples of such trends are the use of the Internet technology, Web portals and the use of “best practices”. Organizations exploit these trends to enhance their businesses. By adopting specific e-business models and strategies, they are able to increase their revenue and gain a competitive edge over their competitors. For public sector organizations, specifically the Department of Education, the question is what e-business trends can be identified and utilized to solve their information systems problems.

When taking into account the organizational structure of the DOE, the provincial departments of education (PEDs) and their autonomous nature, the question is whether the Internet and “Web” can be utilized to create the network of communication channels that is critical for information exchange in either a federated or consolidated information system. The use of electronic technology, e-business principles and

the alignment of electronic information systems with the business processes may enable the DOE to function as an integrated corporate enterprise. Is it possible to utilize ERP, SCM, CRM, and portals in the public sector, specifically in the Department of Education when only services are delivered at cost and no revenue is created except for creating value through saving in costs?

The search for an appropriate information system model and strategies offered by e-business modelling to solve the information problems of the DOE will be done within the framework of an information system plan.

A solution may be a web-based, enterprise-wide, integrated information system based on well-tested electronic business (e-business) models and strategies. To develop such models and strategy an investigation into the management-, organizational and information technology processes is needed. The organizational status is necessary to determine the alignment of the organization's business information processes with the current information systems.

When scanning business trends, it is evident that electronic technology is the cause and driver of modern business strategies and models. Doing business electronically is more efficient, effective and economically viable but is dependent on the alignment of business strategies and processes with electronic technology and information architecture. A question that needs to be answered is: Is alignment a possibility when conducting an investigation within the framework of an ISP?

1.6 The research problem

What electronic information system possibilities, identified within the framework and methodology of an information system plan, may be used as building blocks of a web-based, enterprise-wide, integrated information system for the Department of Education to ensure the availability of high quality information needed in critical decision-making processes?

1.7 Solution to research problem – objectives

To solve the research problem the following goals need to be reached or questions answered:

- Construct the framework and methodology of the information system plan to be used to determine the information system requirements of the DOE
- What are the information requirements of the DOE that are critical in supporting its functions?

- Determine the trends in information system models and strategies by exploring the possibilities offered by e-business modeling.
- Determine whether the information system models and strategies that are identified in an ISP investigation are able to address the DOE information, information management and information system management issues.

1.8 Research methodology

The research approach to follow is an empirical non-experimental study of secondary textual data. The methodology includes an investigation of the state of the Department of Education information systems and the trends pertaining to electronic technology development in the information systems arena. Chapter 4 develops a simple coding scheme to assist in recording the facts about the data models and EMIS survey instruments used by the Department of Education. Included in the study is a comparative analysis of "best practices" as practiced by highly rated service providers in the electronic business arena. The research methodology is applied within an information system planning framework and is aligned with the information management process model as illustrated by Choo (1998).

1.9 Chapter overview and timeframes

The purpose of chapter two is to determine the theoretical framework from an information management perspective that would enable the researcher to construct an information system planning framework and methodology. The ISP framework will be used as guideline for analyzing the information environment of the Department of Education and to find a solution to the organization's information problems. Chapter three will investigate developments in the electronic world of e-business and will attempt to identify the possible building blocks of a web-based enterprise-wide integrated information system solution for the Department of Education. Chapter four will define the framework and methodology of the research. The purpose of chapter five is to analyze the research results and provide guidelines for the acquisition of information for the Department of Education. Chapter six investigates the state of information management and information systems in the Department of Education, specifically the EMIS unit. Chapter seven investigates the "best practices" and trends followed by highly competitive organizations and information systems solution providers. Chapter eight concludes the research findings and proposes a solution to the research problem. It also draws attention to the impact on practitioners and researchers in the field of information system management.

1.10 Summary

The solution to the information system problem will provide a framework within which the Department of Education and other public service organizations may be able to fulfill their informational obligations. By identifying trends in information systems models and strategies, organizations will be able to develop and implement information systems that are able to integrate business processes and provide high quality information cross-functionally where needed and when needed.

Chapter 2 – Literature review on information, information management and information systems.

2.1 Introduction

High quality information is critical for decision-making and planning in any organization including the Department of Education. Organisations use high quality information to ensure continued competitiveness of the business or rendering an efficient service. Private sector organizations utilise information to exchange value by trading in products and services while public sector organizations are focusing on service delivery.

2.2 The characteristics of high quality information

Information is the fulcrum of modern business processes. Information is data transformed into a form that has meaning and is useable by human beings (Laudon, 2002:8) and that is communicated effectively (Castells, 2000:17) between human beings. It is difficult to contest the fact that in the information age, electronic technology increased the efficiency and effectiveness of the transformation and communication of data. However, the old IT adage, "garbage in – garbage out" is still applicable. High quality information can only be created from high quality data. Information quality is dependent on factors such as timeliness, relevance, redundancy, accuracy, ambiguity, meaningfulness and usefulness (Fisher, 2003). The list is by no means exhaustive.

Raising the quality of information increases its value to organisations. The challenge is to measure the value of information in its specific organizational context. Loshin (2004) indicated that he still has to find organisations that list their information as line items on its list of assets and liabilities. Loshin (2004) recommended measurables such as the time value, sharability, increased use, increased quality and the ability to merge various data sources as well as the cost of acquiring, storing and redistributing the information. The key element of getting value out of information is to use the information.

2.3 The technical and business nature and definition of information management

Skyrme (1999:189) defined information management as the application of conventional management processes to information for maximizing the contribution of the information to achieve the organizational objectives. The conventional management processes include the collection, organizing and condensation of data into information with the goal of ensuring efficient management (Gartner Group, 2003) and the planning, organizing and directing of information in a usable format.

There are two perspectives to note, namely the technical and business approach to defining information management. Rowley and Farrow (2002:10) define information management as being "concerned with the promotion of organizational effectiveness through the enhancement of the capabilities of the organization in coping with the demands of its internal and external environment in dynamic as well as stable conditions". This definition is technical in nature. The process model of information management, a business definition of information management, conceptualize information management as a continuous cycle of six closely related processes, i.e. identification of information needs, information acquisition, information storage, organization and retrieval, development of information products and services, information distribution and information use (Choo, 1998:261). Both perspectives are equally important since the management of information in systems is both business oriented and technical in nature and should therefore be collated into one definition. The ultimate goal of information management is to transform information into learning, insight and action (Choo, 1998:260). In the haste to implement an information management strategy, many organizations, including the Department of Education, focused all their resources on the management of information resources, tools and technologies, and information standards. This approach was not necessarily wrong, but a theoretical framework binding these functions (Choo, 1998:260) are necessary, otherwise they will remain loosely coupled entities.

2.4 The process model of information management and its components

The framework or process model of information management (Choo, 1991) forms the point of departure for the development of a framework for an information system plan for an organization, specifically for the Department of Education. The flow of information through any organization may be compared to nerve pulses traveling through the nervous system of the human body. An important component is the feedback component that completes the information process cycle.

2.4.1 Information requirement and needs of an organisation

Organizations have an obligation towards their shareholders or the citizens of the country in terms of the functions that they have to fulfill. These functions include either generating profits or rendering a public service. To perform their functions efficiently they must use information from their internal or external environment to plan and make meaningful decisions. The first question that an organization needs to ask is: What are our information requirements? In other words, what is the minimum set of information required by the organization to perform their duties or obligations in terms of organizational functions, policies or legislation? As Choo (1998:261) indicated, the organizational needs also arise from the

problems, uncertainty and ambiguities encountered in specific organizational situations. The “information requirements” refers to the information needed to successfully execute its business in line with its information strategy, its business models, vision and mission.

In summary, Laudon (2002: 317) defined an information requirement, as “a detailed statement of the information needs that a system must satisfy”. The first step in organizational information system planning is usually an analysis of the organization’s current and possible future information requirements.

2.4.2 The process of acquiring information

The next step after determining the organizational information requirements is identifying the internal and external sources of information and determining the processes involved in acquiring the required information. Large organizations such as the Department of Education has the problem of acquiring information from a proliferation of mostly disparate, incompatible, heterogeneous and non-integrated sources. In cases like these diverse information systems are incorporated and integrated into the new structure through a complex process of re-engineering. Since the reasons for the complex information acquisition are known (Choo, 1998:24), organisations need to concentrate on the following questions. How is the organisation going to collect the required information? What are the required technologies and business processes that need to be put in place to make the acquisition of the required information as efficiently and effectively as possible”? The answers lie in the examples set by other organizations with proven successes in information management and information system management. It may also be possible that a smaller business unit within the organisation had success in collecting information efficiently. The challenge to the organisation is to find those success processes and exploit them to the benefit of the organisation as a whole.

2.4.3 Information Processing

Information processing includes the utilization of information products and services, and distribution of information. It specifically focuses on the processes involved in extracting, transforming, formatting, transporting, storing and enabling access to stored data, and the distribution of information. It not only involves the technological processes but also includes the management and organization of the processes. Acquiring and making sense of the information requires activities including capturing, validation, verification, cleansing, storage, extraction, reorganization and the integration of information. These activities are made possible by using information products or services that need to be properly managed in order to be effective. Taylor in (Choo, 1998:266) advised that these products and services have to be

developed as an integrated set of activities that collectively add value to the information being processed. The distribution or dissemination of information must form part of the processes so that the appropriate information gets to the person who needs it at the time that it is needed.

2.4.4 Information organisation and storage

This component of the process models the organisation and storage of data or information in databases. Procedures for archiving, accessing and retrieval of information are included in this component. The technical architecture expands on these requirements and provides a blueprint for developing an effective and efficient data storage facility that forms the basis of a business intelligence system (*infra*) for the organisation. The component models both data and information management including the technical aspects of database management. The technical aspect of database management includes standardisation of database schemas and data dictionaries. Microsoft (2000) defined the data dictionary as a set of system tables, stored in a catalogue that includes definitions of database structures and related information, such as permissions. For enterprise-wide application, it is essential that organisations need to establish naming conventions, clarity of meaning of terms, ownership and consistency of data and information (Holloway, 1988: 12).

2.4.5 Use of information by information consumers

The information use component models the requirements of the consumers of organizational information. This component models how information consumers are able to interact with data stores to get meaningful information from the organizational information systems. The component also provides feedback to the system, i.e. is able to indicate shortcomings, or discrepancies or additional information needs. The different processes as indicated in the process model are cyclic in nature and encompass the whole information value chain. The evaluation of the user outputs and subsequent revisiting of the informational needs increases the value of the information. Re-evaluation also dictates the type of product needed to link the user to the information stores. Information is extracted by standard querying methods, analysis of data, data mining procedures and multidimensional analysis. This information is used for the creation and application of knowledge (Choo, 1998:25). The process model of information management alone is unable to describe the full information management and information system concept. The process model has to be expanded to include management and organizational processes and the information technology infrastructure and support components.

2.4.6 Management and organizational processes

Harding (1998) identified strategic management, management control and operational control processes as necessary processes that need to support the information system process model. The process model of information management combined with the management, organizational and technological components, models an information system. To fully understand information systems, the manager must understand the broader organization, management and information technology dimensions of systems and their power to provide solutions to challenges and problems in the business environment.

2.5 Defining an information system

The Gartner Group (2003) defines an information system as "the use of and investment in computer technology by the principal or centralized organization formally charged with the responsibility for computer technology." However, information systems are more that just technical issues. A system coordinates activities, business processes and decisions spanning multiple functional areas across the entire organisation and influence unique ways in which organizations coordinate work, information and knowledge. Therefore an information system may be described as a group of interrelated components that work collectively to carry out input, processing, output, storage and control actions in order to convert data into information products that can be used to support forecasting, planning, control, coordination, decision making and operational activities in an organization (Bocit, 1999:27, Laudon, 2002:7). These components encompass the information value chain (Choo 1998:25) and agree with the information process model described above.

Information systems are "socio-technical" systems i.e. one part technical and the other behavioural (Laudon, 2002: 11). In other words, they require substantial social, organizational, intellectual as well as technological investment. From a business perspective, an information system may be defined as "an organizational and management solution based on information technology, to a challenge posed by the environment" (Laudon & Laudon, 2002:11). Generic adapted systems models include inputs, processes and outputs as its core components and feedback, and control processes to cover the management aspect of systems (Laudon & Laudon, 2001:9) which is in agreement with the information process model as described previously.

Information systems are classified according to their functionality or roles (Laudon, 2002:38-39, O'Brien 1999:54), i.e. either as operational systems or management systems (O'Brien, 1999:55). Operational systems include systems where transactional business processing takes place in real-time, for example

capturing learner particulars at registration time. Managerial systems include firstly knowledge or information systems that support managerial decision-making, and secondly strategic-level systems that support long-range planning activities at a senior management level and enabling strategic directions. Even though there are subtle variations, the basic concept remains the same, i.e. they would allow an executive to make smarter and faster decisions (Davenport, 2004).

In terms of the definition of information systems and information management, it may be concluded that “information management systems” and “information systems” has the same meaning. The rest of the report uses the term information system (IS) throughout. In the report, IS is sometimes referred to as information sub-systems, indicating smaller systems that are the building blocks of the full information system. The vision is to have one information system for the Department of Education but it may consist of smaller sub-systems as part of the value chain.

2.5.1 Information systems supporting operational processes

These systems include all transactional systems. They are the most abundant systems that take most of the IT budget and human resources. Transactional systems record the up-to-the minute activities in the daily business processes. They are optimized for processing unit records of transactions. However, these systems are not good at or used for decision-making because data is continually updated and modified. They are the main source of inconsistent data used in decision-making processes.

2.5.2 Information systems supporting management processes

Information systems for management support include all those systems that enable managers to perform their functions, i.e. monitoring and evaluating, control progress, planning and decision-making (Laudon, 2002: 406-422). Large organizations have different types of information systems supporting various functions, organizational levels and business processes. However, most of the time they cannot or do not "talk" to each other. Creating an overall picture of the organization’s operations is difficult, usually because of a lack of an integration framework.

2.6 Defining an enterprise information system

Enterprise systems have the ability to integrate the diverse business processes of a company into an integrated information system. Enterprise systems provide a unified and all-encompassing information system technology platform and environment and a single integrated repository containing all the data

about business processes. Application frameworks, for example enterprise resource planning (ERP), customer relationship management (CRM) and supply chain management (SCM) form the backbone of modern enterprises and establish integration in the entire company (Laudon & Laudon, 2002: 55). The major trend towards upgrading the organization's performance is the development of enterprise systems that is able to integrate the various information systems including operational and management systems that are utilized in the organization. The major types of enterprise systems that are important to especially large organizations are categorised in terms of how data are integrated. The two approaches are data federation and data consolidation (Devlin, 2003).

2.6.1 The consolidation of data in centralized information systems

A centralized information system has a centralized database structure and all transactions from different locations are processed in a client/server environment (Laudon & Laudon, 2002:218). A client/server environment is a multi-tier environment where user interfaces, business rules and database structures are separated into layers. These layers need not be situated in one location. Only one tier or all tiers may be centralised but the current technology is such that it will appear as if all components are in one place. Assume, for argument sake, that all the components are centralised. In a consolidated system, a centralized database is accessed via physical networks or the Internet. Data management is centrally located and includes data ownership, user roles, duties and responsibilities. Centralized database systems increase the functionality of online analytical processing (OLAP) and decision support tools (Jhingran, 2002:558). Placing data centrally means bringing data together from a variety of locations in advance, so that the user query does not always need to be distributed. There is ample time to perform complex extraction, transformation and loading (ETL) manipulations and more time to attend to the issues of cleanliness, semantic and temporal consistency (Devlin, 2003). However, centralized data may not be possible in many environments. Having a huge amount of data in one place may be costly in terms of storage space, database management and slowed access caused by network links spanning long distances. The trend is that organizational databases tend to decentralize into federated database systems (Jhingran, 2002:558).

2.6.2 Federated information systems

In a federated data management system data is stored at various sites. When needed, data "in whatever format is acted upon" (Devlin, 2003) from a specific position, i.e. at a central location. The original data is not duplicated but only used. However, many organizations replicate and distribute copies or parts of databases to network servers at various locations (Bocit, 1999:274). Distributed databases counter the

problems of a centralized database, but have their own weaknesses. Distributed databases have to be regularly duplicated and synchronized otherwise the result will be database silos.

Improvement and further development in electronic technology accelerated the move towards decentralized database systems. Certain departments in an organization cannot share data freely because of it unique functionality, different employee levels or different employees. Centralization of the data is therefore not always possible in all environments. A solution is to leave the data at its original source and negotiate access through a federation (Jhingran, 2002:558-559).

In a federation, the data stays in its original location and is linked to another set at another location, resulting in a dataset in a third location. The third set is not necessarily saved at the third location but may be cached for easy manipulation. The efficiency of the process depends among others on the size of the datasets, the processing power of the respective systems and the connection speed between them (Devlin, 2003). The complexity of the federation depends on the data models of the data sources. For example, one dataset may reside in a relational database while the other may be a comma delimited text file that does not reside in a relational database. In such a case, access to the data is not through SQL queries but through sophisticated application procedures. Data access processes solve the particular problem by simulating the procedures if it cannot gain access to the data via a common structured query language. Federation is not only confined to reading data but, because of increasing demands by users, also caters for writing to remote data sets (Devlin, 2003). Permissions and security becomes a critical issue in this case.

2.6.3 Federation compared to consolidation

Data access (federation) or placement (consolidation) may be performed as two distinct processes but can easily be combined to strengthen the enterprise integration process. In both cases, that is, federation and consolidation, data is requested and the received data resides outside the originating location. The key differences are the time the request is made and the transfer of data. With the federated process, data is processed after the request is made and transformed data is viewed and not necessarily saved in a new location. Federation provides users direct access to data in real-time, which is an increasing demand. During the consolidation process, queries are performed on dataset beforehand and copies of data saved to another centralised location. A common thread in both cases is the mapping and transformation functionality. Mapping provides the ability to understand the relationship between different pieces of data. Transformation is the functionality that actually converts the data to form the new data set or range. To perform mapping and transformation it is necessary to have a detailed description (metadata) of the two

environments in which it is to be applied. The metadata gives a detailed description of the business meaning, relationships, location and technical information (Devlin, 2003). A complete metadata set forms the basis for any information integration process (Devlin, 2003).

Two of the most important factors determining the latency of data in both approaches are the complexity of the transformations and the volumes of data to be processed. Consolidation processes are optimised for large volumes of data and complex transformation procedures while federation emphasises transactions involving individual records and simple transformations by a large number of users at the same time (Devlin, 2003).

2.7 Information system management principles

Bocit (1999:33) declared that there are many definitions for "management information system" (MIS). MIS implies "information system" that manages information at a management or executive level. In other words, MIS is an information system that prepares information for use at an executive level for decision-making and strategic planning. These systems include information reporting systems, decision support systems and executive information systems (Bocit, 1999:33). Laudon (2002) used MIS as meaning "the management of information systems" and used the same meaning as Bocit in a specific context. To avoid confusion and to accommodate the Department of Education and their EMIS units, this research report uses "information system management (ISM) as meaning the "management of information systems".

The primary function of business organizations is to generate revenue by exchanging value and rendering a service. The best way of doing it is by developing strategies and action plans (Laudon, 2002:31) and executing them within the framework of specific business models. Information systems have the capability to effect changes in the organizational structure because of its ability to accelerate the use of information for operational and strategic planning and decision-making.

The acquisition of high quality information and the efficient functioning of business processes are dependent on proper information system management. The rationale of information system management is to align the business processes of the organization and modern information technology. To ensure efficiency and effectiveness of information systems, the primary objective of an organization is to continuously determine its information requirements, assess the status of its information system and information technology infrastructure, ways in which other successful organizations conduct their business and ways and means to adapt their own systems and processes. Businesses therefore need a business plan and specifically a short and long-term information system plan that will provide a roadmap

to help them develop and execute business information strategies and choose business models to reach their business objectives.

There is agreement in the current information technology and information systems arena that business users and not the IT department must define what constitutes good data for a particular task, process or project. It is the IT function to give assistance in this regard (Fisher, 2003). This dual partnership will ensure not only the technical correctness of data but also add value to the data. High quality data result in high quality and trustworthy information. Proper data and information management is therefore essential and must be the primary consideration in the data and information architecture of an organization.

Management, organization and technology need to have an equal role in the development and management of information systems in organizations. When planning operational and strategic information systems for an organization, all three components, namely management organization and technology must be addressed from both a business and technical perspective. Organizations must develop an information system that is synchronized with its business strategies, in other words new systems to be build should be an essential component of the organizational planning process (Laudon, 2002:305). In other words, organisations that are serious about their information assets must have an information system plan that will ensure efficient and effective information management.

2.7.1 The information system planning process

It is important for the organization to have a clear understanding of both its long- and short-term information requirements to ensure the successful implementation of an information system plan.

2.7.2 The information systems plan audit

An audit to determine the status of an organization in terms of its information systems and systems management is a prerequisite for developing an information system plan. The objectives of an information system plan for any organization, including the Department of Education, includes a management audit with respect to its vision, mission, objectives, business strategies, business processes and information requirements. An organizational audit includes its information flow processes, resources management, people skills, capacity and training needs. A technology audit includes a resources inventory, which include an information sub-systems inventory, hardware resources inventory and IT infrastructure and information system architecture.

2.7.2.1 Audit of management

An audit at management level, also known as the business articulation audit (SITA, 2003), is necessary to determine the vision, mission and objectives and business strategies available to attain them. The business articulation process also determines the product or service delivery strategy, the business processes including planning, control and quality assurance with respect to information system processes (Makhatha 2003), the business needs and requirements with respect to information and an information system. Laudon (2002:305) identifies two methods for establishing an organization's short and long-term information requirements, i.e. enterprise analysis, also known as business systems planning, and critical success factor (CSF) analysis. These two are some of the popular and well-established methodologies (Lederer, 2001) that are used to establish an information system plan for organizations.

(a) Enterprise analysis

Laudon (2002:306) defines enterprise analysis as the analysis of enterprise-wide information requirements in terms of organizational units, functions, processes and data elements. The analysis helps to determine the key entities and attributes in the organization's data. Enterprise analysis produces a massive amount of data that is expensive to collect and difficult to analyze (Laudon, 2002:307). A further weakness is that enterprise analysis tends to concentrate on middle and senior management where relatively little information is collected. Enterprise analysis is done on all documentation that is available at a management level, including those used by senior management to base their policies, decisions and action plans on. The intention of individual interviews with senior management is to confirm their alignment with official organisational directives, policies and frameworks.

(b) Critical success factors

An organization's information requirements may be determined by a small number of critical success factors (CSF) also known as strategic analysis. The premise is that there are a small number of objectives that managers can easily identify and on which an information system can focus (Laudon, 2002:307). CSFs are obtained by interviewing senior management. Because of its subjective nature, it is difficult to aggregate CSFs into organizational CSFs, especially in a corporate organization or enterprise.

Although they have their weaknesses, enterprise- and CSF analysis may be successfully utilized in the development of an information system plan for organizations.

2.7.2.2 Organizational audit

An organizational audit determines the status of human resources management including resource utilization, skills development, capacity, roles, responsibilities and duties. Communication channel utilization is also addressed.

2.7.2.3 Technological audit

An information technology and information system audit would take up most of the time spent on auditing the organization's information system and management process. A technology audit normally includes hardware, software, networks infrastructure and IS architecture. A hardware audit would include the type, capacity, capabilities, condition and suitability of desktop computers, servers, storage media, printers, scanners, modems, network switches, hubs, routers and other equipment used in information system support. The software audit usually includes operational-, application-, office automation- and collaboration software with respect to their suitability, currency, efficiency, extensibility, scalability, maintainability and ease of use. An IT network infrastructure and architecture audit include cabling, routers, switches, hubs, ports with respect to specifications, compatibility, lifespan and speed.

The audit output is an inventory specifying the state of information systems in the organization. The results are used to set baselines for each business unit in the organization. Baseline measurements give an indication of the state of the information system and IT infrastructure in the organization. However, baseline measurement will only indicate that the systems are fulfilling the total needs of the organization if there is some sort of comparison to systems used by other organizations in the same or other industry. The process of determining such measurements is called benchmarking (Cook, 2000:145; Gartner Group, 2003; Laudon, 2002:315).

2.7.3 Benchmarking and best practices

With all the rapid changes that are happening globally in the information industry, it is difficult to determine the most effective way to develop and implement an information system. There is also no time for managers to wait for the mystical "silver bullet" to appear and solve all of their problems (Zachman, 1997). A compromise is to investigate the "best practices" (Cross, 1999, Makhatha 2003, Wauts 2002) globally that was successfully implemented by various high profile organizations and use that to solve the specific information system management problems of an organization.

Best practices are documented strategies and tactics employed by highly admired and successful companies. It may not be the best in all fields of development, but due to the nature of competition and their drive for excellence, the profiled practices were implemented and honed to help place their practitioners as the most admired, the most profitable, and the keenest competitors in business (Best Practices LLC; Gartner Group, 2003; Cook, 2000:145-155).

2.7.4 Gap Analysis and recommendations

By comparing the benchmarks of an organization with "best practices" of highly respected companies, it is possible to arrive at a list of shortcomings and possible solutions to a company's problems or even best practices within the organisation. The output of the gap analysis process is recommended solutions that would enable the organization to bridge the identified gaps and solve the organization's information system problems. The gap analysis will also indicate the implications of the proposed changes to be made.

2.7.5 Implementation plan and costing

Implementation of an information system plan is a long-term process. However, implementation should not happen in more than a three to five year cycle due to the tempo at which technology development is taking place and the critical nature of business information. The best way of solving immediate problems, is to determine which information sub-system is critical and should receive priority. This is done by determining the criticality of such a system in terms of the overall informational needs of the organization (WCED, 1999). In this way, attention may be given to short, medium and long-term goals, objectives, and systems developed according to their priority and criticality. Difficulties in implementing the plan must also be taken into account, for example the availability of funds, resources and employee capacity.

2.8 Summary

An information system plan for any organization, including the Departments of Education, may be developed based on a "best practices" methodology and by implementing the processes with respect to information system management. The processes include an audit of the organization's business practices, identifying best practices in the organization's sphere of business, a gap analysis based on best practices and outcome of the organization's audit and a set of recommendations for effecting positive changes in the organization. Instead of redesigning the wheel, an organization may use an accepted ISP methodology

within the given ISP framework to solve its systems issues, and in particular, its information system problems. The outcome of a successful ISP implementation is high quality information that is critical for decision-making and planning.

The ISP framework and methodology provides the practical and technical implementation of the processes as indicated in the theoretical information process model. Successful information solutions may be built on a business intelligence architecture that is able to ensure an end-to-end information flow, and a feedback loop for further enhancement. This will ensure that the business manager will be able to extract the information that he or she wants, when or where it is required.

Chapter 3 - Literature review on electronic technology and its applications

The exponential growth and innovation in electronic technologies lead to the increased power of computer central processor units, storage media and electronic transfer media. Mass production of these media brought the cost of the final products down and made the high power electronic technology and products affordable and available to a broader user base. The development of electronic technology enabled application to increase the economy, efficiency and effectiveness of most business processes. Expanding electronic technologies also had an impact on the development of the Internet. The Internet and Web technology became the medium of inter-locking business applications and the killer technology of isolated stand-alone applications.

3.1 The Internet and World Wide Web

The Internet became tremendously popular during the 1990's, but the start of the second millennium showed an increased popularity in the use of the Internet by users in all walks of life (Skyrme, 1999: 17; Cross, 1999:378). As a business tool, it allowed millions of people to access information on an organisation and its products or services. Using an Internet browser or other Internet applications, anyone with the proper permissions could transfer data to and from other computers connected to the Internet irrespective of the type of computer used or the operating platform. While the Internet is the universal standards technology (Skyrme, 1999:20), the World Wide Web or "Web" is actually the implementation of that technology. The Internet and Web is sometimes mistaken as being synonymous (Gartner Group, 2003). Typical applications include e-mail, file transfer (FTP), bulletin boards and newsgroups. These applications are collectively known as Internet services (Gartner Group, 2003) but distinct from Web services.

The development of the Internet created new requirements for applications, including new methods of application delivery. Browser-based application delivery, or Web Services, emerged as the technology of choice to reduce costs and grow business opportunities (Gibson, 2002:14). The Internet holds the potential to integrate all information in a global network with many private but integrated domains. It enables access to information any time, and with wireless technology, anywhere (Layman, 1997).

The Gartner Group (2003) defined the Internet phenomenon as "a loose confederation of independent yet interconnected networks that share information using a standard set of protocols". Electronic data are transferred globally using a common addressing system and communications protocol known as the Internet Protocol (IP), made possible by a standardized transfer control protocol (TCP) (Cross, 1999:378).

The common protocols and high level of standardization, made the Internet technology ubiquitous and pervasive at relatively low resource utilization in comparison to other technologies and allowed for increase in both the reach and richness of information content (Laudon, 2002:107), which is not possible in other technologies. In other words, without the Internet, if an organisation wants to reach more clients they will have to decrease the volume or richness of information that they would like the clients to have.

The rapid development in electronic technology and its increased use in business processes are impacting on product, service delivery and generation of income. The technological development is causing headaches for senior management who do not want to be burdened with technology issues. All that they want is access to the end- product, i.e. they would like to experience an end-to-end process.

Web technology proved to be the solution to the challenges experienced by users. User IT demands in response to these challenges was the driver for the development of websites with specific characteristics. Certain web sites were built to enable convergence of organizational information, access to services and products from one user interface or web browser. These types of web sites are called web portals.

3.2 Web Portals technology

It is extremely difficult to construct an exact definition of web portals because of the many different types of single and hybrid web portals (PortalCommunity, 2002; IBM, 2001) that have been developed so far. The Gartner Group (2003) described a portal as a “high-traffic Web site” that contains a wide range of content, services, and links to other relevant sites. The Web site is simple to navigate with a customizable user interface. A portal has the ability to concentrate or converge relevant information content and services internal and external to the organization into one point of access. The portal is the communication channel to and from the organization, i.e. it links both its intranet and extranet via the Internet. Information that becomes available to the individual user via a Web portal has the following characteristics:

- It is presented in a structured and organized manner.
- It is easily locatable and shared with all users having authorised access to these portals.
- It is distributed, published and presented from a central location although the location is virtual i.e. anywhere where there is an Internet connection available (KM Connections, 2002; Jambga, 2001; Fitzloff, 1999).
- Users have access to shared information and decisions can be based on consistent and current information and knowledge (IBM GSC, 2002).

3.3 The enterprise information portal (EIP) as a particular type of Web portal

Enterprise information portals are used in a corporate business environment. Its function is to help employees to gather, manage, share and utilize information that is being stored in various databases throughout the organisation (Jambga, 2001). It brings information to the employee in an organized and structured manner. It facilitates interaction with data, information, mined data and shared information. Some elements of a corporate web portal solution include taxonomy, search, content management, document management, expert locator and collaboration as functional portal components (PortalCommunity, 2002). The availability of the functional portal components depends on the scope, context and application of the particular portal. It provides for a personalized single point of entry to an integrated source of corporate information or explicit knowledge, which amounts to the sharing of corporate explicit knowledge. EIPs are applications that enable companies to unlock internally stored information, and provide users with a single gateway to personalized information and knowledge to make informed business decisions. EIPs may be used in organizations to enable users to link to specialized applications or services for example business intelligence-, intranet-, and extranet portals (PortalCommunity, 2002). The strength of EIP is its ability to provide a single access point to various applications and services with varied business processes, on heterogeneous platforms, structured and unstructured information sources, various infrastructures of all partners and the Internet, and makes all resources equally accessible in a central repository (Sybase SA, 2000).

The Internet, Web and Web portals created the opportunity to perform electronic business transactions without touching a piece or paper. Web portal technology enables a single point of entry to the information that resides in federated or consolidated information systems at any location. The location and format of the information is transparent to the user. The same information is available to any other user at the same time, that is, all users use the same information to derive consistent results.

3.4 Electronic business and applications

Electronic business (e-business) amounts to doing business electronically within the organisation and under control of the organisation by completing business processes over open networks (Weill, 2001:5; Kalakota, 2001:5; Laudon, 2002:24). E-business applications enable direct user interaction with the organizational business processes. The development of electronic technology enabled application frameworks to increase the economy, efficiency and effectiveness of most business processes. One of the challenges in e-business systems is to integrate all the existing or new applications so that they may work seamlessly together. Problems that are hampering a complete solution are the company size, budget and

existing legacy systems. Problems with integration also occur when mergers and acquisitions take place, web-enabling applications, migration of legacy systems to new platforms, upgrading network infrastructure, and building an integrated data model from an existing infrastructure (Kalakota & Robinson, 2001:143).

E-business applications have the potential to drive efficient acquisition, processing, transformation, storing and distribution of electronic information. Used with Web technology, especially Web portals it enables access to information from anywhere, at any time and in any format that the user wants it. The user information requirements form the basis of business intelligence (Kalakota, 2001: 358).

3.5 Business intelligence (BI) and reporting

3.5.1 A definition of business intelligence

Cognos (2004) described business intelligence as a process taking volumes of organisational data and turns it into meaningful information for planning and decision-making. Kalakota (2002:358) explained business intelligence reporting as the proactive capturing, organisation and delivery of organisational personalised information to individuals at any time, anywhere and any place. The components of a BI solution include the following elements: data collection and organisation; analysis and segmentation; real-time personalisation; broadcast, retrieval and interaction and performance monitoring and measuring (Kalakota, 2001: 360). The BI components are able to integrate disparate data that are stored in many locations and in different formats. Data integrated by an ETL process are stored in data stores or viewed and used without duplicating the data.

3.5.2 Reporting as the core business intelligence function

A report is a document containing information that is relevant to an organization at a particular time. Although duplicated for distribution, the content is consistent. It creates a common context and a single version for decision-making across the enterprise (Cognos, 2003:1). Two distinct reporting categories were identified: one is production reporting; the other is enterprise business intelligence reporting also named business reporting.

Production reporting are defined as reports generated by using data from operational systems and merging predefined report templates with large volumes of data to produce, publish and distribute fixed, and to a lesser extend ad hoc reports to a wide spectrum of users in the organisation (Cognos, 2003:2). Business

reporting, on the other hand extract its information from data stores or data warehouses that are shielded from the operational or transactional data sources. Business reporting includes multi-dimensional or online analytical processing (OLAP) techniques that are able to generate various view of the same information and tend to highlight trends in the datasets. Business reporting is interactive, i.e. user driven. Cognos (2003:2) indicated that no vendor had been able to provide a reporting solution that delivers full capabilities in both categories, i.e. production and business reporting. Most of these vendors did not support enterprise-wide reporting. Enterprise-wide reporting is characterised by high-volume output of standard reports or production reports distributed to a large number of users throughout the enterprise. Examples of enterprise reports are newsletters, notices to all the staff members, although they may be individually addressed, financial statements and so forth.

3.6 Systems and application standardisation

An investigation into the state of the information system in an organisation during the development of an information system plan, invariably leads to the identification of redundant, duplicate, disparate or totally inefficient applications or systems in the organisations. As was indicated earlier, a decision must be made which system will be scrapped or enhanced. Standardisation is the process where systems are reduced to a limited number of products and vendors (Ventana, 2003). An example is the use of one application development platform, for example VB.net instead of both VB.net and Java.

Another process distinct from standardization is to consolidate multiple systems into one of the existing systems or a new system (Ventana, 2003). The key force behind standardisation is optimising the information architecture of the organization. Complex information architectures are often to blame for the long latency time of data requests (Ventana, 2003:6).

3.7 Summary

Chapter 3 lays the foundation for information management by electronic information systems. The electronic management of information is more efficient than manual processes. The Internet technology increased the richness and reach of information, which in turn increases the information use. The Web portal is the medium to give access to information at any time and anywhere. The applications or solutions, often called business intelligence reporting give access to the tools to process the information in an easy and user-friendly way.

Chapter 4 – Research design and methodology

An in-depth literature study showed that the international community had done extensive research in information systems planning in the private sector. Very little research in information systems planning is evident in the South African government sector although information technology systems went through its planning cycles, especially during solving the year 2000 bug problem (Y2K). The Department of Public Service required that each government department had to have an information system plan (ISP), indicating the absence of such plans. Further investigation lead to the conclusion that there is a framework that could guide government departments to conduct such investigation into the state of information systems and devise a plan to enhance or build new systems that would enable them to increase their performance and service delivery. It was also evident that although international research had stabilised, the rapid growth in electronic technology created the need to reassess the situation continuously and act accordingly.

4.1 Research approach

The research problem as stated in chapter 1 was solved by an empirical and non-experimental study of secondary textual data. The textual data was divided into two sections. Section one included legislation and administrative documents relevant in the South African education system context. The administrative documents included two groups. Group 1 included electronic copies of the data models of the nine provincial Education Departments including the national Department of Education. Group 2 included the EMIS survey instruments used in the collection of education institution information. Section two of the textual data included vendor publications, promotional brochures and their research publications ("white papers").

4.2 Data collection method

Data that were needed to solve the research problem was obtained by qualitatively analysing legislation that is relevant to the education system. Survey instruments used to collect data in the education system and database schemas of the various education information sub-systems were analysed. Legislation included the South African Constitution (Act 200 of 1993), the South African Schools Act (Act 84 of 1996), Adult Basic Education and Training Act (Act 52 of 2000) and the Further Education and Training Act (Act 98 of 1998). Survey instruments used by EMIS to conduct annual surveys included the Annual Schools Survey, Early Childhood Development Survey and the LSEN Survey. The database schemas used by the provincial Education Departments and the Department of Education for the period 1999 to 2004

were included in the research investigation. Written permission was obtained from the Department of Education to extract the database schemas from the Departmental databases. The final part of the data collection process included a qualitative analysis of information system solutions by best-of-breed vendors and service providers. Three international organizations, namely Business Objects, Cognos and SAS were chosen because of their influence in the global information technology market and the unique information system strategies followed by each.

A coding scheme was developed to assist in summarising the various survey instruments and the comparative analysis of the database schemas and the survey instruments.

4.3 The methodology used for describing and analysing the database schemas and survey instruments used in the research project.

The unique objects identified in the education system, also called entities, include learners, education institutions, staff and community. An entity may be described or characterised by adding attributes to it. For example, learner attribute may include sex, race, age and home language. Education institution staff may have attributes including specialisation, sex, race, age, qualifications and subject specific experience. The lists are by no means exhaustive.

In most cases attributes had values chosen from a fixed set of distinct objects and grouped without ordering (Levy, 1980:25). Examples are race = {white, black, coloured, asian} and language = {official languages acknowledged by the Constitution}. Levy (1980:26) defined a sequence as a set of elements listed in a linear order. For example, School-days = {Monday, Tuesday, Wednesday, Thursday, Friday} is an ordered list.

4.4 Representation of attributes in a entity to be used in the current research

The symbol “[attribute]” was constructed to represent the sequence of columns with names chosen from the elements of a given set. For example, [weekday] was used to represent the sequence of days of the week in the successive columns in a database table.

The symbol “[attribute1][attribute2]” was constructed to represent a concatenation of permutations of the elements of the sets representing attribute1 and attribute2 in that order. For example if A={x, y} and B={p, q} then [A][B] represented the sequence of field names of the columns of a database table chosen from the set {xp, xq, yp, yq}.

The symbol "<attribute>" was constructed to represent any element chosen from a sequence of values. The attribute represents the name of a column in a database table. The value of the attribute chosen from a fixed set is stored in a record in a database table.

Where the word "attribute" is used without <> or [] it is deemed to be a constant.

4.5 Application of the coding scheme: some simple examples

Table A

	Male	**Female**
Row1	124	123
Row2	99	23

Table A may be symbolised by Table([sex]) where sex = {male, female}. The values of the attributes, for example the number of male or female learners is stored in consecutive rows in the database table. The attribute representing the value of the variable is implicit to the table representation.

Table B

	Age	…	Gr12Male	Gr12Female	…
Row1	17		24	27	
Row2	18		20	21	

Table B may be symbolised by Table(<Age>[grade][sex]) where sex = {male, female}, age = {1, 2,3 ,…} and grade = {grade 1, grade 2, grade 3, … grade 12}. The column name Gr12Male has two parts to it, namely grade and male attributes. The Age column has one distinct value per row chosen from the "age" set.

Table C

	Age	Grade	Male	Female
Row1	17	12	24	27
Row2	18	12	20	21

Table C may be symbolised by Table(<age><grade>[sex])

Two more examples for clarity.

Table D (<Age>[grade]M)

	Age	…	Gr11M	Gr12M	…
Row1	17		24	27	
Row2	18		20	21	

Table E contain data on male (M) learners by age and grade.

Table E(<age><grade><sex>)

	Age	Grade	Sex	Value
Row1	17	12	Male	24

Row2	17	12	Female	27
Row1	18	12	Male	20
Row2	18	12	Female	21

4.6 Using the information management process model to construct a research framework

The research process took place within a framework built by applying the information management process model concepts (see Choo, 1998: 261-270) and the information system plan approach (Laudon, 2002: 305-8). The process model of information management as discussed in chapter 2, identified distinct processes necessary for successful information system management. These components included the identification of information needs of an organization, the acquisition of such information, the processing of acquired information to enable organization, storage and extraction, and information utilisation. A further component that is critical to the system is the feedback component, which enable systems enhancement. These distinct components formed the framework or set of guidelines used to direct the research process. The framework is an acknowledged information system planning framework for organisations (Wauts, 2002; Laudon, 2002; Mahkatha, 2002, Swanepoel, 1999) where information is regarded as a valuable asset.

4.7 The research framework

The framework includes the following distinct areas presented in the form of questions. Firstly, what are the information requirements of the organization, specifically the Department of Education? Secondly, what is the state of the organization in terms of its business process, IT infrastructure and information architecture? Thirdly, which “best-practice” approaches exist that will best suit the information systems management requirements of the organization. The outputs of the first three questions were used to do a gap analysis, i.e. compare “best-practices” against organizational benchmarks. The last phase in the framework was the recommendations of an appropriate solution to the specific information system problems that exist in the Department of Education.

4.8 The scope of the research assignment

The executive component of the South African education system consists of the national and nine provincial departments of education. The research was limited to the Department of Education national office and specifically the EMIS unit since education is a national competency in terms of Schedule 4 of the Constitution (s125 (1)(b)) and the business reporting function was allocated to EMIS.

Chapter 5 - The information requirements of the DOE

5.1 Introduction

The intention of this chapter is to provide insight into the information requirements of the Department of Education by analysing the primary sources to determine the minimum information requirements that are needed for efficient and effective decision-making and planning in the education sector.

5.2 EMIS information requirements

Chapter 2 provided insight into the EMIS mandate, duties, functions and legal obligations. It was easy to gather as much education information from the field as possible, as is usually the case in many organizations. Indications are that these practices usually led to information overload resulting in inefficient information systems (Losee, 1989; Darlington, 2004). One question that needed to be answered in order to reach the first research objective was: What is the minimum information needed to enable EMIS to perform their functions and duties, i.e. to monitor and evaluate the performance and development of the South African education system?

The duties and functioning of the Department of Education are outlined in the South African Constitution and the various legislation regulating education. Regulations, white papers and policies are interpretations, that is, secondary sources of information, and give effect to legislation. To determine whether the Department of Education is actually performing its obligations efficiently and effectively, measurements have to be taken in the education system at various intervals and key performance indicators developed that would be an indication of its performance. Information is needed to construct indicators. The study was based on the assumption that the education legislation was the primary source used to determine the minimum information needed to construct the said key performance indicators.

5.3 Determining the information requirements of the Department of Education using the South African legislation as primary source.

5.3.1 The South African Constitution, Act 108 of 1996 (The Constitution)

The South African Constitution, hereafter named the “Constitution”, entrenched the right of every qualifying citizen of the country to have access to high quality basic education. The state is obliged to reasonably provide for such education (s29 (1)). To test whether the current government had met its

obligations, measures had to be put in place to measure and monitor the success of the government, and in particular the Department of Education.

Section 29(2) of the Constitution entrenched the basic right of an individual to receive education in one of the official languages of choice in public institutions where it is reasonably possible. The right is balanced by taking into account the rights of others in terms of equity, practicality and the need to redress the results of past racial discriminatory laws and practices. Did this indeed happen? Information is needed to construct indicators that would provide evidence to this effect. Education in an official language of choice is a right provided to individuals in the public schooling system only. The Constitution provides for the establishment of independent education institutions, at own cost and on condition that there is no discrimination based on race and that the basic minimum educational standards are comparable to that of public institutions. The language issue was not explicitly addressed.

To be able to monitor the progress made in providing for basic and further education, information is required to measuring the successes made especially in terms of availability, accessibility, equity, non-discrimination and language of teaching and learning. The challenge is to identify the minimum information requirements for monitoring the implementation of education policies and progress made in terms of the policies. Well-directed and constructed questions in surveys conducted at certain intervals will enable the gathering of facts that could be used to construct key performance indicators.

5.3.2 The South African Schools Act, Act 84 of 1996 (SASA)

The SASA Act was promulgated to specifically regulate the new South African Education system. In the preamble of the Act, it stated that a new national education system for schools must be established to remedy past injustices in education provision. Because of the complexity of the education system, it was reasonable that the State would be allowed to progressively provide a high quality of education to all learners in the system, to combat racism, sexism and all forms of unfair discrimination and intolerance. What information is required to determine whether the State had succeeded in the execution of its duties thus far? The Act provided the basis for poverty eradication and the economic well being of society, protecting and uphold the rights of all learners, parents and educators. The preamble promoted the acceptance of responsibility by learners, educators and parents for the organisation, governance and funding of schools in partnership with the State. Furthermore, the basis for the setting of uniform norms and standards for the education of learners at schools and the organization, governance and funding of schools throughout South Africa was set.

Table 1: Key performance activities (SASA) in Appendix A provide a summary of sections in the South African Schools Act that give an indication of what information is needed from the sector to construct indicators. These sections have been transformed into questions to indicate how specific information might be acquired from data source.

5.3.3 Further Education and Training Act, Act 98 of 1998 (FET).

The purpose of the Act was to provide for the establishment, cooperative governance and funding of public further education and training institutions, to provide for the registration of private FET institutions and to provide for quality assurance and quality promotion in FET and promote programme-based further education and training. Existing FET institutions had to be restructured and transformed so that they could respond better to human resources, economic and development needs of the country. The request was for redress of past discrimination, representivity and equal access to education in the FET sector. The FET sector was, through the desires of the FET Act, required to provide optimal opportunities for learning, the creation of knowledge and the development of intermediate to high level skills in keeping with international standards of academic and technical quality and to respond to the needs of the Republic, the labour market and the communities served by the institutions. The ruling of the Act was a clear indication what was needed to test the successes.

Section 3 specifically regulates the establishment of an FET institution by public notice in the *Provincial Gazette*. Section 4(a-c) indicated that an establishment date had to be determined, an official name be created and the physical location and official address be established. The section obliged the responsible government sector to acquire such information from the FET section, and in particular the FET institution that applied for registration. Sections 6 and 7 regulate mergers and closures of FET institutions. Institutional governance is regulated by section 8 while sections 9 and 10 prescribed the functions and constitution of an FET institution council. Section 14 regulated staff establishment and conditions of employment.

The desires as stated in the preamble were not explicit obligations or duties imposed on the State. Regulation and further legislation had to be developed to make it a requirement or obligation to give effect to these desires. In both cases information is needed from the FET sector to determine whether the State had indeed succeeded in providing a system such as that envisaged in the FET Act or any subsequent legislation. The challenge is to transform the desires and requirements into key performance activities and then designing key performance indicators that would be able to reflect the progress made in meeting the

State desires. The key performance indicators dictate the information to be acquired from the FET sector that could be used to construct the indicators.

5.3.4 Adult Basic Education and Training Act, Act 52 of 2000 (ABET)

The desires of the State for the adult basic education and training sector were recorded in the preamble of the ABET Act. The desire was to establish a national coordinated adult basic education and training system that promotes cooperative governance and provides for programme-based adult basic education and training. Issues for example equity, discrimination, representivity and equal access to ABET facilities had to be addressed. There was also the desire to provide optimal opportunities for adult learning and literacy and development of skills that is of at least the same academic and technical quality as that of the international community. The question, as stated earlier, is: What is the type of information that needs to be acquired from the ABET sector that will enable the government and specifically the Department of Education to determine whether the desires as contemplated in the ABET Act were indeed being satisfied. To be able to develop key performance indicators or metrics, certain facts or measurables had to be collected from the environment.

Section 3 regulated the establishment of a public center. The main requirement was that it had be a juristic person (s3 (2)) that is to be formally constituted and registered with the provincial Department of Education. Section 4 obliged the State to provide facilities for use by the public center. A formally constituted governing body may govern a public center. The governing body of the public center had to conform to the requirements of the Act (s8). If a governing body is not formally constituted the governance of the public center is vested in the Head of Department of the particular province until a governing body had been established (s8 (10)). Section 11 formulated the functions that the governing body had to perform. These functions are directly linked to the desires as contemplated in the preamble of the Act. Information in terms of the functioning of the governing body has to be collected to determine whether the public center is functioning efficiently. For example, section 11(1)(b) stated that the governing body “must develop a business plan for the public center”. A simple survey question would be: “Is a business plan for the public sector in operation?” The answer would provide ample information to establish if the governing body had met its obligations.

To determine the specific requirements entailed interpretation of the legislation and the construction of metrics that would direct the choice of information that would be needed from the environment in order to build the key performance indicators for the public ABET sector.

The ABET Act regulated the admission of learners (see s18) especially in terms of unfair discrimination, the establishment of a representative council of learners (s19 (1)), disciplinary measures in terms of a code of conduct (s20) and the funding of the public center (ss21, 22, 23). Funding was based on the establishment of norms and standards for funding public centers (s22). In other words, certain formulae were used to determine the budget allocations for the public center. Calculations are based on information acquired from the public centers and may include for example the number of learners, number of educators and the programmes offered.

Sections 32, 33 and 34 provided for quality promotion and assurance measures to be in place.
Section 35 of the ABET Act obliged the public center to provide any information that is needed for the protection of any person's rights, governing and quality assurance of the public center.

The minimum information required to determine the proper governance and functioning of the public center include information about the institution itself, for example its location, physical infrastructure, the learners enrolled at the center, the programmes that they follow and governance of the public center.

5.3.5 Information requirements dictated by stakeholders

The Department of Education has an obligation towards its external stakeholders including the general public and international community to provide information in a transparent manner. A specific example is the provision on education statistics to UNESCO and EFA, bodies that does comparative analysis on education on a global scale. Information needed by UNESCO include learner enrolment ratios.

South African Quality Authority regulates quality within the National Qualifications Framework. SAQA requires minimum information to maintain the National Learner Record Database (NLRD). The NLRD contains information on unit standards, qualifications, training providers, education and training quality assurance bodies (ETQA), sector education and training authorities (SETA), learners and their qualifications and achievements. The list is by no means exhaustive. The National Learners' Records Database (NLRD) is a repository to store and maintain records of South African learners and their achievements (SAQA, 2004)

Information is required from the Department of Education on learners or students, their enrolment particulars and achieved qualifications or courses completed or registered for completion. Information is also required on the service provider or training institutions. These records had to be in a granular record format where each field is uniquely identified and not dependent on each other.

In terms of regulations as provided by the SAQA Act (Act 58 of 1995), the Department of Education has an obligation to provide information on learner qualifications and the unit standards – also named fundamentals or subjects – in the general education and training, further education and training and higher education and training bands to an education and training quality assurance body (ETQA) so that the quality of the education and training may be measured and monitored. The particular ETQA's for education is UMALUSI and the Council for Higher Education (CHE).

The information required by SAQA for population of the NLRD had to conform to a minimum content, standards and format as prescribed by the NLRD requirements. The DOE in particular, had to consider the NLRD requirements for its own information acquisition processes.

5.4 External information producers

To provide a comprehensive record of its performance and progress in terms of education provision as required by the Constitution and various Education legislation, and to fulfill the needs of its stakeholders, the Department of Education is dependent on external organizations for their information. Examples of such information producers are SACE, STATSSA, IEC, DPLG, Dept. of Land Affairs, Dept. of Social Services and Dept. of Public Works. Information from these organizations was provided in various formats. Before it could be used, it had to be transformed into a standard format.

The following required information sources for educational use are those from the Department of Provincial and Local Government (DPLG), Department of Land Affairs, the Independent Electoral Commission (IEC) and Statistics South Africa. These datasets are in geographical format, i.e. each record is uniquely identified in terms of spatial coordinates. With special geographical information system (GIS) software the data can be graphically displayed on maps.

Data from the DPLG include municipal boundaries, magisterial districts and local district councils. The Department of Land Affairs provided information on farms, rivers, dams, water projects, main roads, national roads, cities and towns. The IEC provided information on election wards and enumerated areas. STATSSA provide information on census data, for example, population statistics per enumerated area, mortality rates and infant birth rates (SA Explorer, 2002).

Most of the data from the information providers listed above were in a standard geographical information system (GIS) format. Each instance of a record had been geo-coded, i.e. has a set of longitude and latitude coordinates that enabled the instance to be plotted graphically and overlaid on the South African map

including provincial, municipal and ward boundaries. If instances of education data have the reference coordinates, it is possible to overlay education institutions with the geographical maps. These visualization techniques provided a rich source of information that may be used for analysis and planning.

The primary focus of the South African education system is to provide education to qualifying learners. The focus of the current research was on the learner and institution entities. Although the educators are important to the provision of high quality education, they fell outside the scope of the current research.

5.5 The Department of Education's response to the information requirements

The Constitution and education legislation mandated the Department of Education to acquire information from education institutions, semi-state organizations as well as the private sector. The main information acquisition process was, and still is, the annual EMIS surveys. The surveys covered the following focus areas: Annual Schools Survey, 10th School Day Survey, Adult Basic Education and Training Survey, Early Childhood Development Survey, Inclusive Education Survey, Further Education and Training Survey as well as the School Register of Needs Survey (SRN). The SRN was conducted over five year intervals but was updated yearly with data from the Annual School Survey. However, as could be deduced from the Department of Education Statistics at a Glance 2001 report, based on 2001 survey data, and published only in 2004, the SRN database was updated with data that became irrelevant.

The focus area surveys were conducted at a specific date of the year. For example, all public schools completed the Annual Schools Survey form usually during April on the same day. The Annual Schools Survey provided the Department of Education with a comprehensive set of data that covered almost all facets of the schooling system. Each year more information is required depending on the needs of the Department of Education and the specific needs of the provincial Departments of Education. The Annual Schools Survey for 2004 comprised of 80 single sided pages. The format was set for optical character recognition to expedite the capturing of data. The current research assignment used the 2004 Annual Schools Survey document to indicate the effort of the DOE to acquire the information needed to fulfill its mandate and obligations.

5.5.1 The 2004 Annual Schools Survey Instrument.

The Annual Schools Survey collected aggregated information on the learners and staff at the education institutions and granular data on the institution itself. Educator information was duplicated since granular

data on educators was also collected during the same survey. The survey contained five sections namely a general information section, learner and staff information, school governance, school infrastructure and educator information.

The general information classified the education institution, the ordinary school in particular, in terms of its geographical location, its registration particulars and contact detail. In this section, the school was classified according to sector, type, phase, financial model, ownership, geographic location, educational district, educational region, circuit and examination authority. A lack of standards and definition led to ambiguous interpretation of these terms by the various provinces.

The learner and staffing section collected information on learner enrolment and staff appointments. A summary of the data acquired is given in Table 2: Annual Schools Survey - Learner and Staff Statistics in the Appendix A

A section on school governance included information requests on the governing body constitution and functions, school policies, management, administration, curriculum, learner performance, learner support materials (LSM), community and parents, safety and security, resources and equipment, finance and provincial support.

The section on physical infrastructure interrogated the education institution in terms of its environment, infrastructure and physical resources. The section on physical infrastructure is duplicated in the School Register of Needs survey that collected data on a five-year period. The last SRN was conducted in 2000 and a report published in 2001. Of particular interest was that more than 70% of the public schools had no computers and that 12,3% of the schools had 70711 computers shared between them (SRN, 2001).

The section on individual employees contained questions on the personal particulars of the educator, for example identification number, SACE number, PERSAL number, qualifications, experience and curricular duties for the current year. Most of these data is obtainable from the transversal PERSAL system hosted by the Department of Treasury. However, the questions relating to educator-duty was unique to the Annual School Survey.

The data collected about learners by the Annual School Survey was in a tabular format, which forced data aggregation at the source. Information was collected on learner race, sex, grade, age, home language and language of teaching. Data was collected in such a way that the age, grade and sex attributes were grouped

and the race, grade and sex attributed grouped separately. In terms of the model described in chapter 4, the four entities were represented as: Learner (age, grade, sex), Learner (race, grade, sex), Learner (home language, grade, sex) and Learner (language of teaching, grade, sex). The consequence of the separated aggregated data implied that no permutations between race, age, home language and language of teaching was possible. For example, there was no way of providing statistics on the racial distribution per age group or the contentious race group per language of teaching.

It was therefore not possible to monitor or evaluate equity and redress in terms of language of teaching and home language. The same argument applied to race group distribution by age. The conclusion was that the Annual Schools Survey for 2004 including the previous ones could not fulfill all the information requirements needed for monitoring, evaluation and planning of the South African education system.

5.5.2 Other focus area instruments (ECD, LSEN, ABET)

The survey instruments in the other focus areas, for example the ABET, ECD and LSEN surveys were based on the format of the Annual School Survey. A negative aspect of them was that the most important data about learners and staff were aggregated. The Annual Survey for Early Childhood Development 2004 (ECD) for example had the following model for learners: Learner (race, age, sex, grade) and Learner (home language, grade), which made it impossible to determine the comparison between language of teaching, home language and race distribution. Monitoring of progress in equity and redress were not possible through the ECD surveys.

The EMIS surveys formed the basis for the planning and development of data models for EMIS nationally and provincially. The survey forms were all constructed and developed by the cooperative and collaborative efforts of the HEDCOM sub-committee on EMIS. However, each provincial EMIS unit could determine its database schemas. The result was nine different provincial database schemas for all the focus areas and no means of standardization or common definitions except those prescribed by the survey instruments. An investigation in the database schemas for the focus areas per province illustrated this fact.

5.5.3 The Department of Education’s response to the NEPA mandate

The NEPA Act created the bases for the establishment of an education management information system in the public education sector. Soon after 1996, education management information system units (EMIS)

were established in each provincial Education Department as well as the national Department of Education. The Heads of Education Departments Committee (HEDCOM) established a subcommittee on EMIS, as required by the NEPA act, which formed a cooperative and collaborative body consisting of the nine provincial EMIS units and the national EMIS unit. The EMIS staff formed the managerial and organizational backbone of the education information system and relied heavily on external information technology support.

5.6 Summary

Since 1996 EMIS had built a network of information flow paths, mostly paper-based, that started at an education institution level and ended at the Department of Education. The question asked by many education institutions is: “why must we provide all this information to the Department?” This is an indication that information moved in one direction only with no feedback to the source of the information. The impact of accurate, timely and reliable information had thus far not been communicated to the providers of the primary data.

Chapter 6 - Information acquisition and the state of information systems in the DOE

6.1 Introduction

Chapter six provides an assessment of the data models for the three years, 2001 to 2003. A comparative analysis of the data models for the three years for each EMIS unit for the Annual Schools Survey (ASS) sufficed since it was a comprehensive survey and the other surveys had a similar format. The data models of Eastern Cape, Free State and the Western Cape PED's were chosen to represent the other provinces although they were all different. The purpose was to find evidence of inconsistencies, ambiguity and complexity in data storage.

6.2 Analysis of the Annual Schools Survey information system from 2001 to 2003

A comparative analysis of the data models of the ASS for the various years, both that of the provincial and national databases, indicated that the database schemas for each year differed although there was a trend towards standardisation from 2003 to 2004 at the national level and in the Western Cape Province. Each provincial database schema including table names, fieldnames, data types per field and to some extent data definitions differed significantly. The data definitions of each database for the DOE and nine PEDS are listed in Appendix B.

6.2.1 Eastern Cape database schema for ASS2001

The most important data acquisition table, namely the learner table consisted of age group, grade and sex data. The table was designed such that a total of 768 fields had to cater for the 24 different age groups, 16 grades and 2 sex categories. The Microsoft Access database used could not cater for such a large number of fields per table. It had to be split into four sub-tables, namely one for secondary male, secondary female, primary male and primary female. The grades include grades 1 up to grade 12, preprimary, grade R (or sometimes called grade 0), LSEN and "Post Matric". In the specific table, the LSEN grade provided for the learners with special educational needs in the ordinary schools. The "Post Matric" grade reflected learners who repeated grade 12. It could not be concluded that these learners were also included in the headcount reflected in Grade 12. The data model for the four tables were tablename ([agegroup][grade]sex) where sex = {m,f}, agegroup={3,4,5,…25+} and grade = {Gr1, Gr2, …} and tablename ={learnagefprim, learnagemprim, learnagefsec, learnagemsec}. Example of field names were: 6Gr1M (6 years old males in grade 1), 7Gr2F (seven year old females in grade 2) and 17Gr12M.

No data dictionary was given. The semantics of the field names had to be deduced from the name of the tables and the interpretation depended on the experience of the author as an educator and education specialist. The possibility of a wrong interpretation when another researcher analyzes the data model is high. It was possible to deduce that M = Male and F=Female based on the context of the tables. A data dictionary would have confirmed the interpretation. Because the tables were split into primary and secondary groups, the grades sets were different to cater for the specific table. They were Grade (prim) = {pp, grr, gr1, … gr7}, Grade (sec)={gr8, gr9, …, gr12, sen, pm}. Definitions for pp, sen or pm were not given but could be interpreted as those attributes representing preprimary, learners with special education needs and post-matric respectively.

The other learner attributes were contained in the tables “learnracef”, “learnracem”, ”learnteachlang” and “learnhomelang”. In the absence of a data dictionary, the author interpreted the tables as containing information on learner enrolment by race and sex, the number of learners being taught in a specific language and the number of learners per home language respectively. The tables were represented as Learnracef ([grade][race]), learnracem ([grade][race]) where grade={pp, gr,g1,..g12, pm, sen} and race ={a, i, w, c, o}.
Learnteachlang ([grade][language]) and Learnhomelang ([grade][language]) where grade is the same set as above, language = {afr, eng, tsw, sot, ven, zul…} indicating the official South African language. The complete data model for Eastern Cape ASS 2001 is given in Table 3: EC ASS2001 in the Appendix A.

6.2.2 Eastern Cape database schema for ASS2002

A data model for the learner component of the ASS 2002 database was: tblLearnerAgeFemale (<age_years>[grade]), tblLearnRace (<grade>[race][sex]) and both tblLearnerAgeMale tbllearnerHomeLanguage and tbllearnerLearningLanguage as (<grade>[language]). The sets for the attributes in the three tables were the same as those for 2002. The grade set for the languages and race tables had to be extracted from the 2001 database to confirm that it was the same as the 2002 set.

There was a major shift in database schema from 2001 to 2002 data sets including a shift in nomenclature. In the 2002 data model, the table representing the learner enrolment was different from that in 2001. There was a change in name as well as a reduction in the number of tables representing the learners in the Eastern Cape. The table names changed to “tblLearnerAgeFemale” and “tblLearnerAgeMale”. The fieldnames decreased from 768 to 33, which was an increase in database efficiency in terms of database

construction and data storage. At the time of conducting the research, the Eastern Cape Department of Education had not submitted their ASS 2003 datasets, indicating a delay of at least one year.

Although the database schema for the learner age by grade and sex and languages tables changed, the information contained in them remained the same and could not be used for comparative data analysis in the areas of equity and redress. However, the race table extended its information reach by including sex for 2002. The other tables in the database comprised unique fieldnames of variable quantity. The complete data model for Eastern Cape ASS 2002 is given in Table 4: EC ASS2002 in the Appendix A.

6.2.3 Free State Annual Schools Surveys 2001 to 2003

The Free State EMIS unit managed to keep their 2001 to 2003 database schema the same. A data model for the Free State Annual Survey Database 2001/2 for the learner entity only is as follows:

1. Learneragefprim and Learneragefsec, ([age][grade]F), learneragemsec and Learneragefsec ([age][grade]M). The sets are: age={3,4,5, …25, 25+}, grade={pp,grr,gr1,gr2, …gr12, pm, sen}.
2. LearnRaceF ([grade][race]F) and LearnRaceM (grade][race]M). The sets used are grade={pp, gr, g1, g2, … g12, sen, pm} and Race={a, w, i, c, o}.
3. LearnHomeLang and LearnTeachLang ([grade][language]). The sets used are grade={pp, gr, g1, g2, … g12, sen, pm} and language={afr, eng, sot, ven, tsw, …}

See Table 5: FS ASS 2001-2 in Appendix A

6.2.4 Western Cape Annual Schools Survey 2001

The Western Cape database schema for 2001 was symbolised as follows:

1. Learner_Age (<age><sex>[grade])
2. LearnerRace (<grade>[race][sex]>)
3. LearnerLanguage (<grade><medium>[language]

6.2.5 Western Cape ASS 2002 and 2003

The database schema for 2002 changed significantly but remained the same from 2002 to 2003. It followed the standardised normalised database structure. Subsequently, no null values and only unique record entries were stored in the database.

1. Ass2002.Learner_Ages (<gender><age><grade>)

2. Ass2002.Learner_Races(<gender><race><grade>)
3. Ass2002.Learner_Languages(<language><grade><medium>)

An investigation into the database schemas of EMIS at the Department of Education showed that the provincial databases of the nine provincial education departments were duplicated and stored on a file server. Data were extracted from individual datasets when aggregated data was needed for analysis and decision-making at a national level. The 2003 datasets indicated that an integrated data store (IDS) had been developed using a normalized database schema. Indication was that the development was at least at a third normal form (3NF). The national Ass2002 matched the database schema used by the Western Cape during 2002 and 2003. See Table 5: DOE IDS 2002-4 Appendix A.

A policy on Information Management had been developed by EMIS and published in the Government Gazette for comment by the broader public. An output of the Education Information Policy was the development of a draft information standards document due to be published for public comment soon.

6.3 General Education Institution Information – a Master list

The second major entity in the South African education system is the Education Institution where learning and teaching activities occur. The category of institutions includes ordinary schools, special schools that cater for learners with special educational needs, further education and training institutions, higher education and training institutions and various other institutions. The institutions as entity, has various attributes that uniquely identifies and characterise the institution. The apparent lack of standards caused problems in the way the nine provincial departments of education, through their EMIS units, identified and characterised their institutions. All the survey instruments proposed by the national EMIS in collaboration with the provincial EMIS units provided the guidelines for collecting the data needed to characterize the institutions. However, each province stuck to its historic classifications in order to attain consistency in their provinces. The database model showed conformance to the national proposal. However, the data submitted by each province differed significantly with respect to certain attributes.

An interesting flaw in the construction of the master list for all the provinces was the request for the address of the institution. Both the postal and physical addresses were requested by line, i.e. addressline1, addressline2, addressline3 and addressline4. The postal and street codes were included in the address lines. Provinces for example Western Cape and Mpumalanga provided separate fields to record the postal and street codes. Not asking for separate street name, township and town or city particulars makes it difficult to extract the number of institutions located in a specific township or city. Since all provinces

included geographic longitude and latitude information in their datasets, it is possible to geographically determine the position of institutions relative to cities or town. Township or suburb information about schools is difficult to obtain because of incompleteness in data collection but may be done using spatial analysis.

Investigation of the provincial datasets of institutions indicated that confusion about the ownership of schools existed. According to South African property laws, all physical structures belongs to the owners of the land as is indicated on the deed of transfer for that property. There is a difference between the physical ownership of the physical education institution building and the education institution as an institution where learning and teaching takes place. The State takes ownership of the management, organization and control of the institution, and the physical structure if it is the owner of the property, called state land. On the other hand, if the physical property does not belong to the State, the state takes control of the institution by agreement according to Section 14 of the South African Schools Act.

Although all the provincial departments of education used the same templates provided by the Department of Education to collect data about the institutions, the information is sometimes mixed in fields. For example, the Western Cape Education Department (WCED) captured information in the sector school-type columns that implicitly contains information that should be captured in another field. For example, the data item “special school” is captured wrongly in the sector column and duplicated in the school type column. The result is that it could not be determined from the sector column whether the institution is a state or private institution, but the required information may be deduced from the data captured in the ownership column which contains information like “farm, church, mine, NGO, state etc.

The information contained in the education institution table is in granular format, which is ideally suited for an integrated information system. Updating the master list in each province and at the national office is an operational process and is triggered by changes in the status of the institution. Some provinces recaptured the data every year, causing the master list, one of the pillars of the integrated education information system, to be unstable. From the provincial datasets studied, it is evident that some institution names were spelt differently year after year. Some provincial institution identifiers (EMIS numbers) also changed. A typical example is that of Kwa-Zulu Natal who had changes in its EMIS numbers. Most of the other provincial databases showed evidence of name changes. Of all the variations of the master list data, changes in the EMIS number caused the most problems. A change in EMIS number caused a break in the data integration linkages, especially with historic data.

6.4. Summary

The data models, database schemas and data dictionaries of the DOE and PEDs including the EMIS survey instruments indicate that in the current formats, EMIS is unable to collect all the information as required by the various education legislation and needed for the execution of the DOE mandate and functions, i.e. the monitoring and assessment of the education system. Extension to the EMIS surveys is costly and time consuming. For example the 2004 Annual Schools survey form is already a lengthy eighty pages. Addition of more questions will extend the form. Since the form must also conform to OCR requirements, redeveloping the form is expensive and time consuming. Acquisition of data at granular level may solve the problem but may add other problems to the list.

Chapter 7 - Trends in the electronic business arena and the solution to information problems of the DOE

7.1 Introduction - Best practices by best in class service providers or vendors

In a survey of 13 vendors by Forrester Research (2004) in the arena of business intelligence (BI) reporting, three of the top companies, namely Business Objects, Cognos and SAS reached the 400 million dollar (R2800 million) estimated annual revenue mark (Gile, 2004:2). IDC rated Business Objects as the leading BI Tools marketing company in 2003 with a 16.5% market share followed by Cognos (10.9%), SAS (9.4%) and other groups (63.2%) in a market share worth $3.88 billion (R25 Billion) in 2003 (Vesset, 2004).

7.2 Business Objects

Business Objects is a business intelligence vendor with 24,000 customers worldwide (Business Intelligence Standardisation, 2004). Business Objects as a BI company promoted standardisation of products in an organisation. They cover the full BI needs from operational or production reporting to dynamic dashboards. The organisation supplies pre-built and customisable applications that fits an integrated enterprise-wide business intelligence strategy. Business Objects promoted a suite of products that included analysis, an application foundation and data warehousing solutions. Business Objects analysis provided mission-critical analysis of each of the business areas in an organisation using pre-packed metrics and analysis techniques in the areas of customer intelligence, finance, human resources management, product and services and supply chain intelligence. Analytic engines are able to discover hidden trends and predictions. Business Objects incorporated best practice warehousing techniques to provide consolidated enterprise data that optimised for reporting and analysis. With their business intelligence suite of products, Business Objects is able to seamlessly integrate any disparate information systems that exist in an organisation. In other words, they are able to build their solution on top of an organisation's existing information system infrastructure. Their solution is able to connect to any data source regardless of format and location (Business Objects, 2004a).

The Business Object Suite is able to create a complete information infrastructure needed for business intelligence reporting. The Suite allows for access, integration, transfer and delivery of enterprise data from any source for reporting, query and analysis, and analytic applications (Business Objects, 2004b). An extra is the ability to accommodate real-time and batch data integration across the enterprise by using ETL packages to build data marts or data warehouses.

7.3 Cognos

7.3.1 Cognos overview

The Cognos Whitepaper (2003) indicated that reporting is the largest and fastest growing component of the business intelligence market with a compound growth rate of 21%. Vesset (2004) indicated an average annual growth rate of 4.3% over a six-year period, which confirms the first figure. Cognos delivered their solution to more than 22, 000 customers in over 135 countries (Cognos, 2003:10).

Reporting is the focus and strategy of the Cognos suite of applications - to manage reporting growth and strive towards reporting convergence and move the systems integration processes to the information technology component (Cognos, 2003:1). Cognos had been setting the trend in both enterprise production reporting and business reporting. The prediction is that customer demand will force the two domains into a "next generation" EBIS market (Cognos, 2003:4), i.e. merging the two reporting categories into one reporting solution. Cognos provided a web-based scalable reporting solution that can address all the reporting needs of an organisation (Cognos, 2003:9). Cognos identified business intelligence reporting standardization as the emerging trend in the corporate world (Cognos, 2004b: 1).

The components of the Cognos Business Intelligence Suite are reporting, analysis, data visualisation, event management, data integration and analytic applications. These components may be applied separately or as an integrated group. The applications are basing their functionality on a standard operating platform and have the ability to extract data from any disparate data source.

7.3.2 Cognos BI suite - Cognos reporting facility

Cognos ReportNet™ is a reporting application that lets the user create, modify and distribute any report to any part of the organization. The result is that one reporting product based on a single architecture is used for all reporting activities, from analysis reports to cover letters, invoices and financial statements, i.e. from business reporting to production reporting. This approach brings about savings in cost in terms of user training, licensing, maintenance, administration and support. By having access to the same data source consistency in report results are achieved. Reports are created from data resulting from querying disparate data sources located at various sites. Data is not duplicated but only joined and viewed - a federated approach. The suite can be utilised globally, i.e. it has multilingual capabilities, is completely web-based and is accessed by a standard web browser, and is able to scale to many thousands of users.

7.3.3 Cognos analysis tools

Cognos PowerPlay™, the business analysis tool performs online analytical processing (OLAP) on consolidated data stored in relational databases. With its ease-of-use, any user in the organization is able to analyse organizational data by pointing, clicking and dragging. The tool is Web-based, transactions are performed at server level and only the results are returned to the users. This results in increased performance. The tool is scalable over the enterprise. OLAP structures from various other vendors for example Microsoft SQL Server Analysis Services, SAP BW, IBM OLAP for DB2, and Hyperion Essbase is reachable by the Cognos Analysis tool.

7.3.4 Cognos visualiser

It is Cognos's view that management should view information in an attractive and functional way and format. Cognos termed its executive information views as "dashboards". Corporate dashboards are able to show highly aggregated data as indicators and trends on a single view as graphs, tables and pictures. Data is drawn from existing OLAP cubes and any other data that is relevant. The user is able to drill-through to view more detail when needed.

7.3.5 Cognos data integration through the product Cognos DecisionStream™.

DecisionStream is a powerful data integration tool offering ease of administration and automation (MacDonell, 2004). The specific tool is able to make operational data ready for reporting as well as utilising dimensional data from data warehouses or data marts for report writing. The tool is therefore functional in both a federated and consolidated data environment. By being able to extract and transform operational data it is able to supply real-time data for immediate use and therefore decreasing the latency time of data requests. However, data inconsistencies may occur since operational data is not static. By using the ETL facility to consolidate data into an integrated data warehouse, the user gains access to accurate and consistent data for reporting.

7.4 SAS

7.4.1 SAS overview

SAS proved themselves as leaders in the IT/IS industry. They had 26 years of doing business in the IT/IS industry and dealt with approximately 40,000 customers across every global industry, which includes about 90% of the Fortune 500 companies (SAS, 2002a: 3). SAS developed a framework proven to work in any environment or industry. SAS may be regarded as a best-in-class organisation whose strategic

frameworks may be regarded as “best practices”. The vision of SAS is to establish an end-to-end intelligence framework and the technology to optimise the performance of each component of the enterprise using technology that is standards-based and platform independent, transportable and adaptable (SAS, 2002a: 4).

SAS has developed a strategic framework for delivering high-value enterprise intelligence called the SAS Intelligence Value Chain (SAS, 2002a: 1). The objective is to optimise the value of each component resulting in accumulated value for the organisation. The one component builds on the previous one – always adding value to the pool.

Trends, for example deregulation of industries, globalisation, commoditisation, the Internet and political uncertainty need to be recognised and acted upon within the enterprise. SAS argued that the only way to react to such market forces is by creating the value chain in the enterprise where each component can act to its specific environment and area of expertise and at the same time increase its value and the accumulated value of the organisation. In a framework where IT is part of the value chain, it is able to quickly align its infrastructure to support the dynamic needs of the organisation (SAS, 2002a: 2).

7.4.2 Components of the value chain in brief

7.4.2.1 Planning

The SAS intelligence value chain includes components with the potential of adding value, namely the plan, ETL, intelligent storage, business intelligence and analytic intelligence. SAS utilised its experience gained in hundreds of business cases (SAS, 2002a: 1, 5) and developed best practice roadmaps supported by integrated, industry-specific analytical models, project methodologies and consulting expertise. By using these pre-built analytical data models within the planning phase, the outcomes are reduced implementation time and risk and quick return on investments. The integrated approach enables an organisation to share the same data, which ensures consistent results for decision support.

7.4.2.2 ETL

Making the ETL processes a part of the value chain ensures that ETL is not a separate process that pushes data to the various components based on their individual needs. In the value chain framework, the ETL process provides the organization with integrated high quality data extracted and transformed from disparate and heterogeneous data sources situated anywhere in the organization. The ETL process utilises industry standard SQL, is platform independent, creates complete sets of end-to-end metadata and

provides an easy to use graphic user interface. The SAS ETL utility extends the value of the existing legacy systems, hardware and ERP investments that an organisation may have (SAS, 2002a: 6).

Decision-making and planning are based on high volumes of data accessed by a small number of information users. Normal relational database platforms are not optimised for these types of activities (SAS, 2002a: 7). Relational databases are utilised for transactional or operational processes, i.e. many hundreds of transactions performed by many hundreds of users at the same time. To solve this specific problem SAS provided a platform that is able to cater not only for the information needs of business planners and decision makers, but also for the operational needs of the organization. The SAS solution includes relational, OLAP and parallel storage options based on industry standards, for example SQL, metadata frameworks and XML.

7.4.2.3 Business Intelligence component

The business intelligence component is added to the value chain to get rid of multiple point solutions. In other words, the BI component provides one point entry for information requests. The BI component is built on the results of and is fully integrated with the ETL and intelligent storage component. The BI component provides an easy to use graphic user interface that empowers users by giving them access to information in the format they need, when and where they need it (SAS, 2002a:8). An important factor is that through the intelligent storage functionality, users are able to re-use past analysis reports and thereby saving cost and time. In this regard, it also acts as a collaborative medium linking various previously isolated specialists in the organization (SAS, 2002a:8).

7.4.2.4 Analytic intelligence

While business intelligence is about understanding the past, analytic intelligence is about predicting the future (SAS, 2002a: 9). The focus points of the last component of the SAS value chain are predictions, modelling, forecasting, optimisation and simulations. SAS provides best-in-class modelling capabilities, a wide portfolio of analytic algorithms, mathematical data manipulation and modelling capabilities (SAS, 2002a: 9) and provide these to analysts on easy to use user interfaces and visualization techniques. Again, the analytic intelligence component is tightly integrated with the business intelligence, intelligent storage, ETL and planning components and by using their functionality not only adds value on its own but also additional value to the other components.

7.5 Summary

A comparative analysis of the SAS, Business Objects and Cognos solutions showed some commonalities, in the form of ease of use, single point of entry, web-based interface, use of the Internet technology, data federation, a single standardised platform as well as using recognised industry standards that are crucial to any integration process.

With the value chain framework, SAS is able to extend the value of systems and data that is already available in the organization. Each component adds incremental value to the organization. The result is a reduction in cost, increased return on investment, reduced training needs and an integrated information use infrastructure. The cons of such a framework are that although components later in the chain are able to function on their own, they are dependent on the components that come before that. In short, a failing link in the chain will cause serious problems for the organization as a whole.

By identifying an emerging trend in BI and reporting standardisation, Cognos developed the BI suite or solution that was adopted by 22,000 organisations in 135 countries, i.e. the Cognos BI suite became a globally recognised EBIS reporting solution and can certainly be classified as “best practices” performed by a “best-in-class” service provider.

Chapter Eight – Conclusion and recommendations

8.1 Information management, information systems and the information system plan

Chapter 2 dealt with the current theory and practices of practitioners and researchers in information, information management, information systems and information systems management. The researcher used current publications on the topic as well as up to the minute information from influential researchers extracted from the Web. Literature from the Web was justified because of the rapid development in the electronic information arena. Chapters 5, 6 and 7 provided the necessary information that may be used to construct a recommendation that on application will enable the Department of Education to efficiently and effectively manage their information in a web-based integrated enterprise-wide information system platform

To ensure that the management of information in the Department of Education is not a specifically information technology centered, the management and organisational issues as proposed by Laudon and Laudon (2002) are incorporated. In other words, the researcher made sure that information management is a "socio-technical" process. A particular issue of information system management is how to deal with the magnitude of disparate information systems that are present in the Department of Education. Throughout the report emphasis was placed on an information system for the DOE. If an enterprise information system is to be a solution to the DOE's information system problems, then there must be exactly one information system. Because of the size of the DOE, it is inevitable that the building blocks of the enterprise system will be smaller information sub-systems. The sub-systems may play their individual roles but must always collectively increase the value of the whole system.

The second issue that is important to the Department of Education is the choice between a federated and consolidated information system. The organisational nature of the education system forces the DOE to consider both and create a hybrid information system for the country. The digital divide is still a reality in South Africa. The research showed that approximately than 10.3% of the education institutions had access to e-mail facilities in 2003 while less than 6% had access to the Web (Table 7 in Appendix A). The implication is that a paper-based data collection and transport process is still a reality. The human resources and skills scarcity at district level left as the only option a centralised information system at provincial level. The Department of Education and the provincial education departments may form a federation of information sub-systems.

An extensive literature review indicated that most large organisations had similar problems as the DOE when it came to information management and information systems management. Data quality issues are a global phenomenon and all the vendors and service providers made many innovative attempts to solve the information quality problems in their unique way. A common data thread was identified as long latency time, inconsistency, inaccuracy, redundancy, irrelevance and ambiguity, mostly caused by the magnitude of disparate data capturing systems – under the banner of information systems – created in silos. A solution is data integration, but as indicated, that is a complex task. For a large organisation with an existing information systems architecture, the only solution is to start with the development of an information systems plan with the objective to build an enterprise-wide integrated information system. An acknowledged trend is the enhancement of such a system by using the Internet as the enabling technology.

The Internet forms the basis for Web services that make electronic business a possibility. Web portals, specifically enterprise information portals form the single point of entry to an organisation's integrated information system. A business intelligence solution forms the middleware or layer between the portal and the integrated data storage. An ideal business intelligence solution should provide the total information management package, that is from data capturing, ETL, analysis, production reporting to business reporting in an enterprise mode.

The process model of information management provided the justification for choosing the well-known information systems planning framework and methodology as the basis for developing an enterprise-wide integrated information system for the Department of Education. The framework of the ISP provided the guidelines and methodology for the planning process. The first component included the identification of the information requirements of the business processes of the DOE. The process included determining the vision, mission, strategies, objectives and measurements. The objective was to determine the minimum information needed for decision-making and planning. Because of the limited scope of the research project, the researcher assumed that the education legislation was the primary source to be used for determining the minimum information requirements. It was argued that the senior management vision, mission and objectives were derivatives of the primary duties and obligations of the State as included in the relevant legislation and Constitution.

The second component of the ISP framework proposed an audit of the state of EMIS in terms of information systems and information management processes. An analysis of the state of information management included information gathering processes and data storage. The objective was to benchmark the current EMIS processes. The third ISP component guided the researcher towards determining trends in

the e-business arena with respect to information systems management. An intelligent scanning of the electronic information systems environment highlighted emerging trends that high profile organisations exploited to gain a competitive edge over their competition. Because of the pervasiveness of the particular organisations and their success-rate it was accepted that their solutions to the information systems dilemmas amount to “best practice” methods. In order to save time and minimise the risk of implementing inefficient information systems, best practices may be accepted as solution to an organisation’s specific problems.

The education legislation and Constitution that was analysed, gave a clear indication what the obligations and duties of the Department of Education are. The main duties are evaluation and monitoring of the performance of the education system. To measure performance, specific information from the environment is essential. This is collected by the annual EMIS surveys. An analysis of the EMIS surveys indicated that the current data collection is not sufficient. An investigation into the data models of the Department of Education indicated that there was a mismatch between the survey instruments and the data captured. The database schemas were mostly inefficient and lacked standardisation.

8.2 Interpretation of the results

The research confirmed the existence of a multitude of disparate databases and data capturing systems that was unable to communicate and integrate the datasets. The lack of standard data modelling processes, a lack of database schemas and data definitions caused the isolation. The organisational nature of the education system complicated the problem further. The nine provinces functioned autonomously, although education is a national competency in terms of section 126 of the Constitution, but the Constitution stressed cooperation, collaboration and administrative competence. Therefore, the information system may be classified as a hybrid system, i.e. a federated system clustered by a consolidated monitoring information system. These characteristics posed serious challenges to the service providers or vendors of information system solutions to the Department of Education. Another challenge is the lack of information technology infrastructure on an education institution level, causing information capturing to take place manually. A negative consequence of the manual or paper-based capturing process is the manual transportation of survey forms to provincial offices for capturing at their premises.

8.2.1 Information required and acquired using survey instruments and benchmarks

Legislation gave explicit indication of what is required by the State and the Department of Education in particular. The focus of the Constitution and education legislation is equity, redress and basic rights. The

establishment and governance of education institutions are stipulated in the legislation regulating the various sectors of the education system, namely general education and training, further education and training, adult basic education and training and learners with special needs education, among others.

The Department of Education is responsible for developing and enhancing the South African education system as well as monitoring and evaluating the progress made in developing the system. The primary concern of the Department of Education is to determine if the legislative requirements were met. For evaluation and measurement, a minimum set of information is required. According to legislation, the responsibility of information acquisition was bestowed on the EMIS units in the provinces and nationally. In response to this obligation, information acquisition processes were put in place. To determine the state of information management in EMIS, these acquisition processes were investigated.

6.2.2. Analysis of information acquisition processes

EMIS interpretation and response of the legislative information requirements resulted in the development of survey instruments that were used in surveys that were conducted annually. The coding schema developed in chapter 4 was used to construct a model of each survey instrument. When comparing the survey instrument models to the minimum legislative information requirements it became clear that the surveys could not meet the needs or information requirements of the legislation. For example, in terms of equity and redress, the Annual Schools Survey collected information on learners in terms of race, age, sex, language of teaching and learning, home language, disability, causes of death, successes and transfers. The collection of information is such that data had to be aggregated and completed in tabular format. It was impossible to determine the impact of the current education system on the different race groups in the country especially with respect to age, medium of instruction versus home language, success rates, provision of social grants and the cause of death during school years. In other words, there was no way of determining whether the education system is succeeding in terms of equity and redress with respect to the different race groups, and in particular the historically disadvantaged groups.

Equity and redress indicators can be determined in terms of the staff of education institutions since their information was acquired in granular format, that is, questionnaires per individual staff member.

Legislation and the derived policies and regulations gave a clear indication of what was required by the State in terms of service delivery and development. Terms for example “shall” and “must” placed obligations on the State, particularly the Department of Education, to bring about changes in the education system, especially in terms of equity and redress. Specific information was, and still is needed to test whether the State had indeed succeeded in meeting its obligations.

Interviewing senior management to determine the information requirements of the Department of Education was considered as an option but a literature review of information system planning indicated that interviews do not always gave the appropriate results. The information obtained via interviews as well as policy directives, regulations and strategic planning documents were secondary sources of information pertaining to information requirements because these documents were all derivatives of the primary legislation.

The required information was acquired by conducting surveys in the education system. The acquisition was incomplete since not all the acquired information, especially those needed to monitor progress in equity and redress, were collected. For example with all the surveyed data up to 2004 it was not possible to determine the ratio of the number of learners per race not taught in their home language up to a certain age. Changes to the surveys are urgently needed. The only effective solution is to adopt the granular record level methodology where all the possible attributes of an entity are collected and not aggregated at the source.

8.2.2 State of information management – confirmation of information quality

The factor that influenced information quality in EMIS that was determined by the research investigation was confirmed by the factors recorded in the literature. The information management problems that the DOE faced, was typically those of any other large organisation. The research findings also showed that there were organisations that were able to provide solutions to the particular problems, specifically information quality. It was found that long delays caused in publishing information, after conducting annual surveys, were attributed to collecting aggregated data that were in some cases duplicated. The educator information collection during the Annual Schools Survey is a typical example. Aggregating information is a time-consuming and a complex process. At the same time calculation errors are imminent, and if undetected, may lead to invalid data. The manual distribution and collection of paper-based information caused more delays. The organizational structure of EMIS is such that data capturing of all the surveys took place at a provincial level, specifically at the EMIS offices. The result was that capturing took place at nine locations in the country with a survey capturing spread between 478 (Northern Cape) and 6087 (Eastern Cape) education institutions per province (Department of Education, 2003). Further time delays are caused at the Department of Education before national education statistics could be released. The primary reason for the delays was the time taken to extract, transform and loading provincial data from disparate databases into an integrated central database.

Inconsistencies in the disparate databases over yearly periods, the duplication or replication without synchronization of databases within provinces, was the main reason for inconsistencies in information used for decision-making and planning.

Time delays caused information to become irrelevant and even redundant. Delays in the availability of timely data at a national level were due to various factors. One factor was the disparate databases in each of the nine provincial departments of education, caused by lack of standard database schemas and data definitions. The ETL process could not be automated because it had to cater for each individual dataset. The ETL application also had to be redeveloped because the database schemas changed on a yearly basis. Incomplete submissions led to the return of datasets to provinces causing further delays in information delivery. Inconsistencies and inaccuracies lead to a loss of integrity. These factors mentioned above contributed to the low quality of information in the education system.

Analysis of the various survey instruments that were used in the education system indicated that there was opportunity to misinterpret the questions, for example it was not clear what was meant by the term urban/rural location. In aggregation tables the age group 25+ was meant to include learners who were 26 years and older. The symbol 25+ may be interpreted as 25 years and over. Type of education institution had different meanings in a number of the survey instruments. Ambiguity cannot be solved when data had been aggregated.

8.3 Confirmation of results

The research scope excluded an investigation into the content of the databases. A cursory investigation showed that most of the data did not go through a verification and validation process. The conclusion is that validation and verification issues both at collection and capturing level need to be addressed, otherwise the accuracy of information will always be low.

The investigation into the state of information management in EMIS as required by the research project, confirmed the suspicions of the researcher. The first reason for the inability to provide timely, accurate and consistent information to all the information consumers in the education system was the presence of numerous disparate small information systems that are unable to communicate with each other as well as disparate databases that contained inaccurate, inconsistent and duplicated data. The second reason was the lack of information standards and data models for the education system. The third reason was the apparent

lack of skills and capacity of EMIS personnel to develop efficient databases and data capturing applications.

8.4 The significance of the research results and relevance of the study

8.4.1 Proposed information system – information as valuable resource

The Department of Education consists of the national and nine provincial education departments where EMIS is responsible for education information management. Each provincial department of education has its own unique information requirements. It thus makes sense for each department to have its own unique information system, but education is a national competency as determined by the Constitution, NEPA and SA Schools Act. At a national level, there are minimum information requirements in terms of service delivery, evaluation and monitoring the performance of the education system. Although provinces would like to have their information stored at their level and in their control, these same information need to be available at a national level at any time when needed. Two options are recommended to solve the national education needs. The first one is to consolidate all the provincial information at a national level through a complex ETL process. The second option is to consolidate only the information that is critically needed for decision-making and planning into a central data warehouse and leave the information specific to each province in the provincial data stores or data marts. Extra information may be extracted from provincial data marts when needed. The second strategy would enable information to be proactively consolidated into a central repository and made available when needed. This gives the impression that information is available to the information consumer immediately. The second option also enables provinces to have control over their own information but at the same time make it available for national use. The proposed information system is therefore a hybrid system that is a combination of a federated and consolidated information system. The information management processes and information system development that follows in the recommendations are built on these premises.

8.4.2 An IS model for the South African Education system – the best practice solution

The ideal solution for the Department of Education is a web-based, integrated enterprise information management solution based on a hybrid federated and consolidated education information system. Because of the available technology there is no need to centralize all the components of the IS. With the Internet technology available, it is possible, and this is in fact proposed, that a complete IS be implemented in each PED. This is necessary since each province specifically the PED’s, have their unique informational needs apart from the standard national information requirements. The purpose of the

provincial IS is to provide a centralized IS that will service all the district offices and the individual education institutions. The implication is that each education institution will log in to the system via an EMIS Web portal, download the latest data capturing applications and capture their data locally. After verification and validation locally the captured data is uploaded electronically via the Internet to the PED IS. A feedback loop is created via the EMIS portal so that a real-time interaction between the individual education institution and the PED ISM is possible. At the provincial level, data are cleansed, consolidated and integrated by an ETL process and uploaded into a data mart. This process is necessary to separate the operational data from the static business information. As indicated earlier, operational data is only relevant for real-time production reporting while business reporting relies on consistent and stabilized business information.

The IS model proposed that the provincial data reside at a provincial level where they retain control over and ownership of their data. The second part of the EIS consists of the national part based at the DOE and managed by the national EMIS unit. The model proposed that the national EMIS, also called the DOE EMIS unit host the national data warehouse and a business intelligence solution linked to the EMIS Web portal. Because of the duties and obligations of the DOE EMIS unit, they need to have access to time-series information that is not necessarily provincial specific, when required. The model makes provision for DOE EMIS to log on to the EMIS Web portal and view relevant provincial information residing in their provincial data marts. On the selection of the required information, that information is uploaded, in aggregated or unit record format and loaded into the national data warehouse for further use. If real-time information is needed from individual education institutions, the DOE will be able to log on to the IS via the EMIS Web portal and extract the information from the provincial operational data stores. In this way the national department will have access to accurate up-to-date information immediately.

Technology is such that the DOE EMIS unit is able to view all the components of EIS as if it were centrally situated. In reality, the components are situated at provincial level and interlinked via the Internet. The advantages of such a system is that:

- The collection, validation, capturing and validation are done at the lowest level, i.e. the source of the data.
- The capturing of granular records removes the collection of aggregated data, which act as data filters.
- Management at all levels has direct access to real-time information as well as time-variant and consistent information. No time is wasted on complicated ETL processes since the data collection process are based on standard operating procedures and data modeling and data transfer standards.

- Information is selectively available via the EMIS Web portal to the broader public so that less official time is spent on ad hoc requests from the public.

The success of the EIS is dependent on numerous factors. Firstly, approximately 90% of education institutions in South Africa do not have access to email facilities, the minimum requirements for real-time information transfer via the Internet. The only possibility is therefore paper-based capturing at the lowest level. Electronic capturing has to move up to the next level, i.e. the district level. Most district offices in PED's have the use of computers with links to Internet facilities, based on the infrastructure provided by SITA, but on a district level it is the lack of human resources that is a risk factor. The next level is the PED's. PED's have been formally capturing aggregated education information since 1996. The capturing of granular records, which the EIS model proposed, will have an impact on the human resources of the PEDs. A possible solution to that problem is the inclusion of the existing optical mark recognition (OMR) or optical character recognition (OCR) capturing technology in the system.

The efficiency and effectiveness of the EIS will depend on how soon all the education institutions will be online and able to capture their information at the lowest level. The challenge to the Department of Education is how soon they will be able to provide all education institutions with the minimum infrastructure to make such an electronic link possible.

6.4.3 Relevance of the study

The research project established an information system development framework based on the acknowledged information process model. It also provided the methodology for determining the information requirements of the Department of Education, which may be used by any other governmental organisation that has similar information problems. The organization need not have the same organisational structure since the "best practice" methodology proved to be universally implementable, i.e. in public or private sector organisations.

The research also showed that in order to build an enterprise-wide information system, it need not decide between a centralised and a federated system, but build a system that shares the pros and cons of both types of system, i.e. a hybrid information system.

8.5 Summary

Determining the minimum information requirements of the Department of Education is a complicated task, since it is easy to collect all the information possible and be swamped in an information overload.

The critical task is to interact with the education legislation as primary source of information requirements. The legal sphere is a specialist area in itself. The second critical challenge is for the information system unit of the Department of Education to decide quickly on best practices and build an enterprise-wide information system that will enable the Department of Education to add value to the volumes of information that it had gathered and proactively act on information gathering processes that it is supposed to gather for future planning.

An integrated enterprise-wide education information system based on Internet technology is possible if the development of such a system is done scientifically and within the framework and methodology of an information system plan. The information system plan must be based on the principles of information process model, which include the motivations for acquiring the relevant information required for critical decision-making and planning in the education system, the efficient and effective acquisition, organization and storage of information, the processing of such information to increase its value and the value of the Department of Education and its components. An essential component is that which complete the information cycle, i.e. the return of information from the information consumer to the information provider.

With the speed at which technology develops and the urgency at which information is required, it makes sense that there is not enough time to “re-invent the wheel”, hence the adoption of “best-practice” methods by “best-in-class” vendors or service providers. The strategy implies adopting “best practice” methods and avoiding the pit-falls and risks identified by organizations that tried the practices beforehand. It is agreed that not all best practice solutions will be a perfect solution to an organization’s problems but the cost of project failure will be minimized.

The ISP framework and methodology indicated that decisions on the minimum information requirements of the Department of Education should be based on the outcomes of personal interviews with senior management. The researcher opted to use only the legislative framework as primary source of information requirements instead of verifying these information requirements against the requirements and needs highlighted by senior management. A final research question is posed: Is it possible to use only legislation as a primary source of information to determine the information requirements of a government department such as the Department of Education?

9 References

Best Practices LLC, 2003. What is Benchmarking? [online].
Available: http://www.best-in-class.com/site_tools/faq.htm - benchmarking [May 2003]

Brainstorm. 2002. Integration Survival guide [online].
Available: http://www.brainstorm-group.com/bsgweb/whitepaper.asp [February 2004]

Bray, E & De Groof, J (ed.) 1996. *Education under the new Constitution in South Africa*. Leuven: Acco.

Brown, B.D. 2001. *Oracle 9I Web Development: Develop and deploy E-Commerce Applications in an Oracle Environment*. New York: Osborne/McGraw-Hill.

Bocij, P. [et al.] 1999. *Business Information Systems - Technology Development and Management*. London: Pittman Publishing.

Botha, D. 2003. Reader: *Information Management*. Stellenbosch: University of Stellenbosch.

Business Intelligence Standardisation. c2004 [online].
Available: http://www.businessobjects.com/products/bistandardisation/bobjstandardization.asp [August 2004]

Business Objects, 2004a. Information infrastructure [online].
Available: http://www.businessobjects.com/products/infoinfrastructure/default.asp [August 2004]

Business Objects, 2004b. Data Integration [online].
Available: http://www.businessobjects.com/products/dataintegration/default.asp [August 2004]

Castells, M. 2000. *The Rise of the Network Society*. 2nd ed. Oxford: Blackwell Publishers.

Campbell, H.M. & Pellissier, R. 2000. The role of organizational knowledge management strategies in the quest for business intelligence [online].
Available: http://www.sabusinessreview.co.za/December 2000/IT-special-feature/campbell.htm [2002-10-31]

Chang, B. 2001. *Oracle 9I XML Handbook*. New York: Osborne/McGraw-Hill.

Choo, C.W. 1991. Towards an information model of organizations. *The Canadian Journal of Information Science*, 16(3): 32-62.

Choo, C.W. 1998. *The Knowing Organization. How organizations use information to construct meaning, create knowledge, and make decisions.* New York: Oxford University Press.

Cross, M. (ed.) 1999. *MCSD Analyzing Requirements*. New York: Osborne McGraw-Hill.

Cognos Incorporated, 2002. *Choosing standards from BI and Reporting*. Cognos Incorporated

Cognos Enterprise Business Intelligence [online].
Available: http://www.cognos.com/products/Enterprise Business Intelligence.htm [April 2004]

Cognos. 2003. See Cognos White Paper.

Cognos White Paper. 2003. *Setting the Standard*. Burlington: Cognos Incorporated.

Cognos. 2004b. Choosing a standard for BI and reporting. Burlington: Cognos Incorporated.

CRM Phenomenon White Paper [online]. Available: http://magic-sw.com/ [May 2000]

Darlington, J. 2004. Grappling with information overload [online].
Availablehttp://www.sun-sentinel.com/sport/college/gators/ort-sptufbeat1808104aug18,0,2207723.story?coll=tf-gators [August 2004]

Davenport, T & Harris, J. 2004. Accenture Institute for High Performance Business: Automated Decision Making [online].
Available: http://www.bettermanagement.com/library/library.aspx?libraryid=9370[2004-04-21]

Department of Education, 2001. *Report on the School Register of Needs Survey 2000*. Pretoria: Department of Education.

Department of Education. 2002. A statement of policy by the Minister .of Education. *Strategic Plan 2001-2003.*

Department of Education, 2003. *Manual on the Promotion of Access to Information Act (Act 2 of 2000).* Pretoria: Government Printers.

Department of Public Service. 2001. *Handbook on minimum information interoperability standards (MIOS).* Pretoria: Government Printer.

Devlin, B. 2003. Information integration – Distributed access and data consolidation. IBM Software [online].Available: http://www.ibm.com/software/data/integration [March 2004]

Du Plessis, M. 1999. HP preps e-services. *Computerweek*, 22(6): 7.

Field, T. 2002. *Integration uber alles*. (see Brainstorm, 2002).

Firestone, J.M. 2002. Portal Progress and Knowledge Management [online].
Available: http://www.kmci.org/[October 2002]

Fisher, T and Marinos, G. 2003. Better decisions through better data quality management [online].
Available: http://www.dataflux.com/data/dm.pdf [April 2004]

Fitzloff, E. and Gardner, D. 1999. News: Web opens enterprise portals [online].
Available: http://www.computingsa.co.za/1999/02/01/News/new26.htm [2002-10-15]

Further Education and Training Act 98 of 1998. Government Printer: Pretoria.

Gartner Group, 2003. Gartner Glossary of Information Technology Acronyms and Terms, May 2003.
Available: http://www4.gartner.com/6_help/glossary/Gartner_IT_Glossary.pdf[January 2004]

Gile, K. 2004. Grading BI Reporting and Analysis Solutions. Forrester Research Inc.
Available: http://www.Forrester.com [August 2004]

Gottschalk, P. & Hogskolen, P. 1997. Strategic Information Systems Planning: The Implementing Challenge [online].
Available: http://bsb.taylor.edu/ramsower/aus.ac.98/papers/gottsch.htm [February 2004]

Haas, L. & Lin, E. 2002. Federated database technology [online].
Available: http://www-106.ibm.com/developerworks/db2/library/techarticle/0203haas.html [April 2004]

Harding, E. 1998. BSP concepts [online].
Available: http://oz.plymoth.edu/[December 2003]

Hayes, H.A. 2003. Creating a flexible infrastructure for integrating information. Oracle Software [online].
Available: http://www.ibm.com/software/data/integration [March 2004].

Hodge, G. 2001. Metadata made simpler. [online].
Available: http://www.niso.org/metadata made simpler.htm [2002-07-23]

Holloway, S. 1988. *Data Administration*. Aldershot: Gower Technical Press.

IBM GSC, see IBM Global Services Consulting.

IBM Corporation, 2001. IBM Global Services – KCM Practices [online].
Available: http://www.ibm.com/services/kcm [June 2001]

IBM Global Services Consulting, IBM Portal Services: Managing information for better decision making [online].
Available: http://www-1.ibm.com/services/kcm/kcm_portalservices.html [October 2002]

IDC. 2004. Data integration and data warehouse generation [online].
Available: http://www.bettermanagement.com/ [May 2004]

Jambga-Hilliard, T. 2001. Intranets help workers share information [online].
Available: http://www.fingaz.co.zw/fingaz/2001/January/January31/463.shtml [2002-10-15]

Jordaan, OJ and Pellisier, R. 2000. Exploratory research on the measurement of change in organizational structure caused by information systems. *South African Business Review*, July 2000.
Available: http://www.sabusinessreview.co.za/july2000/articles/exploratory_research.htm [May 2004]

Kalakota, R. & Robinson, M. 2001. *E-Business 2.0 Roadmap for success.* Boston: Addison-Wesley.

Laudon, K.C. and Traver, C.G. 2002. *e-Commerce – business technology, society*. Boston MA: Addison-Wesley.

Laudon, KC and Laudon, JP. 2002. *Management Information Systems: Managing the digital firm.* 7th ed. New Yersey: Prentice-Hall, Inc.

Layman, A., Paoli, J., De Rose, S. & Thompson, H.S., 1997. *Specification for XML data*. Microsoft Corporation: MSDN Library Visual Studio 6.0

Lederer, AL, Sethi, V. 2001. The Implementation of Strategic Information Systems Planning Methodologies. *MIS Quarterly,* September 1988: 444-461.

Losee, RM. 1989. Minimizing information overload: the ranking of Electronic Messages, *Journal of Information Science*, 15: 179-189.

Loshin, D. The value of business intelligence [online].
Available: http://www.bettermanagement.com/ [July 2004].

MacDonell, G. in Cognos Enterprise Business Intelligence: Data Preparation/ETL [online].
Available: http://www.cognos.com/products/business intelligence/data integration/ Data Preparation/ETL.html [April 2004]

Magic Software Enterprises Ltd. 2000. The CRM Phenomenon White Paper [online].
Available: http://www.magic-sw.com/[May 2000]

Marchand, D.A, Davenport, T.H. et al. 2000. *Mastering Information Management*. London: Prentice Hall.

Makhatha, L. 2003. *Master Systems Plan Development Proposal for the Department of Education*. Pretoria:

Miami-Dade Community College. 1997. Master plan for Technology: Information Systems [Online].
Available: http://www.mdcc.edu/ctc/mdcc technology master plan - Information systems.htm[May 2003]

Microsoft Corporation. 2000. *Microsoft SQL Server 2000 Books Online*. Microsoft Corporation.

National Education Policy Act 27 of 1996. Government Printer: Pretoria.

National Education Information Policy Notice 1950 of 2004. Government Printers: Pretoria.

O'Brien, JA. 1999. *Management Information Systems*. 4th ed. BOSTON: Irwin/McGraw-Hill.

Osterle, H, Fleisch, E. & Alt, R. 2000. *Business Networking- collaborative processes at work*. Berlin: Springer.

Perkins, A. 1997. *Whitepaper - Enterprise Information Architecture*. Visible Systems Corporation.

Pilot White Paper, 1999. Customer Intelligence: Business Intelligence for CRM Solutions [online]
Available: http://www.pilotsw.com/r_and_t/whtpaper/crmwhtpaper.htm [May 2000]

PortalCommunity, 2002. The Definitive Enterprise Portal Resource [online].
Available: http://www.portalcommunity.com/library/fundamentals/fundamentals.com [October 2002]

Reed, B.J. 2001. *Strategic Information Systems Planning in U.S. State Governments: Status and prospects indicated by quantitative analysis of year 2000 government performance project data*. Government performance project.

Republic of South Africa Constitution Act 200 of 1993. Government Printer: Pretoria.

Rowley, J. 1995. Strategic Information Systems Planning. *Information Services and Use*, 15(1): 57-66.

Rowley, J. & Farrow, J. c2000. *Organizing knowledge: an introduction to managing access to information.* Aldershot : Gower.

SA Explorer [CD ROM]. 2002. Release August 2002, version 2.01. *Municipal Demarcation Board*.

SAS 2001. SAS Whitepaper: The SAS Information Delivery Architecture [online].
Available: http://www.sas.com/. [February 2004]

SAS, 2002a. SAS Whitepaper: The SAS Intelligence Value Chain [online].
Available: http://www.sas.com/ [October 2003]

SAS, 2002b. SAS Whitepaper: Exponentially enhance the Quality of Your Data with SAS ETL [online].
Available: http://www.sas.com/ [October 2003]

SAS 2002c. The Power Behind the Intelligent Enterprise. *SAS Whitepaper*. Heidelberg: SAS Institute Inc.

SAS 2002d. Best Practices approach to Government Technology Solutions. *SAS Whitepaper*. Heidelberg: SAS Institute Inc.

SAS 2003. SAS Whitepaper: SAS Enterprise Guide – A Roadmap [online].
Available: http://www.sas.com/. [February 2004]

South African Schools Act 84 of 1996. Government Printer: Pretoria.

South African Quality Assurance Act 58 of 1995. Government Printer: Pretoria.

Segars, A.H. [et al.] 1998. Strategic information systems planning success: an investigation of the construct and its measurements. *MIS Quarterly*, 22(2)

Sherman, R. 2003. BI Briefs: Mars, Venus and a successful Business Intelligence Architecture. The Thompson Corporation and DM Review [online].
Available: http://www.bettermanagement.com/library/library.aspx?pagetype=1&libraryid=8252
[April 2004]

Sybase SA, 2000. Portals open up the world of e-commerce for banks [online].
Available: http://www.sybase.com/Enterprise [2002-10-15].

SITA, 2003. *Presentation: Project Charter for the DOE* Pretoria: State Information Technology Agency

Skyrme, D.J. 1999. *Knowledge Networking: Creating the collaborative Enterprise*.Johannesburg: Butterworth-Heinemann.

Sullivan, CH. 1985. Systems planning in the information age. *Sloan Management Review*, Winter 1985.

Sutherland, E. 1994. Business Systems Planning [online].
Available: http://sutherla.tripod.com/mgmt550/ibm_bsp.htm[May 2003]

Swanepoel, E. 1999. "The Role of IT&S (Information Technology and Systems) In the Transport Arena" [online].
Available: http://www.its.usyd.edu.au/conferences/thredbo/thredbo_papers_6/Ernsts~1.doc [May 2003]

Sybase SA, 2000. Portals open up the world of e-commerce for banks [online].
Available: http://www.sybase.com/Enterprise/portals open up the world of e-commerce for banks.htm [2002-10-15]

SRN, 2001. See Department of Education, 2001.

Taylor, AG. 1999. *The organization of information*. Englewood: Libraries Unlimited

The Knowledge Management Connection. 2002. Corporate portals, Knowledge portals [online].
Available: http://www.kmconnection.com/pguide/KSP200109.htm [2002-10-15]

Ulrich, W.M. 2002. *Making a Business Case for Legacy Transformations*. See Brainstorm, 2002.

Vesset, D. 2003. IDC: Overview of Business Analytics [online].
Available: http://www.bettermanagement.com/library/library.aspx?pagetype=1&libraryid=8077 [April 2004]

Vesset, D. 2004. Business Objects – leading the Business Intelligence tool market in 2003 [online].
Available: http://www.idc.com [August 2004]

Vesterli, SE. 2001. *Oracle Web Applications*. Berkley: Osborne/McGraw-Hill

Vollmer, K. *Being prepared for integration*. (see Brainstorm, 2002).

Wauts, S. 2002. SITA GITOC Wokshop: Master Systems Planning [online].
Available: http://www.sita.co.za/ [May 2003]

Weill, P & Vitale, M. 2001. *Place to Space – migrating to e-business models*. Boston MA: Harvard Business School Press.

WCED, 1999. See Western Cape Education Department, 1999.

Western Cape Education Department. 1999. *Information Technology: Domain Architecture Document – Presentation slides*.

Wilkerson, P. 2002. Leveraging IT for Business at the Home Depot. See Brainstorm, 2002.
Ventana Research. 2003. Standardising Business Intelligence. Belmont: Ventana Research Inc.
Available: http://www.ventanaresearch.com/ [February 2004].

Zachman, JA. 1997. *The Challenge is Change: A Management Paper*. Zachman International Inc.

APPENDIX A

Table 1: Key performance activities (SASA)

Key Performance Activity	Act Ref.
Redress past injustices in education provision	Preamble
Provide progressively high quality education for all learners	Preamble
Combat racism, sexism and all other forms of unfair discrimination and intolerance	Preamble
Eradicate poverty and promote economic well-being of society	Preamble
Protect and advance our diverse cultures and languages	Preamble
Uphold the basic rights of all learners, parents and educators	Preamble
Promote learners, parents and educator acceptance of the responsibility for the organization, governance and funding of schools in South Africa.	Preamble
Manage compulsory learner admissions and attendance	S3, 4, 5
Manage the language policy	S6
Manage religious observance	S7
Manage learner code of conduct, suspension and prohibition of corporal punishment	S8, 9, 10
Manage representative council of learners	S11
Provide public schools	SS12-17
Manage the constitution of school governing body	SS18-32
Manage closure of public schools	S33
Funding of public schools	S33, 34
Manage establishment of independent schools	SS45-50
Manage home schooling	S51
Promote the duty of schools to provide information	S59

Table 2: Annual Schools Survey - Learner and Staff Statistics

ENTITY		ATTRIBUTES	COMMENTS
1	Learners Control	Grade, sex	Used as control sheet
2	Classes per grade	Grade	Number of classes per grade
3	Staff remuneration	Staff, Remuneration, appointment, duration, sex	Indication who employs staff and conditions of employment
4	Educators	Educator Type, Employer,	Educators by phase and employer
5	Learner Origin and Residence	Province, sex, origin, boarding	Tracking learner movement

6	Learners	Race, Grade, sex	
7	Learners	Disability, race, sex	
8	PSNP	Age	
9	Learners	Age, Grade, sex	
10	Learners	Sex, grade, language (HL)	HL=Home Language
11	Learners	Sex, grade, language (TL)	TL=Teaching Language
12	Learners	Sex, grade, language (PTL)	PTL=Preferred TL
13	LSEN	Disability, sex, language (HL)	HL=Home Language
14	LSEN	Disability, sex, language (TL)	TL=Teaching Language
15	LSEN	Disability, Sex, language (PTL)	PTL=Preferred TL
16	LSEN	Grade, disability, sex	Mainstream SN
17	LSEN	Grade, barriers, sex	Mainstream SN
18	Learners	Grade, transfers, sex	Learner transfers
19	Learners	Grade, success, sex	Failures, drop-out, passes
20	Learners	Agegroup, sex	First Time enrolments
21	Learners	Agegroup, sex, programme	Pre Grade 1 programmes
22	Learners	Agegroup, sex, Cause of Death	Learner Mortality
23	Educators	Agegroup, sex, Cause of Death	Educator Mortality
24	Learners	Grade, sex, parent(s) deceased	
25	Learners	Grade, sex, social grant	Social grant status
26	Learners	GET phase, language, level	Language as subject
27	Learners	Phase, race, activity	Extra mural activities, GET/FET band
28	Learners	Subject, race, level, grade, sex	
29			

Table 3: EC ASS2001

Category	Table Name	Schema
ArtsCulture	Sports	[activities]
Classes	Sch enr by grade	[grades]
Control		[grade]
FirstTimeEnrolment	1stenroll	[age][sex] & [programmes][sex]
LearnerAge	Learnagefprim Learnagefsec Learnagemsec learnagemprim	[age][grade][sex]
Learners_Languages	Learnhomelang Learnteachlang	[grade][language]
LsenRace	Senracef senracem	[disability][race]
lsen_Languages	Senhomelang	[disability][language]

	senlearnlang	
Mortality	Emortality Immortality	[age][sex][causeofdeath]
Staff	Employment Remuneration	[staff][appointment][duration][sex] [staff][remuneration][duration][sex]
Subjects	Subjects	<subject>[grade][level][sex]
Success	Repeaters Failures	[grade][sex]
Transfer	Transfers	[grade][destination]

Table 4: EC ASS 2002

Category	Table Name	Schema
ArtsCulture	TblLearnersArtsCultureMale tblLearnersArtsCultureFemale	[activities]
LearnerRace LSENRace	TblLearnerRace tblLearnerRaceLSEN	<grade><sno>[race][sex]
Classes	TblSchoolClasses	[grades]
Control	TblLearnerSummary	<sno>[grade]
FirstTimeEnrolment	tblLearner1stenroll	[sex][age]
GETLanguage	TblLearnerLanguageGET	[language]<subjectLevel><sno>
LearnerAge	tblLearnagefemale tblLearnagemale	<age_years>[grade]
Learner_Languages	tblLearnerhomelanguage tblLearnlearninglanguage	<grade>[language]
LSEN_Languages	tblLearnerhomelanguageLSEN tblLearnlearninglanguageLSEN	[disability][language]
Mortality	Emortality Imortality	[age][sex][causeofdeath]
Employment	tblschoolstaff	<stafftype>[appointment][duration][sex]
Remuneration	tblschoolstaffpayment	<stafftype>[remuneration][duration][sex]
Subjects	tblSchoolSubjects	<subject><grade><subjectlevel>[race][sex]
Success	tblLearnerRepeat tblLearnerFailed	<grade>[sex]
Transfers	tblLearnerTransfers	<grade>[destination][sex]

Table 5: FS ASS 2001-2

Category	Table Name	Schema
ArtsCulture	Arts	[activities][race]
LearnerRace	Learnracef Learnracem	[grade][race]
Classes	Classes	[grades]
Control	Summary	[sex][grade]

FirstTimeEnrolment	1stEnrol	[agegroup][sex]
GETLanguage	TblLearnerLanguageGET	[language]<subjectLevel><sno>
LearnerAge	learnagefprim learnagefsec learnagemprim learnagemsec	[age]grade]<gender>
Learner_Languages	learnhomelang learnteachlang	[grade][language]
LSEN_Languages	senhomelang senlearnlang	[disability][language]
Mortality	Emortality lmortality	[agegroup][sex][race]
Employment	Employment	<stafftype>[appointment][duration][sex]
Remuneration	tblschoolstaffpayment	<stafftype>[remuneration][duration][sex]
Subjects	Subjects	[grade][subjectlevel][race][sex]<sub_code>
Success	Repeaters Failures	[grade][sex] [grade][sex]
Transfers	Transfers	[grade][sex][destination]
LSENRace	Senracef senracem	[disability][race]

Table 6: DOE IDS 2002-4

Table	Schema
LearnerControl	<Sex><grade>
Classes	<Grade>
Remuneration	<stafftype><remuneration><duration><sex><staff>
FullTimeEducators	<Educatortype><remuneration><educators>
LearnerDistribution	<province><sex><Learners><Boarders>
Learners	<grade><race><sex><learners>
LearningDisability	<disability><race><sex><learner>
PSNP	<age><learners>
Learners	<age><grade><sex><learners>
LearnersHL	<grade><language><sex>
lsenHL	<disability><language><sex>
LearnersLT	<grade><language><sex><learners>
LearnerDisability	<disability><language><sex><learners>
LearnerPL	<grade><language><sex><learners>
lsenTL	<disability><language><sex><lsen>
lsenMainstream	<grade><disability><sex><lsen>
Barriers	<grade><barrier><sex><learners>
Pregnancies	<Grade>
LearnerTransfers	<grade><transfer><sex><learners>
LearnerSuccess	<grade><success><sex><learners>
Grade1	<sex><agegroup>
GradeRProgrammes	<agegroup><sex><programme>< learners>

Mortality	<agegroup><sex><causeofdeath><person>< quantity>
DeceasedParents	<grade><sex><parent>< learners>
SocialGrants	<grade><sex><grantstatus>< learners>
GetLanguage	<phase><subjectlevel><language><learners>
artsculture	<phase><activity><sex><learners>
Subject	<race><level><grade><sex><learners>
GOVERNANCE	<information>
Physical Infrastructure	<information>
Educators	<information>
General Information	<information>

Table 7: Education Institutions with access to the Internet in 2003

Province	Institutions	eMail	Internet	eMail%	Internet%	MailSites**	MailSites%
Free State	3066	223	146	7.3	4.8	37	1.24
Gauteng	2135	887	849	41.5	39.8	110	5.2
Kwa Zulu Nata	6024			0.0	0.0	67	1.1
Eastern Cape*	6183	212	192	3.4	3.1	139	2.3
Limpopo*	4879	119	103	2.4	2.1	1	0.02
Mpumalanga	1919	165	64	8.6	3.3	51	2.7
Northern Cape	470	47	56	10.0	11.9	48	10.2
North West	2167	186	126	8.6	5.8	35	1.6
Western Cape*	1895	1112	132	58.7	7.0	1627	85.9
	28738	2951	1668	10.3	5.8		

Source: Department of Education Annual Schools Survey 2003 (unpublished).

* Source: Department of Education Annual Schools Survey 2002 (unpublished).

** Source: http://www.schools/dns/summary.htm

APPENDIX B (on CD ROM)

Summary of database schemas for the EMIS focus areas of the nine provincial departments of education from 2001 to 2003. The documents are in MS WORD format auto-generated by an extraction application program developed by the researcher.

ACRONYMS

ASS	Annual Schools Survey
BI	Business Intelligence
DOE	Department of Education
ECD	Early Childhood Development
EIP	Enterprise Information Portal
EMIS	Education Management Information System
ETL	Extract, Transform and Loading process during integration of data
FET	Further Education and Training
IS	Information System
ISM	Information System Management
ISP	Information System Plan
IT	Information Technology
LSEN	Learners with Special Educational Needs
NEIP	National Education Information Policy
NEPA	National Education Policy Act, Act 27 of 1996
PED	Provincial Education Department
SACE	South African Council on Educators
SAQA	South Africa Qualifications Authority
SASA	South African Schools Act, Act 84 of 1996
WCED	Western Cape Education Department